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Original articles

Incidence of early surgical site infection after hip hemiarthroplasty in Assiut University trauma unit: an epidemiological study

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Abstract

Objective
This study aims to detect the incidence of early surgical site infection (SSI) in patients who underwent hip hemiarthroplasty following a hip fracture, in Assiut university trauma unit and identifying the possible risk factors.

Patients And Methods
All patients who underwent hip hemiarthroplasty between January 2015 and January 2016 in Assiut university hospital were included in the present study. The detection of SSI was carried out using the United States Centers for Disease Control and Prevention criteria. Demographic and clinical data were collected and analyzed for potential associations with SSI.

Results
Among the 111 patients who met the study inclusion criteria, a total 10 SSIs were documented, giving an infection rate of 9% infection rates were higher in females (p=0.028), Patients who waited for more than 3 days for surgery (p=0.007), patients with body mass index more than 30 (p= 0.001), patients with medical co-morbidities (p 0.001), infection rate was also higher in patients whose skin incision closed by staples (p=0.001). The main microorganism detected was Staphylococcus aureus and, which accounted for 77.8% of the SSIs.

Conclusion
We concluded that the incidence of SSI after hip hemi arthroplasty in Assiut university hospital trauma unit is high in comparison to other studies. the number of days from admission to surgery is a risk factor for the development of SSI. Steps should, therefore, be taken to prevent unnecessary delay of surgery. Presence of medical comorbidities and increased BMI, female gender, were also risk factors for SSI.

Keywords
Hip hemiarthroplasty, surgical site infections.

Introduction

Hip hemiarthroplasty (HHA) is an established treatment for femoral neck fractures of the elderly. [1] The prosthesis-related complications of HHA include: periprosthetic fractures, dislocation, infection, aseptic loosening and acetabular wear. [2] These complications can lead to increase morbidity, mortality and cost. Surgical site infection(SSI) is a common postoperative complication and causes significant postoperative morbidity and mortality, prolongs hospital stay, and adds between 10% and 20% to hospital costs.

SSI become even more problematic when they involve elderly patients who had just undergone hemiarthroplasty for osteoporotic hip fractures. As elderly patients generally have poorer physiological reserves, additional insults in the form of multiple debridement surgeries and infection tend to lead to high mortality rates. [3] Various measures have been put in place to decrease this risk of SSI. These include patient screening, aseptic techniques and use of prophylactic antibiotics. With modern surgical techniques and the use of prophylactic antibiotics, the risk of postoperative SSIs in orthopedic implant surgery is as low as 2%. [4] Various American and European protocols advocate for the initiation of prophylactic antibiotics within one hour of the incision and continued up to 24 hours after the end of the operation. [5-6]

Surgical site infections have been subdivided according to the time into **early infection** presents within 30 days of a surgical procedure, whereas an infection is described as **intermediate** if it occurs between one and three months afterwards and **late** if it presents more than three months after surgery. [7]

This study aimed to report the incidence of SSI in patients who had undergone hip hemiarthroplasty in Assiut university hospital trauma unit and identifying possible risk factors.

Patients and Methods

Between January 2015 to January 2016, 111 patients performed hemi-arthroplasty in the trauma center in Assiut University Hospital, were included prospectively.

Inclusion criteria:

All patients who underwent hip hemiarthroplasty in Assiut university hospital trauma unit in the period from January 2015 to January 2016

Exclusion criteria:

No patient who underwent hip hemiarthroplasty in that period was excluded.

All patients were followed up to 30 days after surgery for detection of early surgical site infection (SSI).

Categorical variables were described by number and percent (N, %), where continuous variables described by mean and standard deviation (Mean, SD). P value < 0.05 was considered statistically significant. All analyses were performed with the IBM SPSS 20.0 software.

Of those "111" patients who were included in this study, 52 (46.8%) were males and 59 (53.2%) were females.

The age of the patients ranged from 35 to 100 years and the mean age was 67.4+11.9 years. There were 76 patients without medical comorbidities (68.5%) and 35 with medical comorbidities (31.5%) specially DM**. (fig 1)**

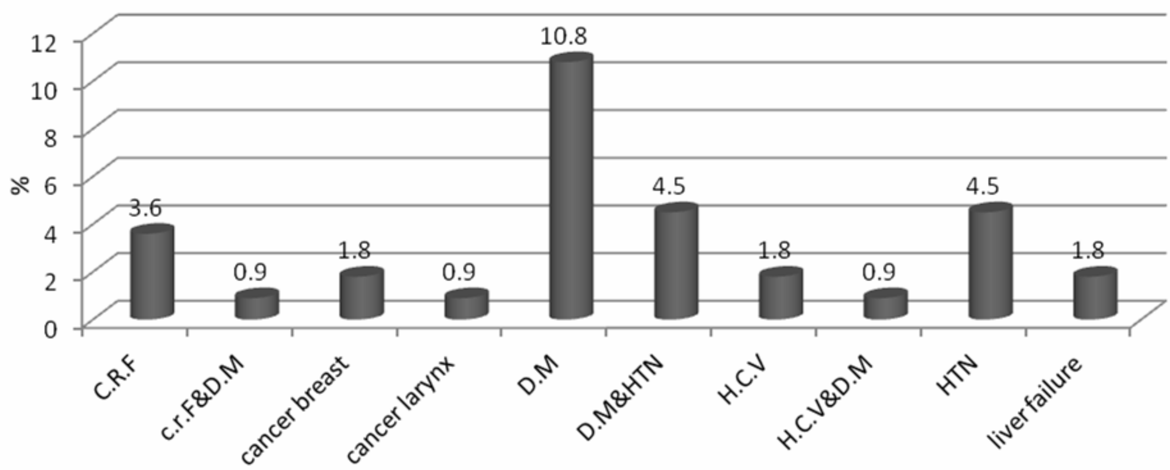

Fig 1: Distribution of medical comorbidities in patients included in the study

From 111 patients there were 76 patients (68.5%) with BMI less than 30 and 35 patients (31.5%) with BMI more than 30.

There were 35 cases had bipolar prosthesis (31.5%) and 76 cases had Thompson prosthesis (68.5%)

103 cases were cemented (92.7%) and 8 were cementless (7.2%)

In 62 cases skin closed by staples (55.9%) and in 49 cases sin closed by stitches (44.1%).

suction drain used in 53 cases (47.7%) and not used in 58 cases (53.3%).

1st generation cephalosporin was given to all cases 30 minutes pre –operative

Operative time of all cases was less than 2 hours.

Pre-operative Hospital stay ranges from 1 day to 12 days. **(table1)**

Table 1: Distribution of preoperative stay in patients included in the study

No. of days	No. of patients	%
1 day	4	3.6
2 days	23	20.7
3 days	35	31.5
4 days	4	3.6
5 days	9	8.2
6 days	12	10.8
7 days	6	5.4
8 days	7	6.3
9 days	5	4.5
10 days	4	3.6
11 days	1	0.9
12 days	1	0.9

Methods of diagnosis of SSI:

A- Full examination of the wound to detect SSI that met the United States Centers for Disease Control and Prevention (CDC) criteria, The CDC, which has defined a set of criteria for the purpose of surveillance, categorizes SSIs into: (a) superficial incisional; (b) deep incisional; and (c) organ/space SSIs.[7]

- **Superficial SSI,** defined as infection that occurs within 30 days after the operation and infection involves only skin or subcutaneous tissue of the incision and at least one of the following:

  1. Purulent drainage, with or without laboratory confirmation, from the superficial incision.
  2. Organisms isolated from an aseptically obtained culture of fluid or tissue from the superficial incision.
  3. At least one of the following signs or symptoms of infection: pain or tenderness, localized swelling, redness, or heat.
  4. Diagnosis of superficial SSI by the surgeon or attending physician.

- **Deep Incisional SSI,** involves deep soft tissues (e.g., fascial and muscle layers) of the incision.

In the present study, organ/space SSI refers to infection involving the bone or hip joint.

B -Culture and sensitivity for infected patients

Documentation was done by taking photos of the surgical site, patients follow up cards and culture and sensitivity reports.

Ethical consideration:

The study was approved by the Ethical Committee of Faculty of Medicine at Assiut University. Informed consent was obtained from each patient. Every patient will be free to refuse participation in the study without affecting the service or the clinical management. Patients will be free to ask any questions about the study.

Results

There were 10 infected cases (9%) at the first month post-operative, 2 cases were superficially infected and 8 cases were deeply infected.
The mean age of the infected cases was 62 years, with no significant difference between infected patients above and below 60 years (p.value=0.273). **(fig2)**

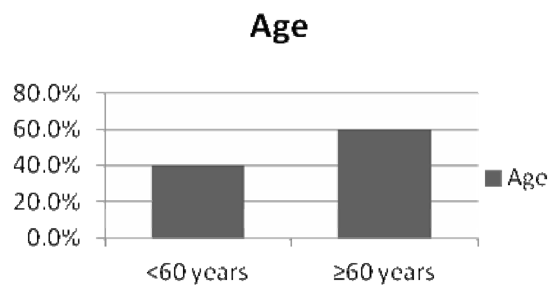

Fig 2: Age of infected cases

There was significant increase in rate of SSI in females (7 infected cases were females and 3 were males) (p value 0.028) **(fig.3)**

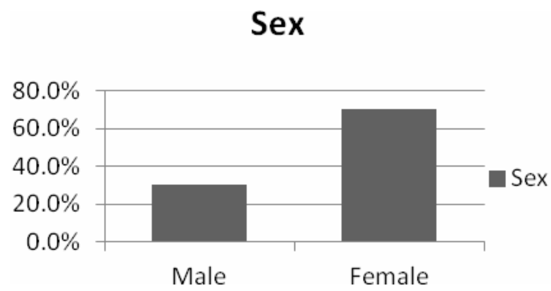

Fig 3: Sex of infected cases

The rate of infection significantly increased in patients with BMI 30 (8) infected cases were with BMI 30 and 2 were <30(p value 0.001) **(fig.4)**

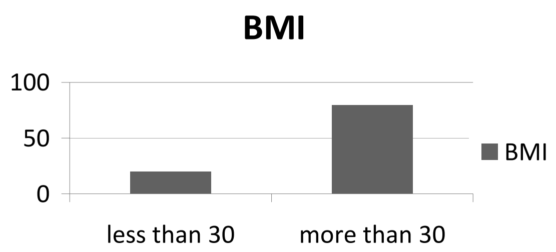

Fig 4: BMI of infected cases

There was significant increase in the rate of SSI in patients with medical comorbidities especially D.M (8 infected cases were with medical comorbidities and 2 were without medical comorbidities (p value 0.001) **(fig.5), (table.2)**

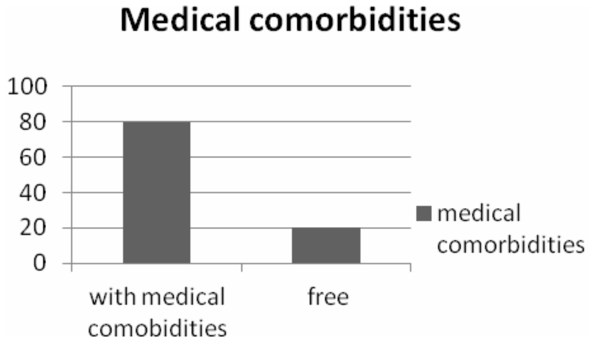

Fig 5: Medical comorbidities in infected patients

Table 2: Distribution of medical comorbidities in infected patients

Medical comorbidities	No.	%
C.R.F&D.M	1	12.5
D.M	3	37.5
D.M&HTN	3	37.5
liver failure	1	12.5

There was significant increase in infection in patient whom skin was closed by staples (staples were used in 8 infected cases and sutures used in 2 infected cases) (p value<0.001) **(fig.6)**

Fig 6: skin closure in infected patients

There was significant increase of SSI in patients stayed more than 3 days pre-operative. (From 10 cases, 8 infected cases stayed 3days) **(fig.7)**

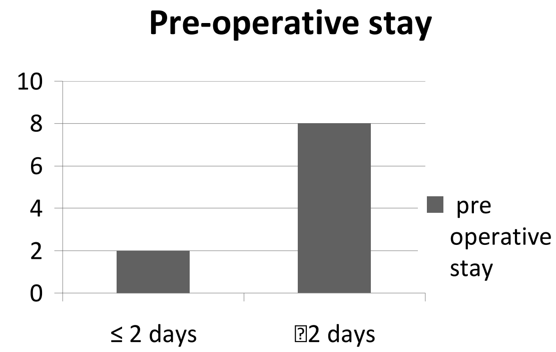

Fig 7: preoperative hospital stay in infected patients

There was no significant difference in infection between the patients who had suction drain or not (p value 0.881)

From 10 infected cases, culture and sensitivity was done for 9 cases, 7 cases were infected by staph aureus , 1case by gram negative bacilli ,and 1 case showed no growth

Discussion

In this study the incidence of early surgical site infection (SSI) after hip hemiarthroplasty in Assiut University Hospital Trauma Unit, was determined.

The population shared in this study comprised of 111 patients 52 males and 59 females with a mean age 67.4±11.9

The results of this study showed that incidence is 9% which is high in comparison to other studies. **(table 3)**

The mean age of infected cases was 62.4 with no significant difference between infected patients above and below 60 years, this confirms reports from ***Lau et al. (2014)*** [3] that age was not found to be associated with infection. But in other studies as, ***Ridgeway et al. (2005)*** studied the link between various risk factors and SSI [8]. They found that an age over 80 years was a significant risk factor for SSI in primary hip hemiarthroplasty. In other study ***Dale et al. (2011)*** compared three Norwegian health registries for hip hemiarthroplasty secondary to fracture, age less than 60 years was found to increase the probability of revision due to infection, which was explained by the fact that young patients requiring hemiarthroplasty are likely to have severe comorbidities with a shortened life expectancy [9].

In this study female sex was a risk factor for infection (p=0.028*) this confirms reports from ***José Cordero-Ampuero et al**.(2010)* that found infection rates were higher in females [10]. but other studies as ***Kurtz SM et al**.(2008)*[11] and ***Willis-Owen CA et al** (2010)* describe a higher infection risk in males.[12]

Medical comorbidities were a risk factor for SSI in this study (p value<0.001) this confirms data from other studies that found strong correlation between medical comorbidities and SSI, ***Lau et al.(2014)*** reports that Patients with diabetes mellitus had a higher SSI rate than those without diabetes mellitus.[3] ***Lai et al.(2007)*** demonstrated that the risk of infection increased by 0.35 % for each additional patient comorbidity[13].

BMI more than 30 was a risk factor for SSI in this study (p value 0.001) Ridgeway ***et al. (2005)*** also found that The risk of SSI was significantly higher in patients with a BMI > 30 compared with values between 20 and 30[8], ***Maoz G et al. (2015)*** also reports that high BMI increase the risk of infection after hip arthroplasty[14], ***José Cordero-Ampuero et al.(2010)*** reported that BMI more than 30 was a risk factor for SSI after hip hemiarthroplasty[10]

In this study pre-operative stay more than 3 days was a risk factor for SSI, other studies also found that increase preoperative hospital stay is a risk factor for SSI. ***lau et al**,(2014)* found that a delay in surgery was associated with an increased rate of SSI; this association remained significant even after controlling for other factors such as diabetes mellitus[3], ***Gabriel B. Tofani et al**,(2016)* found that length of hospital stay before surgery higher than four days increase the risk for SSI [15], ***Shiga et al**,(2008)* showed that surgical delay of more than 48 hours increased the 30-day and 1-year mortality by 41% and 32%, respectively.[16]

Skin closure by staples associated with higher rate of SSI in this study (p value 0.001), meta-analysis by ***Smith et al**. (2010)* also found that the risk of SSI increased threefold when staples were used instead of sutures.[17], other meta-analysis by ***Rohin Krishnan et al**. (2016)* found no significant difference in infection among patients who receive staples and sutures for skin closure.[18]

Using of suction drain in this study had no significant effect on infection, ***Willis-Owen CA et al**(2010)* [12] also found that drains were not found to have any significant predictive value for infection.

In this study the operative time of all cases was less than 2 hours, with no any significant value between infected and non-infected cases. ***Ridgeway et al. (2005)***[8] did not observe any significant association between the procedure time and infection in hip hemiarthroplasty. The same observation was reported by ***Leong et al (2006)***[19]. This may indicate that the presence of other risk factors in patients undergoing hip hemiarthroplasty may have obscured the effect of procedure duration on incidence of infection. [8,19]

***Acklin et al**. (2011)* [20] found high rate of SSI if operative time was more than 100 minutes.

In contrast, ***dale et al**. (2011)*[9] found that rate of SSI was higher if operative time was less than 60 minutes, they explained that, the rapid surgery may result in inferior soft tissue treatment and hemostasis, thereby leading to increased risk of infection.

Staphylococcus aureus was the main pathogen in the infected cases in this study. This confirms results from other studies that showed that staph.aureus is the main pathogens causing SSI especially in hemiarthroplasty**.** ***Ridgeway et al**.(2005)* reported that *Staphylococcus aureus* was the main pathogen and was identified in 50% of SSIs. This was a more common cause of SSI in hemiarthroplasty procedures than THR, and was responsible for 40% of SSIs in primary hemiarthroplasty, for 39% in revision hemiarthroplasty.[8]

Conclusion

This study results showed a high rate of early infection in patients undergoing hip hemiarthroplasty in Assiut university hospital trauma unit comparable to other studies in the world.

This study found some risk factors contributing in SSI such as female gender, BMI 30, medical comorbidities, long preoperative stay and skin closure by staples.

Hip hemiarthroplasty should be treated with high care as patients generally have poorer physiological reserves, any additional insults in the form of multiple debridement surgeries and infection tend to lead to high mortality rates so; Preoperative stay should be decreased as possible, control of medical comorbidities especially diabetes melittus should be achieved before surgery, and the surgery must be carried on by a senior hip surgeon.

Table 3: incidence of SSI after hip hemiarthroplasty in different studies

Study	No. of cases	SSI	
		No.	%
9 %	10	111	***This study***
2.9 %	1	35	***Mue Daniel et al**.(2015)*[21]
4.4 %	20	459	***Sullivan NP et al** (2015)*[22]
4.3 %	57	1320	***Lau et al.**(2014)*[3]
4.68 %	40	848	***Sprowson et al**.(2013)*[23]
6.9 %	15	217	***Acklin et al**.(2011)* [20]
7.3 %	103	1416	***dale et al**.(2011)*[9]
4.06 %	219	5395	***J. Wilson et al**(2008)*[24]
1.7 %	16	949	***Cumming et al**.(2007)*[25]
4.97 %	287	5769	***Ridgeway et al**.(2005)*[8]

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Funding:

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Conflicts of Interest:

There were no conflicts of interest in this study.

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Management of hip dislocations as late sequelae of septic arthritis in children

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Abstract

Background
septic arthritis of the hip remains one of the most challenging problems in pediatric orthopedics. The most beneficial treatment is early diagnosis and treatment. Delay in diagnosis and treatment may result in a spectrum of pathologic changes known as late sequelae of septic arthritis of the hip. These sequelae are stiffness, limping, destruction of the capital femoral epiphysis, limb length discrepancy, and hip subluxation or dislocation. Hip dislocations as sequelae of septic arthritis have special characteristics different from those of dysplastic hip as regard the pathology and treatment. The aim of this study is to suggest different surgical procedures for management of hip dislocations as late sequelae of septic arthritis in children.

Patients and methods
thirteen patients (15 hips) were included in this study; they were 5 males and 8 females, their ages averaged 18 months (range 12-36 months), the left hip was affected in 6 cases, the right was affected in 5 cases and in 2 cases the affection was bilateral. Open reduction was done in all hips (15 hips), osteo-chondroplasty (re-shaping of the femoral head) in 10 hips, femoral varus derotation osteotomy in 9 hips, femoral shortening in 4 hips, and adductor tenotomy in 8 hips. All cases were treated in orthopedic surgery department, faculty of medicine, Zagazig University.

Results
follow up averaged 37 months (range 24-54 months). At latest follow up all cases were evaluated according to Hunka et al criteria and the results were satisfactory in 12 hips and unsatisfactory in 3 hips. Sever limitation of movement occurred in 3 hips, avascular necrosis occurred in 2 hips, and re-dislocation occurred in one hip.

Conclusion
open reduction of the hip dislocations as late sequelae of septic arthritis in children is not an easy task. The aim of reduction is to achieve stability, minimize limb length discrepancy, and to facilitate later total hip replacement. Remodeling potential of the hip dislocation following septic arthritis is less than in hip dysplasia so the pathology should be corrected as one stage as possible and not to wait for remodeling as in hip dysplasia.

Key words
hip, dislocation, septic, management.

Introduction

Septic arthritis of the hip in children is one of the most challenging problems in pediatric orthopedics. The medical history of children with septic arthritis of the hip; generally reveals prematurity, sepsis, neonatal intensive care unit admission, and low birth weight[1]**.** Early diagnosis and treatment remain the most important prognostic factors for a favorable outcome. Delay in diagnosis and treatment may result in a spectrum of pathologic changes known as late sequelae of septic arthritis of the hip. These sequelae are stiffness, limping, destruction of the capital femoral epiphysis, limb length discrepancy, hip subluxation or dislocation, premature closure of the triradiate cartilage and acetabular dysplasia. Dislocation is considered one of the most severe sequelae that may occur after septic arthritis of the hip[2, 3, 4, 5].

Choi et al[6, 7] classified sequelae of septic arthritis of the hip into 4 types and 8 subtypes (figure 1). Dislocations with the femoral head absent were described in Choi et al classification; but dislocations with the femoral head present were not included although the group of dislocations with the femoral head present is a distinct entity with different management protocol and prognostic implication. The presence of the femoral head can be confirmed radiologically or at the time of intervention[1,6,8]. Recently, Faroline and Milane[9] classified sequelae of septic arthritis of the hip into 2 groups and 2 subgroups (figure 2) according to absence or presence of hip dislocation and presence or absence of femoral head.

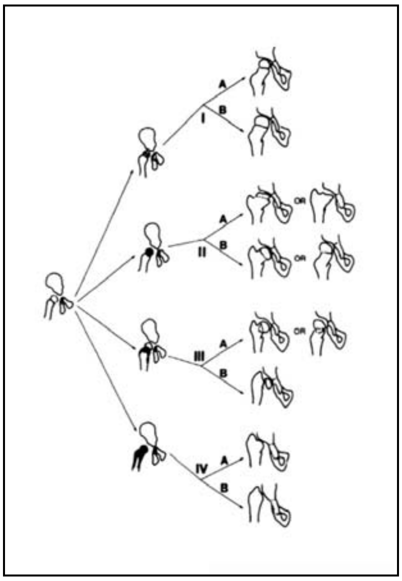

Figure 1: Choi et al[6, 7] classification Type I: A. no residual deformity, **B**. mild coxa magna. **Type II: A**. coxa brevia with deformed head, **B**. progressive coxa vara/valga. **Type III: A**. slipping of femoral neck with severe anteversion or retroversion, **B**. pseudoarthrosis of femoral neck. **Type VI: A**. destruction of femoral head and neck with small medial remnant of the neck, **B**. complete loss of femoral head and neck and no articulation of the hip.

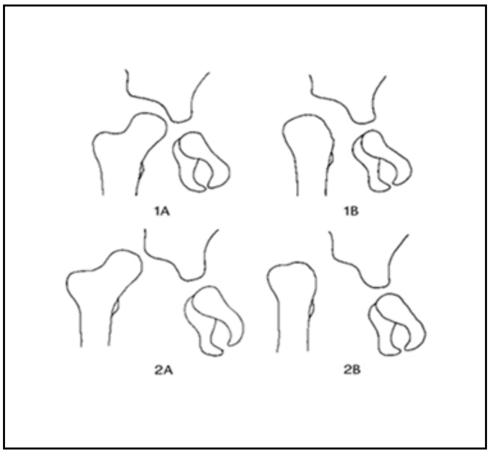

Figure 2: Farolin and Milani[9] classification. **Group I:** hips without dislocation; **A**. with the femoral head present, **B**. with the femoral head absent. **Group II**: hips are dislocated; **A**. femoral head present, **B**. femoral head absent

Femoral head Deformities as sequelae of septic arthritis (according to radiologic and intra-operative findings) were described by El-Tayeby[10]. There are 4 types of head deformities: beard head, collared head, stag-horn head, and unclassified deformity (figure 3).

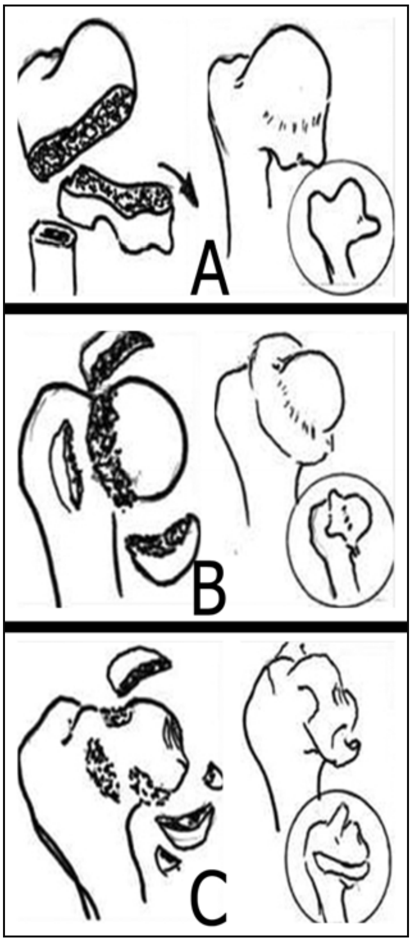

Figure 3: Femoral head deformities[10]. **A: Beard head**; femoral head of normal size or larger with a secondary smaller beard extending downwards. This configuration is due to dislocation of the femoral head hanging over the superior acetabular rim. The stuck head is, thus, split into a usually larger upper dislocated sector and a smaller lower beard. **B: Collared head**; the femoral head is surrounded by a collar all around the neck with maintained smooth superior weight-bearing cartilage, the collar prevent femoral head containment into the acetabulum. **C: Stag-horn head**; head showing an irregular superior articular surface with several protrusions.

Early management of septic arthritis includes parenteral antibiotics and surgical drainage**.** Treatment in neglected cases with late sequelae differs according to presence of dislocation and presence of the femoral head. Stability restoration needs different techniques such as trochanteric arthroplasty or pelvic support osteotomy when the femoral head is absent as contrasted to relocation when adequate femoral head is present[1, 2].

Treatment lines for hip dislocation with the femoral head present following septic arthritis include either closed reduction (with or without adductor tenotomy) or open reduction (with or without supplemental femoral and acetabular osteotomies) when closed reduction has failed[11]**.**

The technique of reconstruction (re-shaping) of the femoral head and neck during open reduction according to radiographic and intra-operative findings was described also by El-Tayeby[9] as osteo-chondroplasty.

Reshaping of femoral head includes: excision of beard in beard head and the collar in collared head, removal of prominent parts with preservation of the superior weight bearing part in stag-horn head. The aim of osteochondroplasty is to facilitate entry of the femoral head within the acetabulum.

Neglected dislocations (unreconstructable) with shortening are treated by Ilizarove with adduction of proximal fragment to stabilize the pelvis and distal osteotomy for lengthening[11].

The aim of this study is to suggest different surgical procedures tailored for management of hip dislocations as late sequelae of septic arthritis in children.

Patients and methods

*** Inclusion criteria:** hip dislocations with the femoral head present as late sequelae of septic arthritis by history of infection during neonatal period; treated medically by antibiotics or surgically by open drainage and evident radiologically. Also cases with hip dislocation and deformed femoral head detected during open reduction for developmental dysplasia of the hip.

*** Exclusion criteria:** hip dislocations with absent femoral head were not included in the study. Also cases with developmental dysplasia of the hip, cerebral palsy and paralytic dislocations were not included.

Thirteen patients (15 hips) were included in this study (table 1, 2, 3, 4); they were 5 males and 8 females, their ages averaged 18 months (range 12-36 months), the left hip was affected in 6 cases, the right was affected in 5 cases, and in 2 cases the affection was bilateral. All cases were treated in orthopedic surgery department, faculty of medicine, Zagazig University. History of septic arthritis in the neonatal period treated medically with antibiotics was positive in 5 cases, surgically drained in 6 cases and 2 cases were discovered during open reduction of the hip for developmental dysplasia of the hip (figure 4). The main complaint was limping in 10 cases, limb-length inequality in 6 cases, and pain in 2 cases.

Table 1: Table of our patients

Case No.	Age/ months	Sex	Side	Radiologic findings Farolin Type	Intra-operative Findings	Operative Procedures	Follow-Up /month	Result
1	18	Female	Left	2 A	Collared head	Open reduction +Osteochondroplasty	48	Unsatisfactory
2	30	Female	Bilateral	2 A	Rt. Oval Lt. Oval	Open reduction +varus osteotomy +femoral shortening	36	Satisfactory
3	36	Female	Right	2 A	Beard head	Open reduction +Osteochondroplasty +femoral +varus osteotomy shortening	24	Satisfactory
4	28	Female	Right	2 A	Oval head	Open reduction +varus osteotomy	30	Satisfactory
5	18	Male	Bilateral	2 A	Rt.Collared Lt.Collared	Open reduction +Osteochondroplasty	36	Satisfactory
6	24	Female	Left	2 A	Oval head	Open reduction +varus osteotomy	48	Satisfactory
7	22	Male	Right	2 A	Collared head	Open reduction +Osteochondroplasty	30	Satisfactory
8	12	Male	Left	2 A	Oval head	Open reduction	42	Satisfactory
9	18	Female	Right	2 A	Beard head	Open reduction +Osteochondroplasty +varus osteotomy	54	Satisfactory
10	30	Male	Left	2 A	Collared head	Open reduction +Osteochondroplasty +varus osteotomy	36	Unsatisfactory
11	30	Female	left	2 A	Collared head	Open reduction +Osteochondroplasty +varus osteotomy	24	Satisfactory
12	18	Female	Left	2 A	Beard head	Open reduction +Osteochondroplasty +varus osteotomy	42	Unsatisfactory
13	36	Male	Right	2 A	Beard head	Open reduction +Osteochondroplasty +femoral shortening +varus osteotomy	30	Satisfactory

Table 2: Table of Pre-operative radiology, intra-operative findings

Case No.	Radiology					Operative findings			
	Capital femoral epiphysis	**Acetabular index**	**Acetabulum**	**Tri-radiate cartilage**	**Shenton line**	**Capital femoral epiphysis**	**Acetabulum**	**Cartilage**	**Soft tissues**
1	Not visual-ized	20	Irregular	Open	Broken	Collared head	Irregular, filled with fibrous tissue	Fibrous tissue	Dense fibrous adhesions
2	Not visual-ized on left side Smaller on right side	Rt.32 Lt.34	Dysplastic both	Open	Broken	Rt. Oval head Lt. Oval head	Shallow	Normal	Pulvinar
3	Small	37	Dysplastic	Open	Broken	Beard head	Shallow, fibrous adhesions	Normal	Capsular adhesions
4	Small	28	Normal	Open	Broken	Oval head	Normal, filled with fibro-fatty tissue	Normal	Pulvinar
5	Not visual-ized on both sides	Rt.24 Lt.22	Normal both	Open	Broken	Rt.Collared head Lt.Collared head	Normal, filled with fibro-fatty tissue	Normal	Pulvinar
6	Small	36	Dysplastic	Open	Broken	Oval head	Shallow	Normal	Pulvinar
7	Small	27	Normal	Open	Broken	Collared head	Shallow, fibrous adhesions	Normal	Capsular adhesions
8	Not visual-ized	30	Dysplastic	Open	Broken	Oval head	Shallow	Normal	
9	Not visual-ized	26	Irregular	Open	Broken	Beard head	Irregular, filled with fibrous tissue	Fibrous tissue	Capsular adhesions
10	Not visual-ized	27	Normal	Open	Broken	Collared head	Normal, filled with fibro-fatty tissue	Normal	Dense fibrous adhesions
11	Small	24	Normal	Open	Broken	Collared head	Normal, filled with fibro-fatty tissue	Normal	Pulvinar
12	Distorted	29	Irregular	Open	Broken	Beard head	Irregular , filled with fibrous tissue	Fibrous tissue	Capsular adhesions
13	Small	29	Normal	Open	Broken	Beard head	Normal, filled with fibrous tissue	Normal	Pulvinar

Table 3: Details of intervention

Operative procedures	Number in which performed (Hips)
Open reduction (OR)	15
Femoral varus derotation osteotomy (VDRO)	9
Femoral shortening	4
Osteochondroplasty	10
Adductor tenotomy	8

Table 4: Summary of operative findings

Findings	Structure
Deformed (beard, collared, or oval), small, flattened or spherical with coxa magna.	Capital femoral epiphysis
Normal or dysplastic, false acetabulum, irregular and filled with fibrous tissue	Acetabulum
Normal or covered with fibrous tissue	Cartilage
Capsular adhesions, synovial hypertrophy, pulvinar, fibrous tissues	Soft tissues

Clinically: movements were limited to a certain degrees in different directions; flexion averaged 95° (range 65°-110°) degrees, extension averaged -2° (range -15°-5°), abduction averaged 25° degrees (0°-30°), adduction averaged 20 degrees (range 0-25), medial rotation averaged 15° (range 5°- 25°), and lateral rotation averaged 25° (10°-35°). Flexion deformity was present in 5 hips and averaged 8° (range 5°-15°). Shortening was present in 6 cases and averaged 2 cm (range 1-3 cm). Trendelenburg was positive in 7 cases and difficult to elicit in 6 cases.

Radiologically: dislocation was evident in all cases and diagnosed by broken Shenton line (15 hips), displacement of femoral epiphysis outside acetabulum (7 hips). All hips were Grade 2A according to Farolin classification. Acetabular index averaged 28° (range 20°- 37°). The femoral head was beard in 4 hips. Ossific center was absent in 7 hips and deformed in one hip. CT was done in 5 cases for assessment of cartilaginous femoral head and any ossification. MRI was not done in this study.

Surgical procedures

- **Approach:** all cases were operated through anterior approach (bikini incision), developing the interval between sartorius and tensor fascia lata. Sartorius and rectus femoris were cut and reflected downwards. Iliopsoas was cut and reflected upwards after exposure of femoral nerve. Exposure of the femoral nerve was difficult in 5 hips which necessitated exposure of the nerve from above inguinal ligament then proceed downwards; also in 7 hips the Iliopsoas was amalgamated with the capsule with difficult dissection and reflection. Iliac crest was split and the outer part was reflected downwards exposing the outer side of iliac bone down to the hip capsule. Well-planned capsulotomy was done (T- shaped, V- shaped, or single cut parallel to acetabular margin) to facilitate later capsulorrhaphy. The femoral head was exposed which was beard in 4 hips, oval in 5 hips, and collared in 6 hips. Ligamentum teres was absent in 11 hips. The acetabulum was cleared of any intra-articular fibrous tissue down to exposure of articular cartilage. The articular cartilage was healthy and covered with fibrous tissue in 12 hips, and destroyed with fibrosis in 3 hips. Also the acetabulum was cleared of adherent anterior capsule and remnants of ligamentum teres down to cutting the transverse ligament.

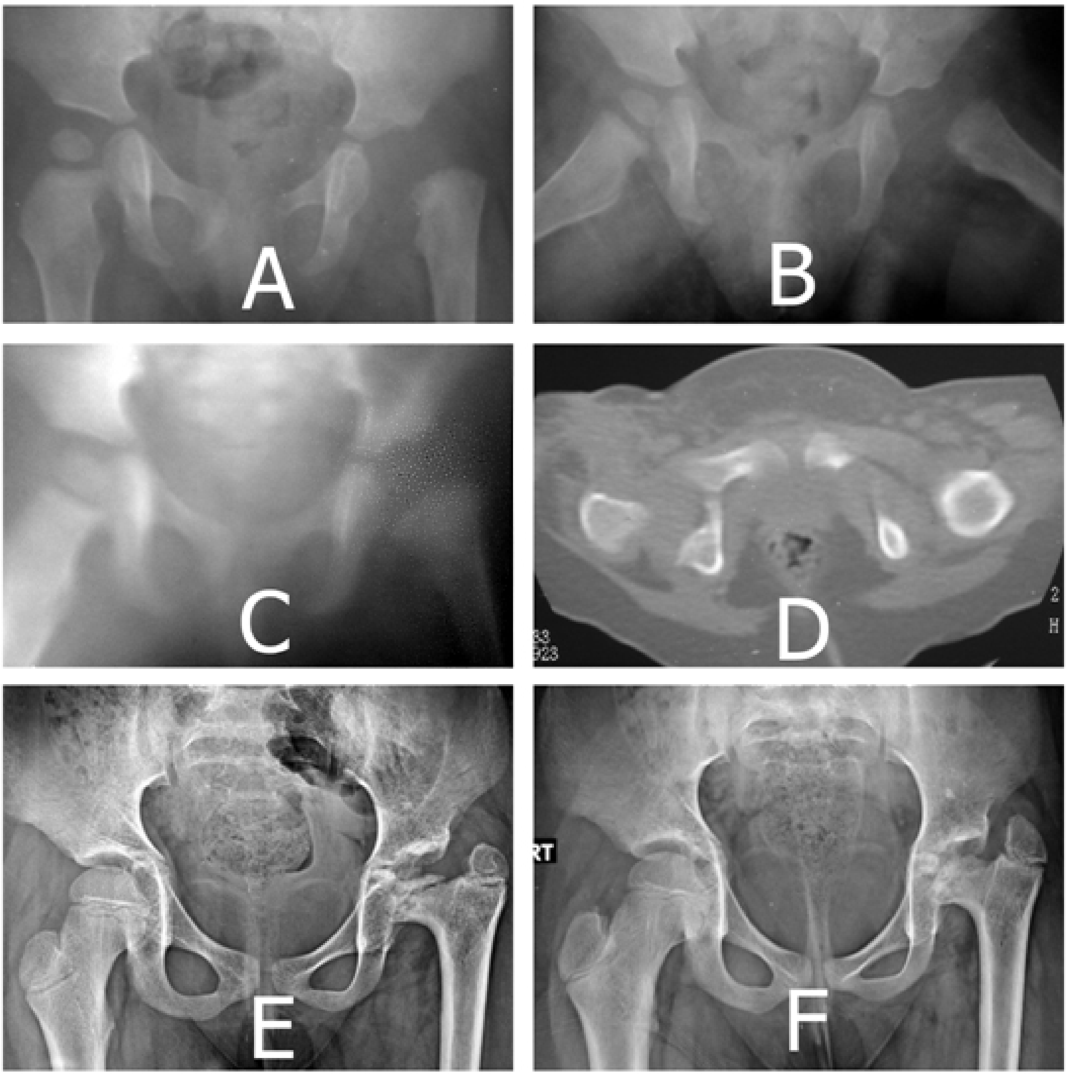

Figure 4: A, girl 2 years old, septic dislocation left hip treated by surgical drainage at age one month, absent upper femoral epiphysis. **B**, frog-leg lateral view. **C**, three months after open reduction, restored Shenton line but still absent ossification centre. **D**, CT shows containment of cartilaginous head within acetabulum. **E**, 3 years post-operative, flattened upper femoral epiphysis, coxa vara. **F**, 5 years post-operative, small rounded upper femoral epiphysis, trochanteric overgrowth, coxa vara.

- **Osteo-chondroplasty** was done in 10 hips to facilitate entry of the femoral head within the acetabulum. In beard head (4 hips) the lower part was excised, in collared head (6 hips) the collar was excised, and in stag-horn head the prominent parts were excised with preservation of the superior weight bearing part.
- **Trial reduction** was done; it was difficult in 4 hips as the femoral head was higher than the acetabulum and femoral shortening of average 2 cm (range 1-3 cm) was done. Reduction was stable in abduction and internal rotation in 9 hips and femoral varus derotation osteotomy was done. No pelvic osteotomies were done in this study.
- **Femoral osteotomy** was done through separate lateral approach for shortening and correction of the geometry of upper femur.
- **Pre-operative traction** was not used in any patient with high dislocation but rather femoral shortening was used to bring the femoral head to the level of the acetabulum.
- **Adductor tenotomy** was done in 8 hips.

Wound was closed then toe to nipple cast was applied for 4 weeks to be changed under anaesthesia for evaluation of hip stability. The second cast was removed at 10 weeks to be replaced with broomstick plaster for 2 weeks. After cast removal all cases were followed up every 2 weeks for 2 visits then every month till 6 month from cast removal. Weight bearing was allowed when knee flexion reaches 90°. No braces were used for the patients in this study.

Results

Follow up averaged 37 months (range 24-54 months). At latest follow up all cases were evaluated **clinically** according to Hunka et al criteria[12] as satisfactory or unsatisfactory. Satisfactory results include, stable joint, arc of flexion of 70° or more, flexion contracture not more than 20°, pain free hip, and the patient is able to perform activities of daily living.

The results were **satisfactory** in 12 hips and **unsatisfactory** in 3 hips. Fourteen hips were stable and one hip was unstable (re-dislocation). At latest follow up (table 5) flexion averaged 103° (range 70° 125°), extension averaged 4° (-10°-15°), abduction averaged 42° (10°-50°), medial rotation averaged 30° (0°-45°), and lateral rotation averaged 37° (20°-50°). Flexion deformity was present in 3 hips and averaged 8° (average 5°-10°). There were no pain with daily activities in 14 hips and one hip was painful.

Table 5: Clinical results according to Hunka et al12 criteria

Case No.	Range of motion (Degrees)					Flexion contracture (Degrees)	Hip stability	Pain	Final results
	Flexion	Extension	Abduction	Medial rotation	Lateral rotation				
1	70	-10	20	0	20	10	Stable	Painful	Unsatisfactory
2	Rt. 110 Lt. 110	Rt. 0 Lt. 0	Rt. 50 Lt. 50	Rt. 45 Lt. 40	Rt. 50 Lt. 45	-	Stable	None	Satisfactory
3	100	10	45	40	45	-	Stable	None	Satisfactory
4	120	15	50	35	30	-	Stable	None	Satisfactory
5	Rt. 90 Lt. 90	Rt. 5 Lt. 5	Rt. 50 Lt. 50	Rt. 30 Lt. 35	Rt. 40 Lt. 35	-	Stable	None	Satisfactory
6	120	10	50	35	25	-	Stable	None	Satisfactory
7	115	10	45	45	50	-	Stable	None	Satisfactory
8	125	5	40	35	45	-	Stable	None	Satisfactory
9	105	0	50	30	40	-	Stable	None	Satisfactory
10	70	-5	15	0	25	5	Unstable	None	Unsatisfactory
11	120	5	40	40	45	-	Stable	None	Satisfactory
12	65	-5	10	0	15	5	Stable	None	Unsatisfactory
13	115	10	50	45	50	-	Stable	None	Satisfactory

All cases were evaluated **radiologically** (table 6) for condition of the capital femoral epiphysis as regard size, regularity, and containment within the acetabulum, occurrence of avascular necrosis, neck shaft angle, continuity of Shenton line, acetabular index, and the tri-radiate cartilage. The epiphysis was small in 7 hips, flattened in 3 hips, irregular in 3 hips, and nearly normal in 3 hips. Avascular necrosis occurred in 2 hips. Neck shaft angle averaged 121° (range 90°-121°). Shenton line was intact in all cases. Acetabular index averaged 21° (range 15°-28°). Tri-radiate cartilage was open in all hips.

Table 6: Table of Radiological results

Case No.	Follow up (Y. M)	Capital femoral epiphysis and neck	AVN	Neck shaft angle	Shenton line	Acetabular index	Tri-radiate cartilage
1	48	Small, rounded	+	90	Intact	20	Open
2	36	Normal	-	Rt.120 Lt.115	Intact	Rt.24 Lt.23	Open
3	24	Flattened	+	125	Intact	28	Open
4	30	Normal	-	130	Intact	22	Open
5	36	Small rounded	-	Rt.125 Lt.120	Intact	Rt.18 Lt.19	Open
6	48	Small rounded	-	110	Intact	20	Open
7	30	Flattened, coxa magna	-	130	Intact	23	Open
8	42	Small irregular	-	125	Intact	18	Open
9	54	Flattened	-	135	Intact	15	Open
10	36	Small, irregular	-	125	Broken	25	Open
11	24	Normal	-	120	Intact	20	Open
12	42	Small, irregular	-	110	Intact	26	Open
13	30	Rounded small	-	135	Intact	17	Open

Complications: sever limitation of movement occurred in 3 hips, avascular necrosis occurred in 2 hips, and re-dislocation occurred in one hip**.**

- **Case 1:** (No. 1, table 1, 2, 5, 6) A girl aged 2 years (figure 5) presented with septic dislocation left hip. She has history of septic arthritis after discharge from the pediatric intensive care unit and treated by surgical drainage. Open reduction was done, hip spica applied for 10 weeks, followed by broomstick plaster for 2 weeks. She was followed up till the age of 7 years. Now the upper femoral epiphysis is apparent but small with trochanteric overgrowth and coxa vara, no dislocation. There is shortening of 2 cm, flexion deformity 10°, and mild pain on activities. The result is **unsatisfactory**.

- **Case 2:** (No. 3, table 1, 2, 5, 6) A girl aged 1 year (figure 6) presented with septic dislocation right hip with beard type femoral head deformity. Open reduction was done at age 3 years with osteochondroplasty, femoral shortening, and derotation. Plate extraction was done after one year. She was followed up for one year after plate extraction. The result is **satisfactory**.

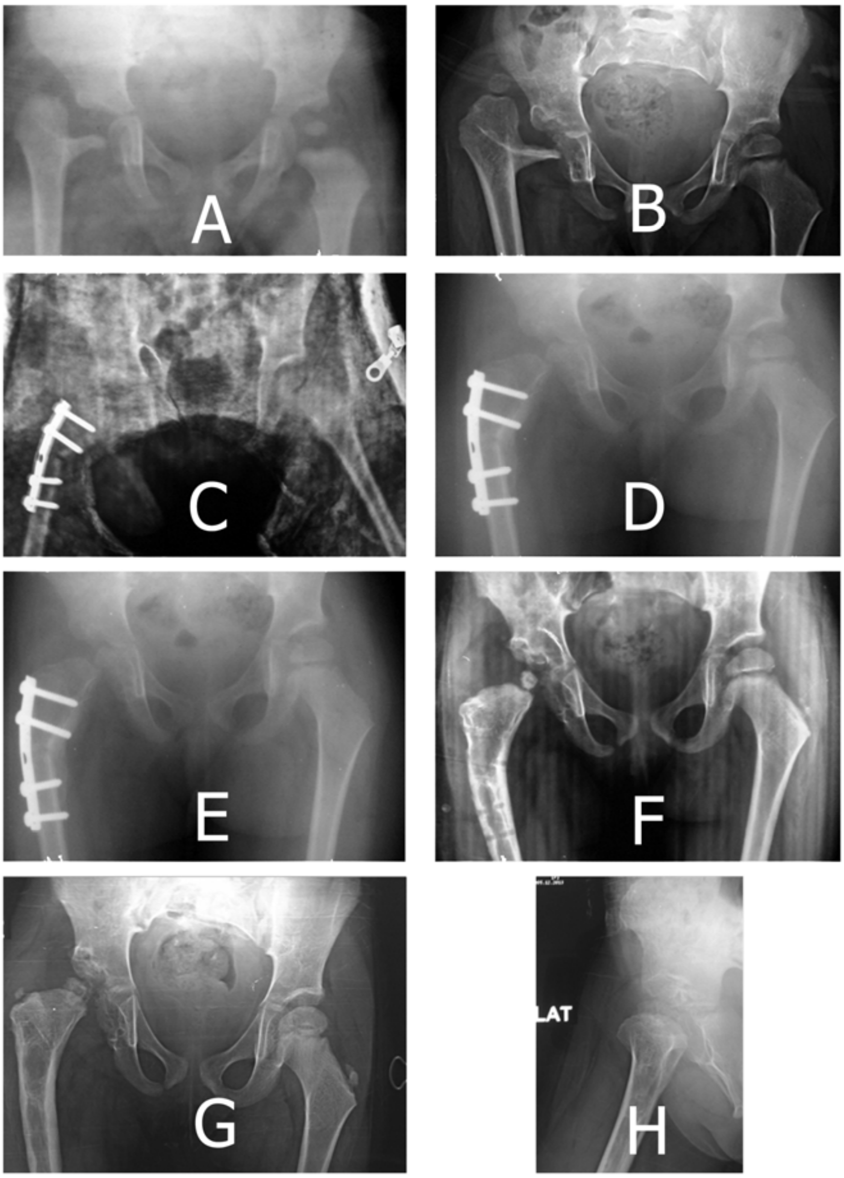

Figure 5: A, girl 1 year, septic dislocation right hip with beard type femoral head deformity. **B**, age three years. **C**, immediate post-operative after open reduction, osteo-chondroplasty, femoral shortening with derotation. **D**, three months post-operative. **E**, one year post-operative. **F**, 6 months after plate extraction. **G**, one year after plate extraction

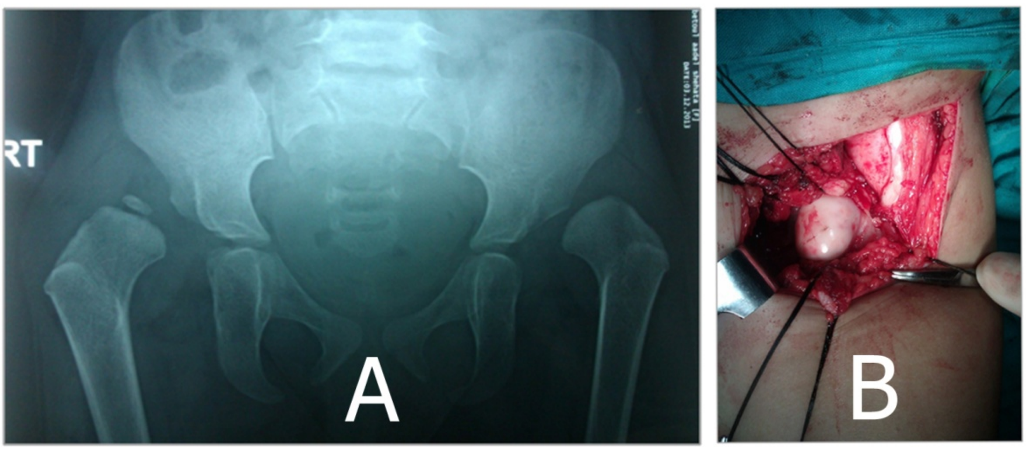

Figure 6: A, 30 month girl shows bilateral DDH, absent femoral epiphysis on left side. **B**, intra-operative findings, oval femoral head, and short neck.

Discussion

Septic arthritis of the hip is one of the most challenging problems in pediatric orthopedics, delay in diagnosis and treatment may result in a spectrum of pathologic changes known as late sequelae of septic arthritis of the hip. One of the most severe sequelae of septic arthritis is the dislocation[1]. Dislocations as sequelae of septic arthritis differ from those of dysplastic hip in pathologic changes and management protocol. In septic arthritis the pathology starts intra-articular with bacterial infection of the synovium and subsequently of all the structures within the joint, which causes an intense inflammatory reaction, possibly leading to destruction of the articular cartilage and later of the whole joint with or without dislocation[3]. In hip dysplasia the pathology starts by capsular laxity with improper containment of the femoral head within the acetabulum, so there is no biologic stimulus for growth of the acetabulum that leads to acetabular dysplasia, dislocation, and lastly secondary femoral changes as increased femoral torsion and coxa valga[14].

The aim of reduction in septic dislocation is also different from that of hip dysplasia. In septic dislocation the aim of reduction is to achieve stability for normal weight bearing, encourage normal development of the femoral shaft, minimize anticipated limb length discrepancy, and creation of a socket to facilitate later total hip replacement[8]. In hip dysplasia, open reduction aims at restoration of a normally developing hip joint[14].

Open reduction in septic dislocations has its difficulties because of the adhesions and extensive fibrosis at the acetabular floor, and femoral head deformities with difficult penetration into the acetabulum. Also extensive fibrosis of the muscles around the hip as iliopsoas makes its dissection from the capsule difficult with improper later capsulorrhaphy[9]. Remodeling potential of the hip with septic sequelae is less than in hip dysplasia so the pathology should be corrected as one stage as possible and not to wait for remodeling as in hip dysplasia[9].

In this study open reduction was done through anterior approach and femoral osteotomies were done through separate lateral approach; although El Tayeby[10] used a modified single approach to expose the iliac bone, the hip and upper third of the femur. We felt that this extensive approach will expose the upper femur with the risk of vascular impairment of upper femur but in our approach the upper femoral blood supply will not be violated.

In septic dislocations the upper femoral changes (head deformities, coxa valga, and increased femoral torsion) occurs earlier than acetabular changes (dysplasia), so the younger the age of the patient at the time of presentation the more tendency of the surgeon for femoral than pelvic procedures. In this study open reduction is associated with femoral procedures as reconstruction of the femoral head to allow penetration into the acetabulum and correction of the geometry of the upper femur for hip stability with no pelvic osteotomies; this can be explained by the young age group (average 18 months) of the patients included in this study**.** Johari et al[1] performed pelvic osteotomies (Dega, and shelf) in 6 hips out of 18 hips included in his study as the age averaged 5.1 years in these hips. Also El Tayeby[10] performed pelvic osteotomies (Dega, Salter, and triple osteotomy) in 14 hips out of 16 hips included in his study as the age averaged 5.3 years in his study.

Choi classification[6,7] which is the main radiographic classification provides detailed information of deformities but it is complicated, not feasible to apply in young age group, and dislocations with the femoral head present were not included. In this study we used Farolin classification[9]; it is simple and easily applied to the young age group.

On final evaluation of results we used Hunka et al criteria[12] which is more suitable to this age group than Ponseti score[13] in which some items could not be fulfilled as walking for long distance which is difficult to evaluate in this age group. Also it is difficult to separate pain, limping, and limitation of motion from each other in this age group as they are closely related**.**

The level of satisfactory results in septic dislocations is different from developmental dysplasia of the hip as in septic dislocation we need stable, painless nearly mobile hip, in developmental dysplasia of the hip we need stable, painless freely mobile hip.

Comparison of results: the results in this study are satisfactory in 12 hips and unsatisfactory in 3 hips and this is nearly similar to the results obtained by El Tayeby[10] as the results were satisfactory in 13 hips and unsatisfactory in 3 hips according to Hunka et al criteria[12].

Complications

- Sever limitation of motion occurred in 3 hips in which there were excessive fibrous tissue within the acetabulum with adhesions of Iliopsoas to capsule, and the femoral head deformity was of stag horn type.
- Avascular necrosis occurred in 2 hips in which surgery was difficult due to adhesions with resec-

tion of parts of the stag horn head. But it is difficult to ascertain that the avascular necrosis is a postoperative complication or from the start as MRI was not done and the femoral head was not seen in the preoperative radiographs.

- Redislocation occurred in one hip in which avascular necrosis occurred with loss of the femoral head contour and is prepared for pelvic support osteotomy.

Conclusion

Septic arthritis of the hip in children is a nightmare for orthopedic surgeons. The most important prognostic factor is early diagnosis and treatment. Delayed or neglected treatment results in pathologic changes known as late sequelae of septic arthritis. Hip dislocation is one of the most severe sequelae of septic arthritis. Treatment of the dislocation is closed or open reduction. Open reduction of the septic dislocations is not an easy task. The aim of reduction is to achieve stability, minimize limb length discrepancy, and to facilitate later total hip replacement. Remodeling potential of the hip dislocation following septic arthritis is less than in hip dysplasia so the pathology should be corrected as one stage as possible and not to wait for remodeling as in hip dysplasia.

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Early results of medial opening wedge high tibial osteotomy for osteoarthritis knee

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Abstract

Background

Medial gonarthrosis is a joint disease that causes knee pain, reduction of activity and progressive alteration of the medial compartment, mainly in elderly and fat people [1]. Medial opening wedge high tibial osteotomy (MOWHTO) is an established procedure in the treatment of patients with medial compartmental osteoarthritis [2]. The aim of our study was to assess the early results of medial open wedge osteotomy in medial uni-compartment OA fixed with a plate.

Patients & methods

Patients included in this study were 25 patients. The minimum follow up of patients was 6 months. The patients mean age was 47 years, ranging from 36 to 59 years. All the patients were suffering from medial uni-compartmental osteoarthritis of knee joint. They treated with an oblique medial opening wedge high tibial osteotomy and fixation by using a plate.

Result

All the patients were evaluated at the end of the study regarding their function demand and they were further graded according to their satisfaction.

A total of 15 patients (60%) reported the procedure as excellent; eight patients (32%) much better and two patients (8%) little better. The mean correction angle was 9.6 degrees. Full weight-bearing was achieved after an average of ten weeks (range: 8-12 weeks). Superficial infection, deep infection, skin irritation, and cutaneous saphenous nerve hyposensitivity were complications occurred in the patients of the study group. The mean preoperative Oxford knee score (OKS) was 20; while the mean postoperative oxford knee score (OKS) was 37.

Conclusion

Medial opening wedge high tibial osteotomy (MOWHTO) fixed with a plate is a physiologically better surgery in primary medial compartment OA of the knee in early stages. The procedure is a very good alternative to unicompartmental or total knee arthroplasty. Early results are very gratifying. However, achieving successful outcomes requires proper patient selection, effective planning, meticulous surgical techniques, and good rehabilitative programs.

Keywords

Medial opening wedge, High tibial osteotomy, medial unicompartmental osteoarthritis knee.

Introduction

Management of OA of the knee aims to relieve pain and improve mobility. Conservative therapies do not alter the natural history or progression of OA, and thus are not curative. Initial treatment includes educational therapies in the form of exercise, braces, shoe raises and weight reduction [3,4] . Pharmacologic agents recommended for the initial management of knee OA include NSAIDs, intra-articular corticosteroid injections, intra-articular hyaluronate injections and intra-articular injections of platelet-rich plasma (PRP). Varus deformity associated with arthritic knee warrants operative intervention [5-7]. High Tibial Osteotomy (HTO) for osteoarthritis of the knee gained acceptance in the 1960s and is now well-established modality [8]. Many techniques have been developed i.e. closing wedge, opening wedge, dome and "en chevron" osteotomies, but opening (medial) and closing (lateral) wedge osteotomies are the most commonly used. Medial opening wedge high tibial osteotomy (MOWHTO) is a simple procedure and requires less dissection, the fibular osteotomy is not required, so less neurovascular complications. No bone resection of the lateral tibia is done hence, the normal anatomical tibial bone shape is maintained post HTO, which allows for easy conversion to knee replacement later on. There is no shortening of the limb. These features made it the osteotomy of choice for correcting varus deformity in unicompartmental OA knee [9 ,10].

The goal of an osteotomy is to reduce knee pain by transfer the mechanical axis from the pathologic area to the normal compartment in varus knee thus redistributing the load; also slows destruction of the medial joint compartment and the need for knee replacement is delayed.

Thus, the aim of our study was first to evaluate the early results of the medial opening wedge high tibial osteotomy (MOWHTO) and then to evaluate union at the osteotomy site and strength of the construct in view of weight bearing [11].

Patients Selection

Patients included in this study were 25 patients, 10 patients were prospective and 15 patients were retrospective. All patients were operated on a single knee. A prospective study between February 2015 and March 2017, while a retrospective study starting from July 2013. The minimum follow up of patients was 6 months. The patients' mean age was 47 years, ranging from 36 to 59 years, with symptomatic osteoarthritis knee of the medial compartment, and genu varum. They were 3 women and 22 men. They treated with an oblique medial opening wedge high tibial osteotomy and fixation by using a T-buttress plate without any augmentation except 6 patients of the study group that had bone substitute added to fill osteotomy site for enhancing bone union.

The inclusion criteria active patients younger than 60 years, active patients who agreed to be compliant with the postoperative protocol, with symptomatic primary osteoarthritis of the medial compartment, intact lateral and patellofemoral compartments, genu varum < 15^{o}, good range of motion (ROM) (ie, flexion > 90° and flexion contracture < 10°), body mass index (BMI) < 35, without ligamentous instability, and failed non-surgical treatment methods. 14 patients (56%) had grade III and 11 patients (44%) grade II severity according to Kellgren Lawrence grading system.

The exclusion criteria were symptomatic osteoarthritis in the lateral or patellofemoral compartments, osteoporosis (defined as a bone mineral density that lies 2.5 standard deviations more below the average value for young healthy women), varus deformity >15°, flexion contracture >10°, range of motion <90°, and the presence of severe osteoarthritis (defined as a grade of IV on the Kellgren–Lawrence radiographic grading scale).Patients who had a history of inflammatory arthritis, joint infection, on immunosuppressive therapy, or intra-articular knee fractures excluded from the study. Also, patients who had neurological or ligamentous instability were excluded from the study. Femoral varus patients with varus malalignment and normal Tibial bone varus angle (TBVA) (<5°) and medial proximal tibial angle (MPTA, 85-90°) have a bone varus of the distal femur (lateral distal femoral angle, LDFA >90°) were excluded from the study.

Preoperative evaluation and planning:

All patients were evaluated preoperatively using Oxford knee score (OKS) [12] **,** knee standing anteroposterior views and a true lateral radiograph with the knee in 30° of flexion. Full-length A-P view standing radiographs (the standing anteroposterior view including the hip, knee, and ankle joint), or lower extremity scannogram. The routine use of magnetic resonance imaging (MRI) to evaluate meniscal tears, cartilage lesions or ligament injuries in patients with osteoarthritis of the knee recommended. Parameters assisted in the frontal plane are Kellgren-Lawrence Grading Scale for osteoarthritis [13].

Mechanical tibiofemoral angle (to measure varus angle), by drawing a line from the center of the femoral head to the center of the knee, and from this point to the center of the ankle . Fig.1 The intersection of the lines on the knee gives the degree of varus , and Mechanical axis (Mikulicz-line) or weight bearing axis (a line is drawn from the center of the femoral head to the center of ankle joint) are measured on the full-length A-P view standing radiographs or lower extremity scannogram. The normal axis passes 10 mm medial of the center of the knee joint in the region of the tibial spine (ranging from 3 to 17 mm). Also assessing Lateral distal femoral angle (LDFA) 88° (85-90°), Medial proximal tibial angle (MPTA) 87° (85-90°), and Joint line convergence angle (JLCA) 2° (1-3 °) [14]. The osteotomy should maintain neutral joint-line obliquity and thus not increase the shear stresses at the joint surface.

Excessive obliquity prevents the shift of weight bearing to the lateral compartment and may cause a recurrence of the varus deformity following high tibial osteotomy [15]. Centre of rotation of angulation (CORA): The intersection point of the proximal and distal mechanical axes. The axis of correction of angulation and the osteotomy should pass through the same CORA to avoid displacement of the bone ends [14], and tibial bone varus angle (TBVA) 0° (<0-5°) [16].While Parameters in the sagittal plane are posterior tibial slope (6-10°) and Insall-Salvati Index (1.0). [17]

For calculation of the opening wedge, we draw a line from the center of the femoral head to the center of the talus (Fig. 1). In varus malalignment, the mechanical axis passes the tibial plateau more medially than the physiological mechanical axis deviation (MAD) of 10 mm (ranging from 3 to 17 mm). Next, a line that is parallel to the tibial plateau is drawn. A third line is drawn with the desired mechanical axis from the center of the femoral head to a point 62% lateral on the transverse diameter of the tibial plateau (Fujisawa point). The desired mechanical axis continued to the center of the ankle in its postoperative position. The center of rotation of angulation (CORA) lies in the lateral cortex at the tip of the fibula. Line 1 connects CORA with the middle of the ankle joint. Line 2drawn from CORA to the center of the ankle in its postoperative position and crosses the desired mechanical axis at the center of the ankle. The angle between lines 1 and 2 forms the correction angle [15].

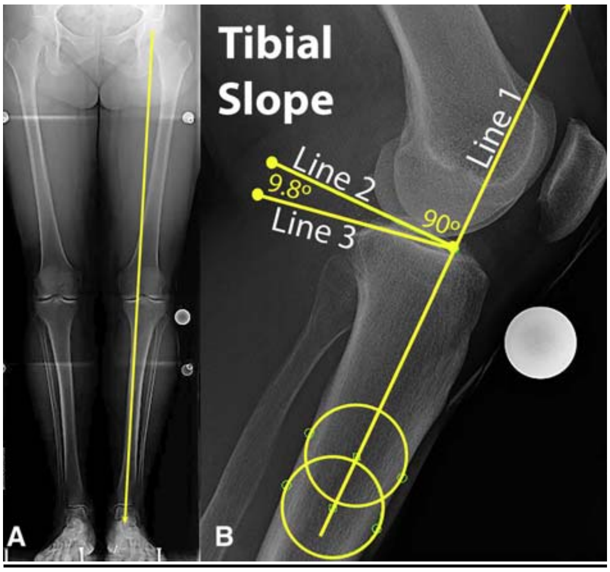

Fig 1: (A) Long-length standing radiograph of the bilateral lower extremities showing the left lower limb mechanical axis with varus malalignment. **(B)** Lateral radiograph of a left knee with associated measurement of the tibial slope by drawing 2 circles in the tibial shaft that are each tangent to the anterior to posterior cortices, and drawing a straight line extending between the central point of the circles to find the anteroposterior midpoint of the tibia (line 1). A second line (line 2) is drawn perpendicular to the first at the level of the tibial plateau, and a third line (line 3) is drawn along the tibial slope, using the medial femoral condyle. The angle measured between the second and third lines is the preoperative angle of the tibial slope [18].

Surgical techniques:

The patient was positioned supine on the operating table. A thigh tourniquet applied. The knee and leg draped free. The foot covered using very fine stockinet and adhesive drape to minimize the bulging at the ankle so that it will be possible to be better realize the femoro-tibial alignment after the correction.The C-arm of an image intensifier set up opposite to the surgeon. A diagnostic knee arthroscopy was performed, where the menisci, ligaments, and articular cartilage were inspected and debrided or meniscal surgery carried out if necessary.

A slightly oblique vertical incision made parallel to the medial border of the patellar tendon, beginning at the level of the inferior pole of the patella and extending to the tibial tuberosity. For exposure, the anteromedial aspect of the tibia by a skin incision centered between the medial border of the anterior tibial tubercle and the anterior edge of the medial collateral ligament (at the line of medial border of patella) and extending 6–8 cm distally from the joint line. A sharp dissection performed to expose the deep fascia over the pes anserineus, which retracted distally using a periosteal elevator to expose the superficial fibers of the medial ligament.

The superficial layer of the medial collateral ligament released, with subperiosteal elevation from the medial to the posterior portion. Superficial medial ligament dissected from the bone proximally up to the level of the osteotomy (Fig. 2). There was no risk of instability because the deepest and much more stabilizing tibio-meniscal bundle of the ligament remains intact. A blunt Hohmann retractor passed deep to the medial collateral ligament around the posteromedial corner of the proximal tibia, and along the posterior cortex of the tibia to protect the posterior neurovascular structures. A second retractor placed under the patellar tendon. The procedure facilitated by flexion of the knee.

Figure 2: Released superficial layer of the medial collateral ligament with subperiosteal elevation.

A pre-contoured T-shaped plate positioned on medial cortex 1-2 cm distal joint line, to make sure there is still enough space for the proximal part of the plate by selecting 2 holes in cross bar, a combination hole for proximal tibial part fixation, another hole for osteotomy area and 4 holes for fixation of distal tibial part. Then under the guidance of fluoroscopy, with the knee in extension, a 2-mm K-wire advanced medially from 1–2 cm distal to the level of the joint up to the lateral cortex and parallel to the joint line to ensure maintenance of the original tibial slope and prevent extension of the fracture to the tibial condyles (Fig. 3).

Figure 3: K-wire advanced parallel to the joint line under the guidance of fluoroscopy.

Other 2-mm K-wire introduced under fluoroscopic guidance to mark the saw cut (Fig. 4). The start point on the medial tibia is normally approximately 3-4 cm distal to the medial joint line. A Kirschner wire inserted in the oblique direction (20° to the tibial shaft) from the metaphyseal-diaphyseal junction of the medial proximal tibial cortex, which corresponds to a point just above the upper border of the pes anserinus. The lateral aiming point was the upper third of the proximal tibiofibular joint. A tibial osteotomy was performed just below and parallel to the guide pin, initially with an oscillating saw (Fig. 5) and then with a thin osteotome.

The extent of the osteotomy was checked by fluoroscopy to ensure an appropriate depth and direction of the cut (up to 1 cm medial to the lateral cortex). The osteotomy performed using an oscillating saw for the outer medial and anterior cortices, followed by a ½-inch osteotome placed over the guide pin and verified by fluoroscopy as the osteotomy performed. A ¾- in osteotome used for the posterior cortex, with the edge palpated posterior to the tibia as the osteotome advanced. The osteotomy carried to within 10 mm of the lateral cortex.

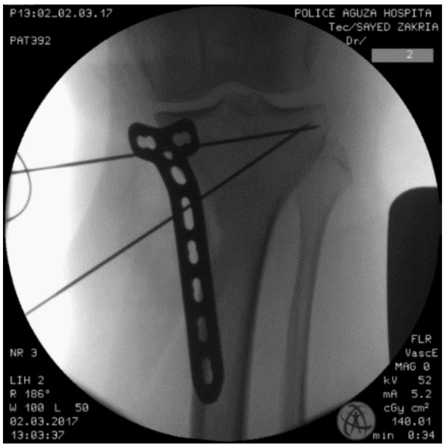

Figure 4: Under the guidance of fluoroscopy, other K-wire introduced toward upper third of the proximal tibiofibular joint.

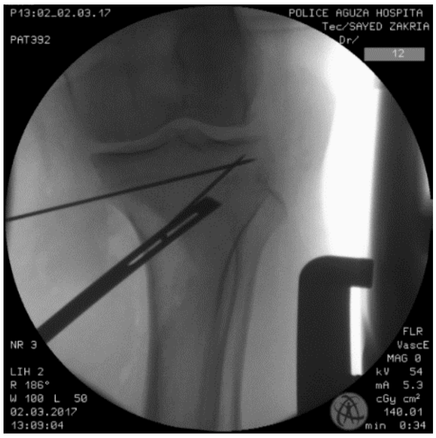

Figure 5: Under the guidance of fluoroscopy, the oscillating saw below and parallel to the second guide pin.

The bone at the site of the osteotomy opened, by pushing the portion of the tibia distal into valgus while counter posting lateral side of the knee and the osteotomies maintains the proximal end of the tibia in place. The opening should advance slowly to allow gradual opening of the osteotomy. Maximum attention is given to keep the lateral cortex intact to benefit from its hinge feature. The sagittal plane correction should also be assessed by looking carefully at the amount of opening of the osteotomy anteriorly and posteriorly. The tibia is a triangular bone in cross section with apex anterior; the opening must be greater at the posteromedial part of the osteotomy than at the anterior part in order to avoid increasing the posterior tibial slope and patella baja. If the gap anteriorly is equal to that at the posteromedial corner, the posterior slope of the tibia will inadvertently increase.

After adequate exposure of the osteotomy line, the osteotomy guide wire can be removed. Intra-operative assessment of correction can be done by using cable method, in which the electrocautery cord stretched from center of the hip to the center of the ankle and should be located at 62% of the tibial width and just lateral to the lateral tibial spine at the knee.

Internal fixation achieved by using the T-buttress plate, which allows healing starts in the lateral and dorsal part of the osteotomy and promotes osteogenesis through stable fixation with the precise amount of elasticity. The angle of correction maintained, thereby avoiding a later loss of correction. The plate secured with 6.5-mm 2cancellous screws proximally and 4.5-mm 3-4 self-tapping cortical screws distally (Fig. 6). No bone grafts added. Some cases augmented by bone substitute composed of hydroxyapatite with 65% porosity or β tricalcium phosphate with 60% porosity for enhancing bone union. Finally, the wound closed by repairing the superficial medial collateral ligament. After the closure of the layers and placement of a drain, the patient's knee put into a hinged immobilizer, or above knee posterior slab.

Figure 6: fluoroscopic picture after complete fixation.

Postoperative care and rehabilitation:

The patient is limited to partial weight bearing (15kg to 20 kg) for six weeks, after which the patient can begin full weight-bearing. On the first postoperative day, the patient started isometric quadriceps exercises and used CPM (continuous passive motion) apparatus to ease his/her movements. The patient rehabilitated with quadriceps muscle and hamstring strengthening exercises. Short radiographs were taken at six and twelve weeks to ensure maintenance of position and healing, and long leg alignment films done at six months to assess the correction achieved. The follow-up program wase:

- Immediately after the operation, the patient put in a hinged knee brace for 2 weeks. Postoperative x-ray knee A-P view and lateral view done.
- The patient is encouraged to do static exercises just after the operation to enforce the quadriceps muscle.
- The patient discharged after 2 days from the hospital and given a course of broad-spectrum antibiotics and antithrombotic drugs.
- The first visit after 2 weeks, x-ray knee anterior - posterior view and lateral view done and assessment of the wound and removal of the surgical stitches.
- The second visit after one month of the 1st visit, a new x-ray knee AP and lateral views done to assess bone union at the osteotomy site. If there is a good callus the patient is allowed full weight bearing and knee flexion and extension exercises. Stop antithrombotic treatment.
- The third visit after one and half month of the 2nd visit, a new x-ray knee AP and lateral views done to assess bone union at the osteotomy site. Removal of the hinged knee brace if there is adequate bone union.

The fourth visit 3 months after the 3rd visit, a new X-ray knee AP and lateral views done to assess bone union at the osteotomy site, quadriceps strength, and range of knee motion. Activities like cycling, brisk walking, driving, and riding were allowed after confirming complete consolidation of osteotomy at around 4 months.

Results

All patients included in this study had medial compartment osteoarthritis with an intact lateral compartment; they offered surgery if they had a varus knee deformity and their knee symptoms persisted despite conservative treatment. 12 patients had an arthroscopic evaluation of the joint status, 6 patients with a partial resection of the medial meniscus, other 6 patients also had a cartilage and synovial thickening debridement and in one patient had a drilling of osteochondral defect (OCD) by microfracture awl after debridement. The mean correction was 9.6 degrees, with a standard deviation of 3.41 (range: 5 to 16 degrees). All patients were followed-up until the bony union of the osteotomy radiologically documented. The mean follow-up period was 19 months (range: 6 - 40 months). Three of the 25 patients were women and 22 were men. The mean age was 47 years, ranging from 36 to 59 years. Walking without crutches and full weight-bearing was achieved after an average of ten weeks (range: 8-12 weeks). At the first follow-up examinations, hyposensitivity in the area of the cutaneous branch of the saphenous nerve (N. infrapatellaris) was observed in 3 patients.

A total of 15 patients (60%) reported the procedure as excellent; eight patients (32%) much better and two patients (8%) little better. All patients had a full range of motion reached within 12-week follow-up examination. Radiologically, consolidation is evident with bone formation in the osteotomy gap and variable formation of callus starting in the lateral and dorsal part of the osteotomy. Femoro-tibial axis, tibial slope and patellar height achieved at correction maintained during the bony healing phase without significant loss of correction. During the whole period of the study, no cases of implant failure reported. Only 6 patients of the study group had bone substitute added to fill osteotomy site for enhancing bone union. Fifty percent of patients who had bone substitute added to fill osteotomy site were infected. No patients had prior knee surgery except one patient had an internal fixation of an osteochondral defect in medial femoral condyle. This patient was the only one had a deep infection after 8 weeks and treated by debridement, metal changed without bone substitute added and antibiotics; complete bone union achieved in 12 wks. The mean preoperative oxford knee score (OKS) was 20; while the mean postoperative Oxford knee score (OKS) was 37.

Figure 7: Pre-operative scanogram both lower limbs . B, Pre-operative clinical standing view both lower limbs

Figure 8: Post-operative follow-up x-rays: A, after 2 weeks. B,after 3 months . C, after 6 months.

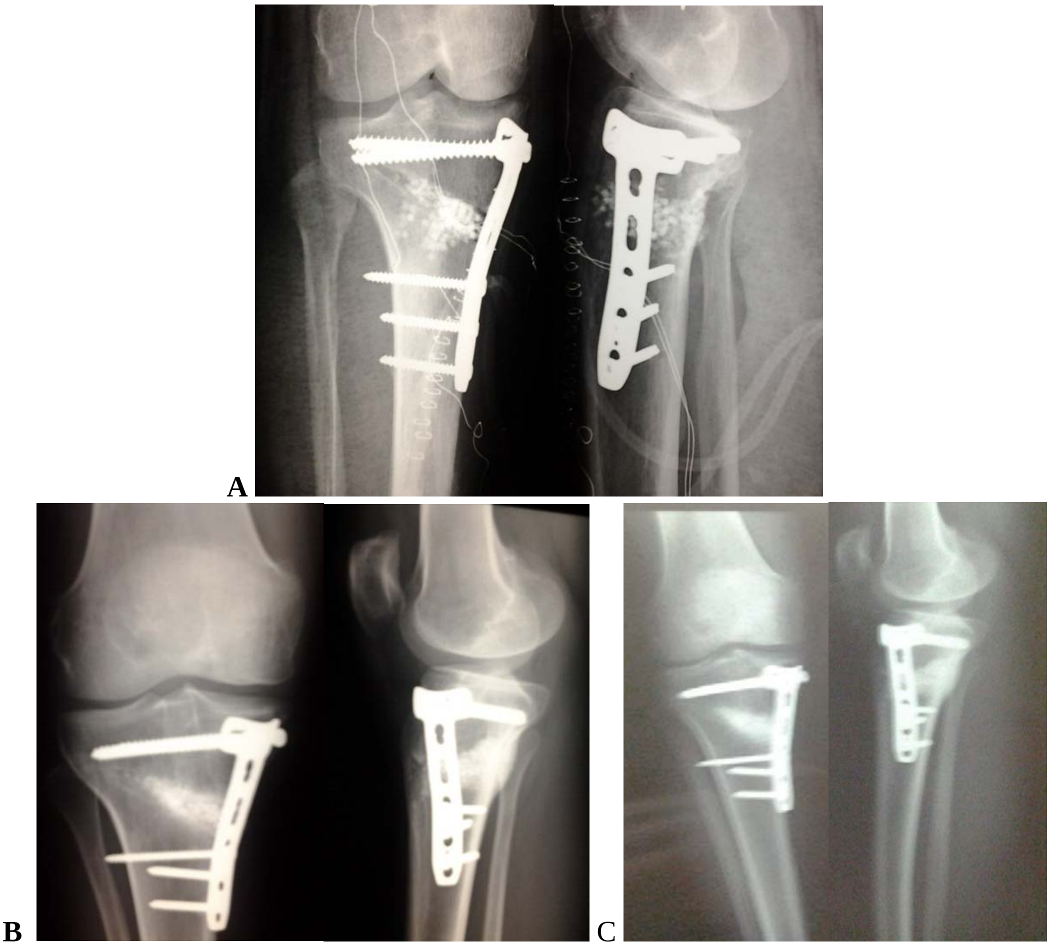

Figure 9: Post-operative follow-up x-rays: A, in operative day. B,, after 2 months C, after 1 year.

Discussion

Osteoarthritis is most common joint disease of the elderly and knee being the commonest joint involved [19, 20]. Unicompartmental or total knee replacement is the main stay of treatment when conservative treatments were ineffective. High tibial osteotomy resolves pain in the joint due to the translation of mechanical axis into the relatively better lateral tibial plateau in the long run and its decompressive effects in the early period , it improves the Knee function and prevents further deterioration of the joint at the previous speed. The closed wedge HTO may also lead to shortening of patellar tendon and loss of inclination of the tibial plateau which makes the subsequent total knee arthroplasty technically more challenging [21,22] . Correction of varus deformity by medial opening wedge high tibial osteotomy (MOWHTO) in an active patient with medial compartment arthritis enables medial approach that minimizes the risk of neurovascular lesions and the need for wide dissection of the soft tissues. The procedure allows controlled opening of the wedge leading to proper alignment and adequate correction of the deformity.

To achieve the satisfactory outcomes after MOWHTO, there are both mechanical and biological factors that must be considered. Important mechanical factors include the fixation technique and having an intact lateral cortex and lateral soft-tissue hinge .Furthermore, the use of bone grafts to fill gaps can increase mechanical stability and enhance bone healing. Although autologous iliac bone grafts considered the gold standard, donor site morbidity with these grafts is unavoidable. The use of synthetic bone substitutes is another option, but this technique has also been reported to have several disadvantages, including delayed incorporation into bone, soft tissue irritation, and infections.

When using a T-buttress plate alone, the elasticity of the plate has been shown to be an essential factor in encouraging bone growth by mechanical stimulation, even without bone grafts or the use of bone substitute material. By evaluation , both the clinical and the radiographic union. The osteotomy in this study group became united within 8–12 weeks. However, patients without bone substitute augmentation required a non-significantly longer time to form bone unions than patients treated with adding bone substitute augment.

The incidence of nonunion, loss of correction and failure in the opening-wedge technique depends on the stability of the fixation. Favourable short- and mid-term clinical results have been demonstrated in this study of opening-wedge HTO using this plate. The alignment of the lower limb could be maintained following an opening-wedge HTO with stable plate fixation, combined with a bone substitute or not with accurate correction and provide favourable short to mid-term clinical outcomes.

The amount of correction (valgisation) to be aimed at is still much debated. Reported good results were when the Mikulicz line passed through a point between 30% and 40% lateral to the midpoint of the knee. Based on this, the term “Fujisawa point” has been coined, which is defined as 62% of the entire width, measured from the medial side. We advocate some overcorrection of the varus deformity, but not more than 5°, and not beyond the Fujisawa point.

Arthroscopy of the knee joint may be performed before surgical correction to verify the preoperative clinical and radiological findings, and to rule out and treat the intraarticular pathologies.

Excellent results are obtained in patients’ 60 years of age at the time of surgery. The patellar height may be reduced post-operatively because the tibial tubercle is lowered by elongating the proximal tibia, significantly greater in knees requiring >15° of correction. Alteration of patellar height may affect the range of motion (ROM) of the knee. However, the ROM was not significantly reduced in this study patients’ at the most recent follow-up. The increase in posterior tibial slope may also be a problem as it affects the kinematics of the knee, the stability and the joint contact pressure. The triangular geometry of the osteotomy planes prevents increasing the tibial slope.

Technical pearls to avoid complications for opening wedge high tibial osteotomy :

- The plate must be positioned before osteotomy to make sure there is still enough space for the proximal part of the plate.
- Placement of guide pin and osteotomy too proximal can lead to lateral tibial plateau fracture.
- Verify osteotomy starting point at the medial cortex, using a guide pin, and avoid too oblique osteotomy: maintain 15° to 20°.
- Perform subperiosteal dissection to protect superficial medial collateral ligament.
- Secure fixation medial collateral ligament repair to avoid valgus instability.
- Measurement pitfalls: anterior tibial gap should be one half of posteromedial gap to avoid increasing the posterior tibial slope and patella baja.
- The osteotomy opening should be advanced slowly to allow gradual opening of the osteotomy. Maximum attention was given to keep the lateral cortex intact to benefit from its hinge feature.
- Rehabilitation: implement immediate motion, patellar mobilization.

This study has some limitations with regard to the assessment of lower limb alignment. Pre- and postoperative radiographic evaluation was performed using standard weight-bearing radiographs. For more accurate assessment, long-leg standing radiographs or CT scanogram lower limbs should be taken, although obtaining these films can be time-consuming, cumbersome, expensive and problematic. However, a reasonable assumption of accuracy is based on the concept that the mechanical axis in long-leg radiographs correlates well with the femorotibial angle (FTA), which is formed by the intersection of the anatomical femoral and tibial axes in standard radiographs of the knee.

Conclusions

Medial opening wedge high tibial osteotomy (MOWHTO) using a rigid plate fixation system is a reliable procedure that provides good functional outcomes in short- and mid-term follow-up for patients with varus medial unicompartmental OA of the knee. The concept of joint preservation to improve prognosis is appropriate for patients in our population.

The use of (MOWHTO) for the treatment of varus malaligned knees increased because it offers improvements over the lateral closing wedge techniques with low complication rates. The fact that it is easier to perform, corrects the deformity close to its origin, provides more predictable corrections and better preservation of the bone stock and avoids injuries to the peroneal nerve and proximal tibiofibular joint. This osteotomy also enables the surgeon to avoid any of the comorbidities associated with a concurrent fibula osteotomy.

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Modified Stoppa approach is appropriate for open reduction and Internal fixation of type C pelvic fracture

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Abstract

Objectives

To evaluate feasibility and safety of elective open reduction and internal fixation of type C pelvic ring disruptions of variant grades through Modified Stoppa approach (MSA).

Patients & Methods

30 patients with type C1, C2 and C3 pelvic fracture and anterior column acetabular injuries underwent reduction through Pfannenstiel skin incision made 2 cm proximal to the symphesis pubis with an incision made 2 cm posterior to anterior superior iliac spine and runs posteriorly for cases had high iliac and sacroiliac joint fracture or fracture dislocation. Functional outcome was assessed using the Merle d'Aubigné (PMA) score and quality of reduction was evaluated by radiographic measurements of residual pelvic ring displacement.

Results

All patients passed smooth intraoperative and immediate postoperative (PO) courses, apart from 3 patients developed superficial wound infection without localization that was managed conservatively, 2 patients developed localized superficial wound infection that required stitch removal to allow wound drainage and one case developed deep wound infection that required removal of multiple stitches for drainage. Mean PO hospital stay was 5±1.1 days. Functional outcome, at end of follow-up, was excellent in 9, good in 16, fair in 3 and poor in 2 patients with mean PMA score of 16.2±2. Repair was anatomical in 23 patients, while it was imperfect in 7 patients. Final radiological outcome was excellent in 15, good in 9, fair in 4 and poor in 2. Collectively outcome was satisfactory in 24 but was unsatisfactory in 6 patients.

Conclusion

MSA provided convenient field exposure with acceptable room for open reduction and internal fixation of pelvic ring disruptions within reasonable operative time and with acceptable intraoperative blood loss. PO wound-related complications were confined to superficial and occasional deep wound infections. Functional and radiological outcomes of repair are satisfactory and within acceptable ranges.

Keywords

Modified Stoppa approach, Open reduction, Pelvic fracture, Functional outcome, Radiological outcome.

Introduction

Most pelvic ring injuries are due to high-energy trauma [1] and are associated with significant morbidity and mortality [2] secondary to associated abdominal, thoracic and head injuries [1]. Moreover, unstable disruption of pelvic ring mostly results in hemorrhage that may be massive or life-threatening [1] and hemorrhagic shock can occur in about 10% of cases with pelvic ring injuries [2].

Unfortunately, isolated injuries to the anterior or posterior pelvic ring rarely occur and disruption to the anterior pelvic ring, either fracture of the superior or inferior pubic ramus, or pubic symphysis, may indicate an additional pelvic ring disruption [3] and about 45% of bilateral ramus fractures and 42% of dual-ramus fractures had concomitant sacral fractures not observed on plain radiographs, while these occult sacral fractures were found in only 11.1% of patients with inferior ramus fractures [4].

Combined pelvic ring disruptions and acetabular fractures are not uncommon and are associated with multiple system injuries and high Injury Severity Scores with early death rate of 19% of patients with combined anterior-posterior compression injuries and 6% with lateral compression injuries [5].

The Stoppa approach is an intrapelvic approach initially used for inguinal hernia surgery by **Stoppa et al.** [6] and was introduced as the method for approaching the anterior acetabulum and pelvic bone by **Hirvensalo et al.** [7]. Modified Stoppa approach (MSA) is used for the treatment of acetabular fractures targeting gentle soft-tissue preparation, anatomic reduction and stable internal fixation [8]. MSA allows exposure of most of the inner true bony pelvis including the entire pelvic brim and the quadrilateral surface allowing visualization up to 2 cm above and 5 cm below the pelvic brim along the quadrilateral surface, providing adequate anterior exposure for clamp and implant placement [9].

Aim of the work

The present study was designed to evaluate feasibility and safety of elective open reduction and internal fixation of type C pelvic ring disruptions of variant grades through Modified Stoppa approach.

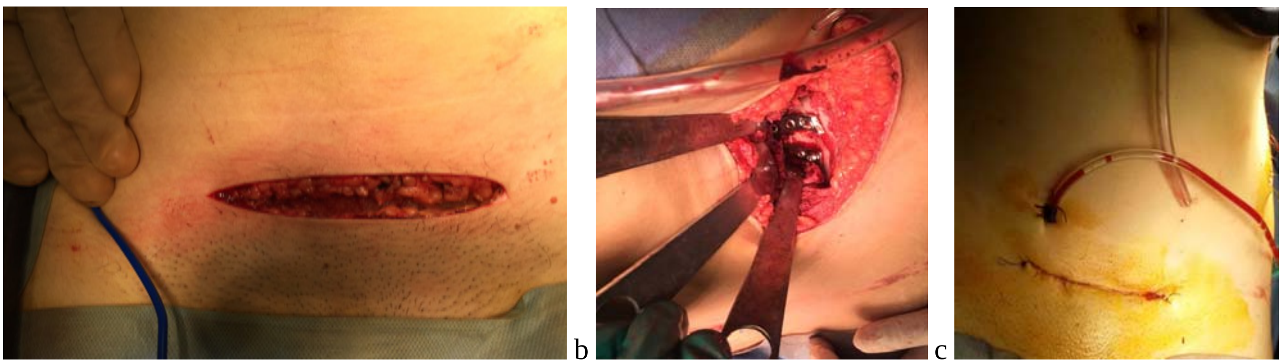
Patients & Methods

The study protocol was approved by the Local Ethical Committee. The study was conducted at Department of Orthopedic Surgery, Faculty of Medicine for Girls, Alzhraa University Hospital and Heliopolis Hospital Cairo, Egypt since Feb. 2012 up to follow-up period of 18 months for the last case operated upon. Inclusion criteria included presentation by clinical manifestations of unstable pelvic ring injury of variant grades that confirmed radiologically. Patients fulfilling inclusion criteria and signed written fully informed consent concerning the assigned surgical procedure were included in the study. Patients with type A and isolated type B pelvic ring injuries were excluded from the study.

Operative Technique

All surgeries were performed under general anesthesia; patient was catheterized, positioned in supine with slight hip flexion on a radiolucent operating table and C-arm was ready to check the accuracy of fracture reduction . Modified Stoppa approach was performed as previously described in literature [10, 11]. Briefly, a Pfannenstiel skin incision was made 2 cm proximal to the symphesis pubis (Fig 1a). After exposure of rectus abdominis muscle, an incision was made in linea alba and both recti were separated laterally, retraced to expose fascia transversalis that was incised just above the symphesis pubis to approach the internal aspect of the pelvis. The cave of retzius was bluntly dissected and the bladder protected by blunt retractor. Three Hoffman retractors were inserted; one over the superior pubic ramus to reflect the anterior abdominal wall away, and rectus abdominis muscle was released superiorly from body of the pubis, the 2nd was inserted over the anterior edge of acetabulum to protect external iliac vessels and the 3rd was inserted under the iliopsoas from its medial border. Corona mortis was identified and ligated at about 6 cm lateral to symphesis pubis and subperiosteal dissection was performed along the pelvic brim. Obturator nerve and vessels were identified and protected during the operation, then, external oblique muscle was released and reflected medially, subperiosteal dissection was performed to reach internal iliac fossa, thus facilitating reduction and fixation (Fig 1b).

A second incision was made 2 cm posterior to anterior superior iliac spine (ASIS) and runs posteriorly for reduction and fixation of high iliac fractures and sacroiliac joint fracture or fracture dislocation. After completion of reduction and fixation, hemostasis was assured and two drains were placed, in retropubic recess and in the iliac fossa and then wound was closed in layers (Fig 1c)



a b c

Fig. 1: a: showing the Pfannenstiel incision **b:** showing the anterior fixation of the sacroiliac joint through incision made 2 cm posterior to anterior superior iliac spine and runs posteriorly **c:** showing the site of the Pfannenstiel and the lateral incisions. Both incisions were closed and cavities were drained

Postoperative care

After surgery, Patients were encouraged to perform intermittent, pain-free quadriceps, hip- and knee-flexion exercises with traction starting on the 2nd PO day. Then, non-weight bearing on the operated side was maintained for about 4 weeks; thereafter, tolerable weight bearing with a pair of crutches was allowed. Full weight bearing was permitted about 12 weeks after surgery, depending on the degree of radiographic consolidation of the fracture. Throughout the PO period, isometric quadriceps contraction exercise with the leg in extension was encouraged.

Study outcome

1. Functional outcome was assessed using the Merle d'Aubigné (PMA) score [12] using a 6-point scale for a total PMA score of 3 to 18, with a score of 18 was considered as an excellent; 15-17 as good; 12-14 as fair grade and 3-11 as poor clinical outcome [13].
2. Radiologic outcomes were assessed by union time and quality of reduction (Fig 2a-c). Quality of reduction was assessed using the radiographic measurements of the residual displacement of the pelvic ring determined from the difference in the height of femoral head from a line perpendicular to the long axis of the sacrum. Thus, quality of reduction was graded as excellent if maximal displacement was 0–4 mm, good if displacement was 5–10 mm, fair in case of displacement of 11–20 mm, or poor if displacement was > 20 mm [14].
3. Frequency of complications as loss of reduction, infection, nerve palsy, post-traumatic arthritis, osteonecrosis of the femoral head and heterotopic ossification was recorded.

a b C

Fig. 2: a: X-rat film showing the fracture site **b:** Immediate PO X-ray film showing reduction and fixation of the sacroiliac joint fracture and symphsis pubis dislocation **c:** Follow-up X-ray film showing fracture healing

Results

The study included 30 patients fulfilled the inclusion criteria; 18 males and 12 females with mean age of 41.2±9.8; range: 24-63 years. Majority of injuries were secondary to vehicle accident. Three patients had combined injuries including acetabular and anterior column injuries. As regards type of injury, 17 patients had complete posterior ring disruption (C1 type) of which 9 patients had fracture through Iliac bone (C1.1 type) and 8 patients had fracture through sacroiliac joint (C1.2 type); another 7 patients C2 type in the form of C1 type fracture and contralateral type B fracture and 6 patients had bilateral C1 type fracture (C3 type). Mean duration between trauma inflection and surgical intervention was 2.4±1.1; range: 1-5 days (Table 1).

All surgeries were conducted uneventfully within a mean operative time of 162±23.4; range: 120-205 minutes and estimated IO blood loss was 1087±280; range: 600-1500 ml. Mean length of Pfannenstiel incision was 9.2±1.2; range: 8-12 cm and all Pfannenstiel wounds and most of the lateral incision are closed using subcutical continuous vicryl 0/3 suture without subcutaneous drainage (Fig. 1). All patients resumed oral intake within a mean PO time of 3.7±1.5; range: 2-6 hours. During immediate PO period, 6 patients developed wound related complications; three patients developed superficial wound infection without localization and responded to conservative wound dressing, antiedematous and antibiotic therapy. Another two patients developed localized superficial wound infection that required stitch removal to allow wound drainage, samples were obtained for culture and sensitivity test was performed and empirical antibiotic was given till result of sensitivity test had defined the appropriate antimicrobial drug; both cases responded to treatment and drainage site had closed by primary intention. One case developed deep wound infection that required removal of multiple stitches for drainage, after response to appropriate antimicrobial and wound dryness, wound debridement was performed and drainage site was closed by secondary sutures. Mean duration of postoperative hospital stay was 5±1.1; range: 3-7 days, (Table 2).

Clinical evaluation at end of follow-up detected 9 patients (30%) with excellent clinical outcome, 16 patients (53.3%) had good outcome, while 3 patients (10%) had fair and only two patients (6.7%) had poor outcome with a mean of final PMA score of 16.2±2; range: 11-18. PO radiological evaluation defined anatomical fracture repair in 23 patients (76.7%), while it was imperfect in 7 patients (23.3%) and none showed poor repair. Final radiological outcome was excellent in 15 cases (50%), good in 9 cases (30%), fair in 4 cases (13.3%) and poor in 2 cases (6.7%). Collectively outcome was satisfactory in 24 patients (80%) and unsatisfactory in 6 patients (6.7%), (Table 3, Fig. 2).

Table 1: Characteristics of studied populations

Variables			Findings
Age (years)			41.2±9.8 (24- 63)
Sex	Male		18 (60%)
	Female		12 (40%)
Cause of injury	Vehicle accident		26 (86.7%)
	Fall from height		4 (13.3%)
Type of fracture	C1	C1.1	9 (30%)
		C1.2	8 (26.7%)
	C2		7 (23.3%)
	C3		6 (20%)
Time between trauma inflection and surgical intervention (days)			2.4±1.1 (1-5)

Data are presented as mean±SD & numbers; range & percentages are in parenthesis

Table 2: Operative and immediate PO data of studied populations

Variables			Findings
Operative time (min)			162±23.4 (120-205)
Operative blood loss			1087±280 (600-1500)
Wound-related data	Wound length (cm)		9.2±1.2 (8-12)
	Complications	Superficial infection without localization	3 (10%)
		Localized superficial infection	2 (6.7%)
		Deep wound infection	1 (3.3%)
Time till resumption of oral intake			3.7±1.5 (2-6)
Duration of PO hospital stay (days)			5±1.1 (3-7)

Data are presented as mean±SD & numbers; range & percentages are in parenthesis

Table 3: Outcome of studied populations determined at end of follow-up

Variables			Statistics
Final PMA score	Frequency of scores	18	9 (30%)
		15-17	16 (53.3%)
		12-14	3 (10%)
		3-11	2 (6.7%)
	Total		16.2±2 (11- 18)
Radiological evaluation		Anatomical	23 (76.7%)
		Imperfect	7 (23.3%)
Final radiological outcome		Excellent	15 (50%)
		Good	9 (30%)
		Fair	4 (13.3%)
		Poor	2 (6.7%)
Outcome		Satisfactory	24 (80%)
		Unsatisfactory	6 (20%)

Data are presented as numbers & mean±SD; percentages & ranges are in parenthesis

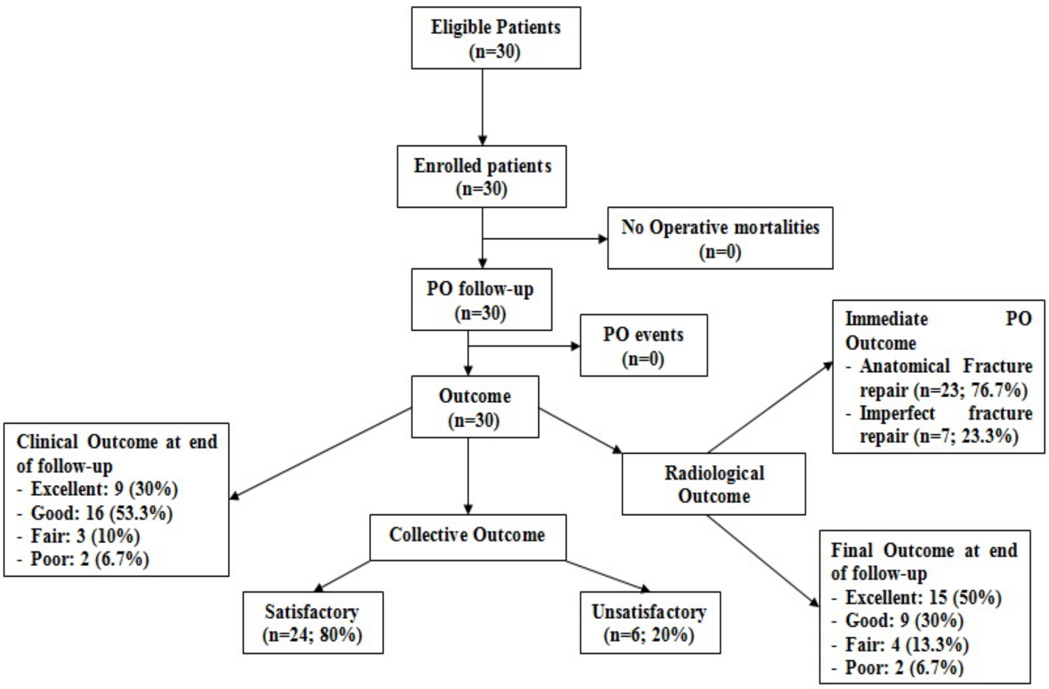


Fig. (3): Flow sheet of outcome of studied patients

Discussion

The study included 30 patients with type C1-3pelvic fracture and anterior column acetabular injuries, all surgeries were conducted uneventfully using the modified Stoppa approach (MSA) through Pfannenstiel incision of mean length of 9.2±1.2 cm within a mean operative time of 162±23.4 minutes and with estimated IO blood loss of 1087±280 ml. These figures go in hand with **Mei et al.** (15) who investigated the feasibility and effectiveness of MSA in treatment of bilateral pelvic pubic fractures through incision length of 8-10 cm and found operation time range was 75-135 minutes and IO blood loss had ranged from 400 to 900 ml. Also, **Yang et al.** [16] documented the effectiveness of MSA with medial wall spring plate for repairing quadrilateral of acetabulum fracture and reported mean operative time of 130 minutes and amount of IO bleeding of 650 ml.

All fractures' repairs were conducted through MSA with a second postero-lateral incision. In line with repair through more than one incision, **Šrám et al.** [17] repaired comminuted acetabular fracture using the Stoppa approach alone in four patients, combination of Stoppa and Kocher-Langenbeck approach in 6 and three approaches were employed in five patients and recorded no adverse intra- or post-operative events. Also, **Taller et al.** [18] performed fixation of acetabular fracture using isolated Stoppa approach in 11 patients and a procedure combining the Stoppa approach with another method in four patients.

As regards orthopedic outcome, PO radiological evaluation detected anatomical fracture repair in 23 patients (76.7%) and imperfect repair in 7 patients. At end of follow-up, mean final PMA score was 16.2±2 and final radiological outcome was excellent-to-good in 25 (83.3%) cases, fair in 4 cases and poor in 2 cases, but collectively outcome was satisfactory in 24 patients and unsatisfactory in 6 patients. These figures are in accordance with that previously documented in literature [15, 16, 18, 19, 20, 21, 22] concerning functional and radiological outcome of repair of pelvic ring disruption through MSA.

The reported wound-related complications are confined to development of subcutaneous infection that was deep subcutaneous infection in one patient and superficial in 5 patients. Similarly, **Isaacson et al.** [20] reported that MSA-induced complications included one superficial infection, three deep infections, two patients with temporary lateral thigh numbness, and one inguinal hernia and **Oh et al.** [22] reported that MSA can be used for stable anterior ring fixation with low complication rate. Also, **Fan et al.** [23] documented that MSA can be used to treat pelvic and acetabular fractures effectively, and it has advantages of easy manipulation and a low complication rate.

Modified Stoppa approach being extraperitoneal approach allowed conduction of the repair procedure without intestinal manipulations and no peritoneal injuries had occurred, this permitted early resumption of oral intake within a range of 2-6 hours and spared the need for intravenous fluid therapy which is advantageous for elderly patients to safeguard against overloaded circulation which carries multiple cardiopulmonary risks.

In support of the safety and efficacy of open reduction of pubic ring and/or acetabular fractures through MSA, **Mei et al.** [15] documented that MSA has characteristics of convenience and directness of incisions, clear operation field, easy reduction, few complications and fast recovery and so concluded that MSA is an ideal choice in surgical treatment of bilateral pubic fractures. Also, **Yang et al.** (16) found quadrilateral acetabulum fracture can be fixed with medial wall spring plate by MSA or combined with other approaches to obtain good exposure, less invasion, satisfactory reduction, stable fixation, and low complications. Thereafter, **Oh et al.** [22] found stable anterior ring fixation placed via MSA can result in excellent reduction and stable screw fixation with a low complication rate. Moreover, **Elmadağ et al.** [24, 25] documented that MSA is a good minimally invasive alternative to the ilioinguinal approach and can be used to treat many complex acetabular fractures.

As another support for the efficacy of MSA, **Murcia-Asensio et al.** [26] found Stoppa approach in hip revision surgery can complement traditional approaches to control the intrapelvic structures, remove migrated implants of previous surgery and reconstruct the pelvic defect. Also, **Schäffler et al.** [27] were able to perform all osteo-synthesis in elderly patients with primarily ventral acetabular fractures and medial protrusion of the femoral head with the MSA, in combination with the first window of the ilioinguinal approach and documented that the plate was applied in most patients without complications.

Recently, in 2017, **Wang et al.** [28] compared the efficacy and safety of open reduction and internal fixation through ilioinguinal approach and MSA for treatment of displaced acetabular fractures and documented that both techniques can obtain satisfactory clinical functions but MSA is superior in terms of operation time and IO blood loss. Also, **Meena et al.** [29] reported better reduction and lower complication rates with less operative time when anterior acetabular fractures was operated with MSA compared to ilioinguinal approach.

Conclusion

Modified Stoppa approach provided convenient field exposure with acceptable room for open reduction and internal fixation of pelvic ring disruptions within reasonable operative time and with acceptable IO blood loss. PO wound-related complications were confined to superficial and occasional deep wound infections. Functional and radiological outcomes of repair are satisfactory and within acceptable ranges.

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Modified double tendon transfer for reconstruction after resection of tumors of the distal ulna.

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ABSTRACT

Introduction:
The distal ulna is a rare site for development of primary bone neoplasm. The ideal method of reconstruction after resection of tumors of the distal ulna remains a controversial issue. The aim of this study was to evaluate the results of our modifications of a technique described by Breen et al to stabilize the proximal ulna stump after tumor resection using double tendon transfer.
Patients & Methods:
Between 2007 and 2014 six patients underwent resection of primary bone tumors of the distal ulna and stabilization the proximal ulnar stump using double tendon transfer of both flexor and extensor carpi ulnaris. There were 4 males and 2 females with the dominant limb affected in 4 patients. The mean age was 34.3 years. Five patients had a benign aggressive tumor (Giant cell tumor), and only one patient had low grade chondrosarcoma. The average length of resection was 7.75cm. At last follow up functional evaluation was done using the Musculoskeletal Tumour Society score (MSTS).
Results:
After an average follow up of 43.3 months there was no evidence of local recurrence of the primary lesion or evidence of distant metastasis. Clinically there were no signs of instability of the proximal stump of the ulna. Radiologically there was neither ulnar deviation of the carpal bone nor radial convergence of the ulnar stump in all patients. The overall MTSS score at final follow up scored 26.3(87. 8%). The best scores where in the hand positioning and dexterity followed by pain score. The lowest score was the lifting ability (3.5). The overall functions scored 4.3. All patients were able to perform their pre-operative activities.
Conclusion:
Primary bone tumours of the distal ulna are rare. Studies dealing with the management are therefore limited with few patients. No general consensus can be formulated from these studies due to few numbers of patients, different methods of reconstruction and different scoring systems. However, the current study results suggest that double tendon transfer may have a rule in increasing the stability of the ulnar stump thus providing a better function.
Keywords:
Distal ulna -primary bone tumours- tendon transfer- tumour resection

INTRODUCTION:

The distal ulna is a rare site for development of primary bone neoplasm. [1] Wide local resection of the distal part of the ulna is needed to achieve adequate local control of the locally aggressive benign and malignant bone tumors that arise in the distal ulna.

The complex anatomy and function of the distal radio-ulnar and ulno-carpal joints combined with the close relationship with the ulnar neurovascular bundle and tendons, make the reconstruction after resection in this area challenging.[2,3,4]

Excision of the distal ulna often leads to instability of the forearm with possible dynamic radio-ulnar convergence. This may lead to pain, weakness, and loss of the strength of the hand grip as the remaining proximal ulnar stump may impinge upon the distal radius [5,6,7].

Furthermore, about 20% of the load of the hand that crosses the wrist is supported by the ulna [8,7]. Loss of this support leads to instability of the radio-carpal joint and may be complicated by rupture of extensor tendons of the hand [9,10].

Most of the knowledge about resection and reconstruction of the distal ulna has been gained from the management of degenerative condition of the distal radio-ulnar joint using the Darrach procedure and Sauvý-Kapandji procedure and their modifications. [11,12]

Reconstruction after tumor resection of the distal ulna remains a controversial issue. Soft tissue reconstruction alone or combined with bony or prosthetic reconstruction was used for

reconstruction after tumor resection of the distal ulna with variable results. Some authors recommended using no reconstruction at all. [13,14]
Osseous reconstruction using either allograft [15], distal ulna prosthesis [7], proximal fibular graft [16] and ulnar support reconstruction [17] was combined with soft tissue reconstruction.
Soft tissue reconstruction includes tenodesis of either flexor or extensor carpi ulnaris or both. [1,18]
In this study, we evaluated the results of our modifications of a technique described by Breen et al [18] to stabilize the proximal ulna stump after tumor resection in 6 patients using double tendon transfer.

PATIENTS AND METHODS

Between 2007 and 2014 six patients underwent resection of primary bone tumors of the distal ulna and stabilization the proximal ulnar stump using double tendon transfer of both flexor and extensor carpi ulnaris. Only patients with follow up period more than 12 months were included.

There were 4 males and 2 females with the dominant limb affected in 4 patients. The mean age was 34.3 years (range: 23-45 years).
All patients had a routine initial assessment tumor work up including adequate history taking, clinical assessment and radiological evaluation. All patients had a preoperative biopsy in our department by a surgeon of the oncology team.
Five patients had a benign aggressive tumor (Giant cell tumor), and only one patient had low grade chondrosarcoma. The level of resection was decided based on the preoperative evaluation. All patients had adequate wide local excision with a safety margin of at least 2 cm proximal to the tumor. The average length of resection was 7.75cm (range: 6-12cm)
The resection was done through a dorsal incision between extensor carpi unlaris and flexor carpi ulnaris preserving the dorsal cutaneous branch of the ulnar nerve. The tumor of distal ulna along with at least 2 cm of normal bone was excised together with triangular fibro-catilagenous complex to avoid tumor contamination of distal margin. The distal radio-ulnar joint was approached started dorsally and as far radially as possible. The ulnar border of the pronator quadratus and a part of the distal radio-ulnar joint capsule were included in the resection. In one case, an additional anterior approach was needed due to extensive radial and anterior extension of the tumor.
Identification and isolation of both the tendons of flexor carpi ulnaris and extensor carpi ulnaris was done.
A 3.5 mm or 4.5mm drill hole was drilled in a posterior- anterior direction, 5 -10 mm above the end of the ulnar stump. The diameter of the drill hole should be correlated with the diameter of the ulnar stump to avoid iatrogenic fracture.
The tendon of flexor carpi ulnaris was split longitudinally 3cm distal to ulnar osteotomy up to a point 2cm proximal to the cut end of the bone and the ulnar half is left attached proximally then it was passed through the volar hole of a drill hole and out through the medulla of the cut end of the bone. The tendon was then directed to the volar direction and sutured to the remaining half under slight tension with non-absorbable sutures. This would dynamically stabilize the ulnar stump.
The extensor carpi ulnaris tendon was split to a point 3 cm proximal to the cut end of the ulna and left attached distally, then the radial half of the tendon was passed through the medulla of the cut end of the bone out through the dorsal drill hole with the forearm held in supination and wrist in neutral or slight ulnar deviation. The tendon split was then directed to the ulnar side and sutured back on itself with non-absorbable sutures. The tenodesis effect of this maneuver can effectively stabilize the ulnar stump and provide longitudinal suspensory support to the carpal bone. Table 1 Figure **1.**

Soft tissue repair of the remnant IRUJ capsule, pronator quadratus muscle to the ECU was done to increase the ulnar side stability of the wrist joint.
Adequate hemostasis was achieved after tourniquet was released. The wound was closed in layers over suction drain. The limb was splinted in an above elbow splint with the forearm held in mid-way supination for 3 weeks. The sutures were removed on 14th day.
Regular follow up was done every three months both functional and oncological. At last follow up functional evaluation was done using the Musculoskeletal Tumour Society score (MSTS). [19]

Table 1: pre-and postoperative data of the patients.

patient	Age / Sex	Pathology	Side/ Dominance	Length of resection (cm)	Follow up (months)	Occupation
1	23 / M	GCT	Lt / No	8	82	Student
2	44/ F	GCT	Rt / Yes	6.5	70	Housewife
3	25/ M	GCT	Rt / Yes	7	55	Engineer
4	45/ M	Chondrosarcoma	Lt / No	12	20	Farmer
5	29/ F	GCT	Rt / Yes	6	18	Housewife
6	40/ M	GCT	Rt / Yes	7	15	Secretary
Mean	34.3			7.75	43.3	

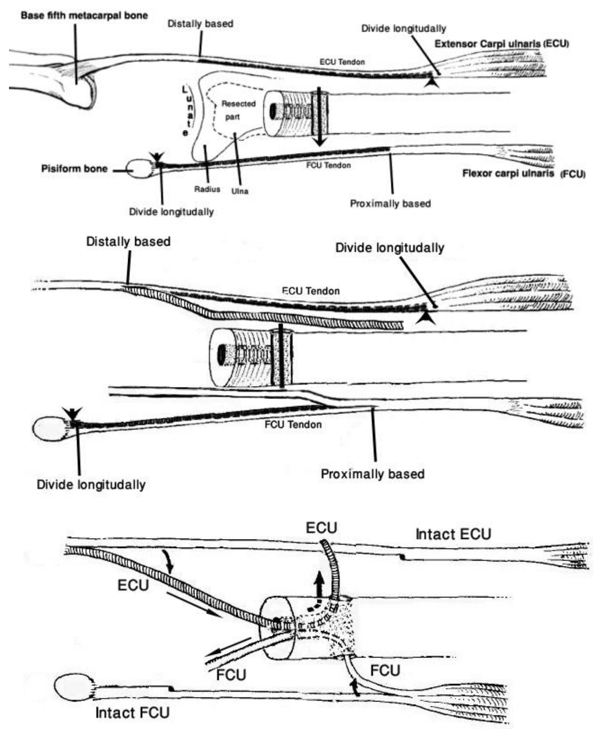

Figure 1: Schematic representation of the double tendon transfer technique

A: planning of a distally based ECU and proximally based FCU with drilling of the stump of the ulna.

B: dividing a distally based ECU and proximally based FCU hemi tendon.

C: passage of a distally based ECU tendon through the medulla of the ulna out through the dorsal drill hole and passage of the proximally based FCU tendon from the volar drill hole and through the medulla of the ulna.

A

B

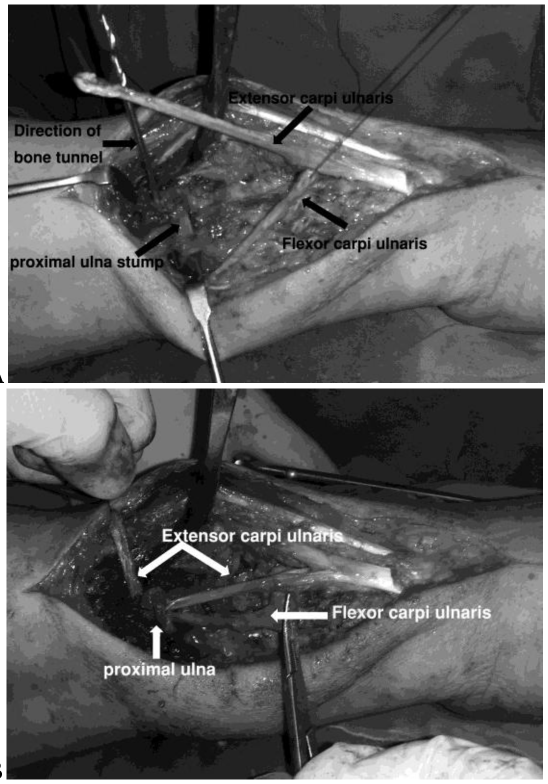

Figure 2: intra-operative appearance of the double tendon transfer.

A: preparation of the tendon and the bony tunnel.

B: after passing the tendons through the drill hole and the medulla of the distal ulna.

Results

After an average follow up of 43.3 months (range: 15-82months) all of six patients showed neither evidence of local recurrence of the primary lesion nor evidence of distant metastasis at last follow up.

Clinically there were no signs of instability of the proximal stump of the ulna.

There was no tenting of the skin over the remaining stump at rest or even with pronation supination. Figure **3**

Radiologically there was neither ulnar deviation of the carpal bone nor radial convergence of the ulnar stump in all patients. Figure **3**

The overall MSTS score at final follow up scored 26.3(87. 8%). The best scores where in the hand positioning and dexterity followed by pain score. The lowest score was the lifting ability (3.5). The overall functions scored 4.3. All patients were able to perform their pre-operative activities.

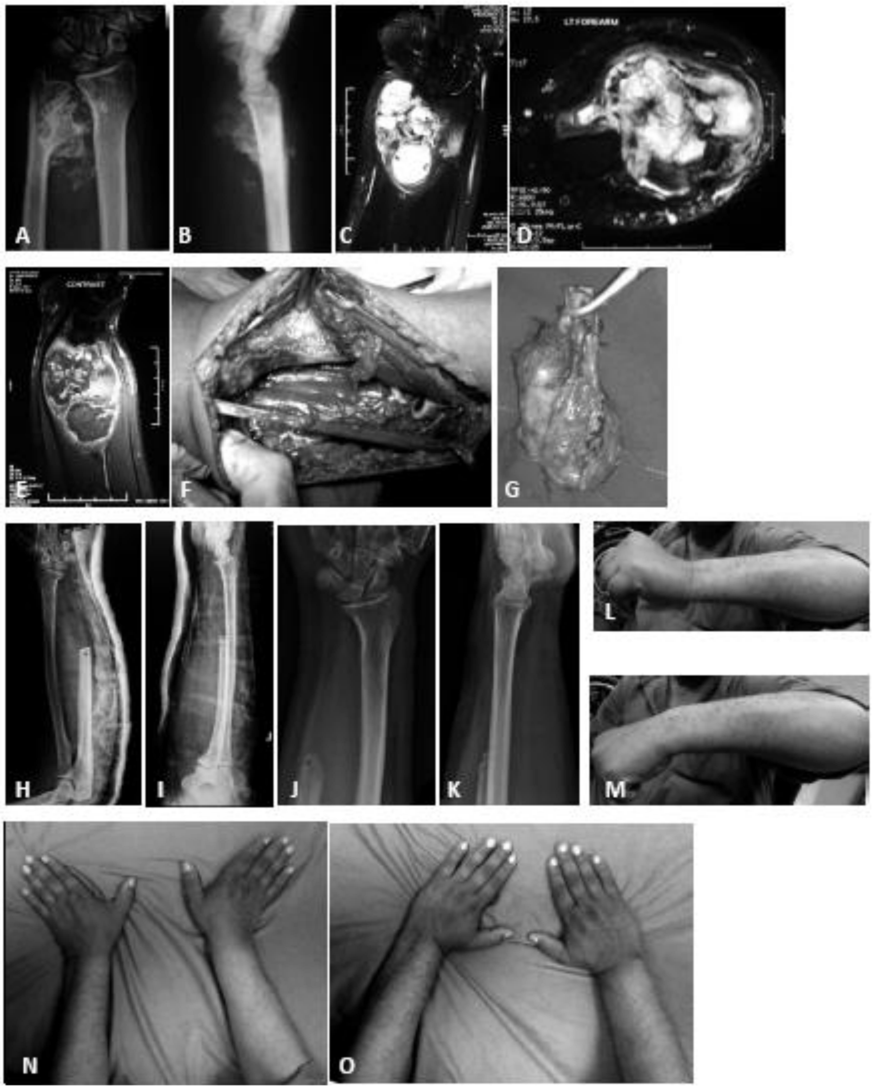

Figure 3: case 4; a 45 year old male patient with left side chondrosarcoma distal ulna;
A, B: preoperative x-ray.
C, D, E: preoperative MRI
F: Intra-operative appearance.
G: 12 cm excised segment
H, I: Early postoperative x ray.
J, K: x-ray at final follow up 20 month.
L, M: Clinical outcome with no prominence of ulna stump with extension and flexion of the wrist.
N, O: Clinical outcome with no limitation of radial or ulnar deviation of the wrist.

Table 2: The Musculoskeletal Tumour society score at last follow up (30 points score)

Patient	**Follow up (months)**	**pain**	**Function**	**Emotional acceptance**	**Hand positioning**	**Dexterity**	**Lifting ability**	**Total (%)** (out of 30)
1	82	4	4	5	5	5	3	26(86.7%)
2	70	5	4	4	5	5	4	27(90%)
3	55	5	4	4	5	5	4	27(90%)
4	20	4	5	4	5	4	3	25(83.3%)
5	18	5	5	3	4	5	4	26(86.7)
6	15	5	4	5	5	5	3	27(90%)
Mean	**43.3**	**4.7**	**4.3**	**4.2**	**4.8**	**4.8**	**3.5**	**26.3(87. 8%)**

DISCUSSION:

The reconstruction after resection of primary bone tumours of the distal ulna is a controversial issue. Few scattered cases have been reported using different methods of reconstruction. Most of the published reports compare their results with that of the Darrach procedure for treatment of degenerative condition of the distal ulna. [14]

Resection of tumor of the distal ulna is often longer in length and sacrifices the stabilizing soft tissues structures to achieve adequate local tumor control thus it would be expected to have less favorable functional outcome compare to degenerative condition. [20,21] The stability of the IRUJ is mainly dependent on the soft tissue stabilizing structures since the bony articulation only provides 20% of the joint stability. [22]

In this study, the average length of distal ulna resection was 7.75 cm which is comparable to the length of resected distal ulna reported by other authors for tumor. [13,14,20,23]

Soft tissue reconstruction is the most commonly used method of reconstruction after resection of tumors of the distal ulna alone or combined with other methods of skeletal reconstruction. [1, 6,16,17,24,25,26]

In a series of eight patients, Ferracini et al [6] reported good or excellent results in seven in whom stabilization was performed using the FCU tendon or fascia lata. In their series only one patient had a fair outcome in which no stabilization method was used. They recommend soft-tissue stabilization of the stump of the ulna whenever possible.

Despite the good results reported after using different soft tissue reconstruction techniques few studies recommended no soft tissue reconstruction after tumor excision of distal ulna. [13,14,27]

In a study of 12 patients that had resection of the distal ulna for tumors without reconstruction, Dhinsa et al[14] at the final follow up reported a MSTS score of 64% (40% to 93%), with the lowest scores being for the ability to lift (2.2- 44%), function (2.8- 56%), and emotional acceptance(2.5-50%). Compared to the current study, the final MSTS score was (87. 8%) with the score of lifting ability (3.5- 70%), function (4.3-86%) and emotional acceptance (4.2-84%). The improvement of the score reflects the effect of increased stability of the ulna stump on the overall function. Double transfer can provide both multidirectional stability for the ulnar stump and suspensory support to the wrist during lifting objects. Combined active and passive stabilizing effect of the double transfer can effectively stabilize the ulnar stump in different positions of the wrist. [18]

Either proximally based [1,23, 28 , 29 , 30] or distally based [31] ECU remains the most commonly used tendon transfer for stabilization of the ulnar stump after resection of the distal ulna due to the sizable tendon and the easy accessibility in the operative field.

In this study, we reversed the double tendon transfer introduced by Breen et al, [18,32]. Instead of using the distally based FCU and proximally based ECU tendon transfer we used proximally based FCU and distally based ECU. The double transfer is supposed not only to provide both dynamic and static stability of the proximal stump of the ulna but also alleviate some mechanical disadvantages of using single tendon transfer. [33]

Adjusting the suitable tension of a distally based tendon to keep the proximal stump of the ulna away from the radius is biomechanically challenging. The position of the wrist joint during tensioning of the tendon can greatly affect the efficiency of the transfer. If the tendon is tensioned to the stump of the ulna with the wrist in neutral position it will not efficiently prevent the ulnar stump from hitting the radius in ulnar deviation as tension of the transfer will be lax. [34] On the other hand, if the tendon is tensioned with the wrist in ulnar deviation this will adversely increase the tension with radial deviation resulting in considerable reduction of wrist motion with subsequent increase in radiocarpal stress causing postoperative wrist pain. This greatly reduced the popularity of isolated distally base tenodesis. [5,33]

In this study, we used a distally based ECU tendon for static tenodesis of the ulnar stump instead of the distally based FCU described by Breen et al., [18,32]. The tenodesis between the insertion of the FCU to the pisiform bone and the proximal stump of the ulna can result in reduction radial deviation and extension of the wrist joint with progressive piso-triquetral joint degeneration due to increased stress across the joint. [33] On the other hand, ECU as a distally based transfer is attached to the base of the 5th metacarpal bone which provide two advantages; first being more distal than the insertion of FCU into pisiform bone provide more length between the stump of the proximal ulna and the anchorage point of the tendosis which allow relatively more wrist movement without affecting the stability of the tenodesis and second the metacarpal base as an anchorage point is more stable than the small pisiform bone that would be expected to cause postoperative pain due to stress at the anchorage point of the tenodesis [33].

The double tendon transfer allows the proximally base FCU to actively control the stability of the ulnar stump when the tension in distally based ECU tenodesis is expected to decrease with ulnar deviation of the wrist. The distally based ECU tendon also provide direct transfer of the load of the hand and carpal bone to the proximal ulnar stump and this was reflected on increasing the ability to left object in our patients compared to other studies[13]. The tendon double transfer provides a reciprocal stability of the stump of the ulna throughout different positions of the wrist. [18]

CONCLUSION:

Primary bone tumours of the distal ulna are rare. Studies dealing with the management are therefore limited with few patients. No general consensus can be formulated from these studies dues to few numbers of patients, different methods of reconstruction and different scoring systems. However, the results of current study suggest that double tendon transfer may have a rule in increasing the stability of the ulnar stumpafter tumor excision of the distal ulna thus providing a better function.

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Anteromedial plate osteosynthesis of midshaft humeral fractures: is it safe?

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Abstract

Background
Treatment of humeral shaft fractures has been a subject of debate for many decades. Even though a large majority of humeral shaft fractures can be treated by non-operative methods, few conditions like open fractures, polytrauma, ipsilateral humeral shaft and forearm fractures require surgical intervention. The goal of treatment of humeral shaft fractures is to establish union with an acceptable humeral alignment and to restore the patient to the pre-injury level of function. The purpose of this study was to determine the outcome of anteromedial plate osteosynthesis of midshaft humeral fractures through an anterolateral approach regarding radial nerve injury, operative time and time for union.
Patients and methods
This is a prospective study conducted at an academic Level 1 Trauma Center from February 2015 to October 2017. The study included 20 patients (11 males, 9 females) with mid shaft humeral fractures treated with anteromedial plate osteosynthesis through an anterolateral approach using 4.5 dynamic compression plates. Their mean age was 36.5 years (20-60). The dominant side was affected in 13 patients and the non-dominant side was affected in 7 patients. The mean operative time was 57.5 minutes (30-90). The mean follow-up period was 13.4 weeks (12- 22). Patients were assessed clinically, radiographically and functionally using the DASH score and Rodriguez-Merchan score.
Results
At the time of our final follow-up, no hardware failure or fracture displacement were recorded. 90% of fractures united and 10% required secondary grafting. 85% of cases achieved excellent or good functional outcome and 10% required secondary procedures. Only one case had postoperative radial nerve injury representing only 5% of cases, which spontaneously recovered within 6 months without the need for surgical interference. The mean time for union was 12.4 (11-16) weeks. 9 patients showed 1ry union (45 %), while 11 patients showed 2ry union (55%). The mean DASH score was 31.08 (22.5-36.7). Rodriguez-Merchan score was excellent in 10 patients, good in 7 patients and fair in 3 patients.
Conclusion
Anteromedial humeral plate osteosynthesis via the anterolateral approach is an easy, rigid and safe method of fixation with good functional outcome.
Level of evidence
Therapeutic level IV.

Keywords
Humerus, fracture, anteromedial, radial nerve, palsy.

Introduction

Humeral shaft fractures are common fractures in the orthopedic casualty representing about 3 % of all fractures.[1]

Even though conservative treatment can be successful in most humeral shaft fractures, surgical intervention is indicated in certain conditions, including failure of closed reduction, open fractures, associated vascular injury, associated ipsilateral forearm and elbow fractures, segmental fractures, bilateral humeral shaft fractures and fractures in polytrauma patients.[2]

Plate osteosynthesis is still the gold standard method of fixation of humeral shaft fractures.[3] The posterior and anterolateral approaches are the standard approaches for internal fixation of these fractures. There is a risk of iatrogenic radial nerve injury during posterior and anterolateral plating mostly due to manipulation of the nerve during surgery.[4-8]

This study was done to assess the incidence of radial nerve palsy and non-union in anteromedial plate osteosynthesis through an anterolateral approach.

Patients and methods:

This is a prospective study conducted at an academic Level 1 Trauma Center from February 2015 to October 2017. The study included 20 patients (11 males, 9 females) with mid shaft humeral fractures treated with anteromedial plate osteosynthesis through an anterolateral approach using 4.5 dynamic compression plates. Their mean age was 36.5 years (20-60). The dominant side was affected in 13 patients and the non-dominant side was affected in 7 patients. Regarding the fracture pattern according to the AO/OTA classification, 2 patients had A1 pattern (spiral), 4 patients had A2 pattern (oblique) 11 patients had A3 pattern (transverse), one patient had B1 (spiral wedge) and 2 patients had B2 (bending wedge) (**figure 1**). The mean operative time was 57.5 minutes (30-90). The mean intraoperative blood loss was 239.5 cc (100-400). The mean follow-up period was 14.7 weeks (12-22). Patients were assessed clinically, radiographically and functionally using DASH score (the Arabic version) and Rodriguez–Merchan score (**table 1**).[9,10]

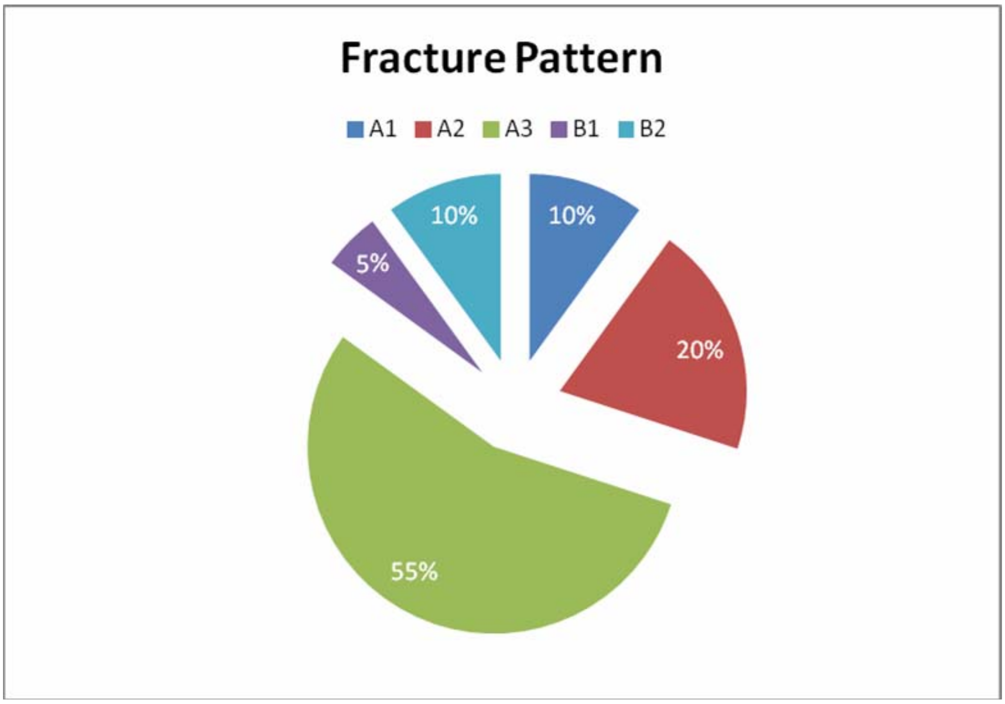

Figure 1: Fracture pattern percentage.

Table 1: Rodriguez–Merchan score for the elbow.(10)

Rating	Elbow range of movement	Shoulder range of movement	Pain	Disability
Excellent	Extension 5˚ Flexion 130˚	Full range of movement	None	None
Good	Extension 15˚ Flexion 120˚	<10 % loss of total range of movement	Occasional	Minimum
Fair	Extension 30˚ Flexion 110˚	10-30% loss of total range of movement	With activity	Moderate
Poor	Extension 40˚ Flexion 90˚	>30 % loss of total range of movement	Variable	Severe

Operative technique:

The patients were placed in supine position with the arm in abduction on arm board. The incision was made along the lateral border of biceps (**figure 2A**) with sufficient length to allow insertion of 8 to 10 hole DCP (Dynamic Compression Plate). The space between biceps and brachialis was identified (**figure**

2B) and the musculocutaneous nerve visualized and protected (**figure 2C**). The biceps was retracted medially and the brachialis muscle was split longitudinally to expose the humerus. The fracture site was cleaned of fracture hematoma and interposed soft tissues. The arm was externally rotated to facilitate the visualization of the anteromedial surface of the humerus. Reduction was done by applying traction to the distal humerus to restore bone length then angulation and rotation were corrected (**figure 3A)**. Fractures were fixed with 4.5 mm DCP applied to the anteromedial surface of the Humerus (**figures 3B,C)**.

Figure 2: (A) Skin incision, (B) Anterolateral dissection lateral to the biceps, (C) Identification of the musculocutaneous nerve.

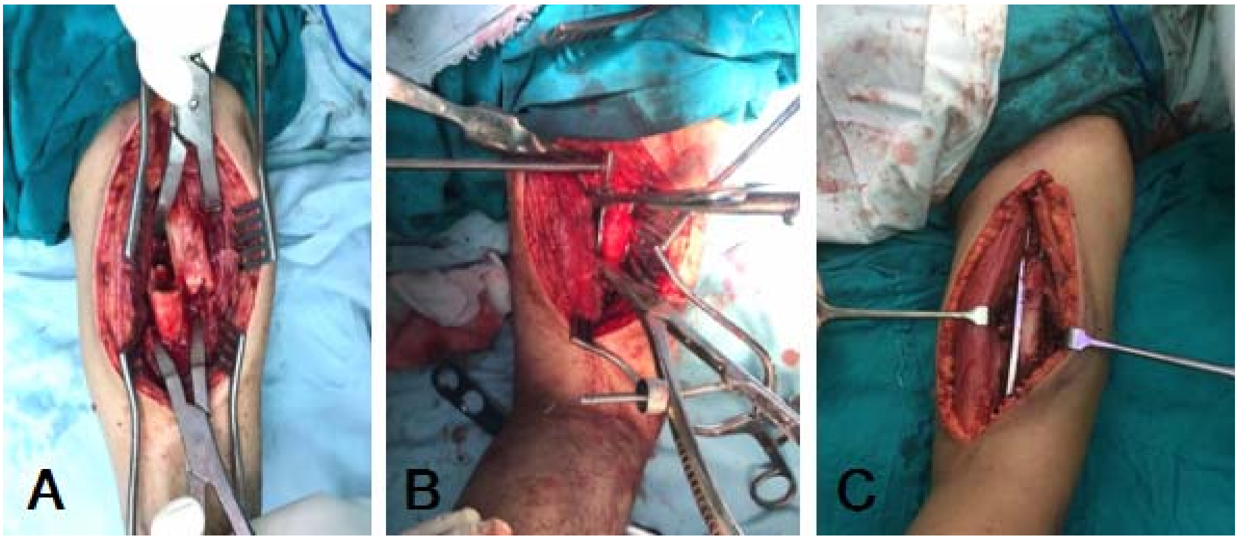

Figure 3: (A) Reduction of the fracture, (B,C) Applying the plate to the anteromedial surface.

Postoperative care:

The arm is supported in a sling. Careful postoperative neurovascular assessment is important. Immediate post-operative radiograph was taken. Gentle use of the hand and the elbow can usually begin as soon as the patient's comfort permits. Forceful use of the arm should be discouraged, but gentle, assisted range of motion for shoulder and elbow can usually be added at an early stage. Follow-up radiographs were done at 6 weeks, 12 weeks, 3 months and 6 months to assess fracture union (**figure 4**).

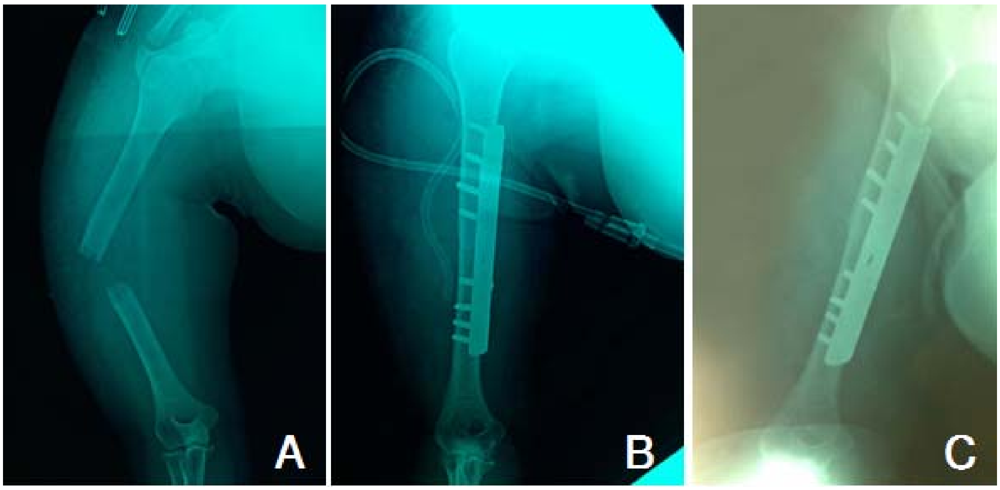

Figure 4: (A) Pre-operative X-ray, (B) Immediate post-operative X-ray, (C) Follow-up X-ray after 6 weeks.

Results

No patients were lost to follow-up, which was for a mean of 13.4 weeks (12-22). Eighteen patients (90%) achieved union clinically and radiologically at a mean of 12.8 weeks (9-16). Two patients (10%) failed to achieve union by the 16th week as evidenced clinically by pain at the fracture site and radiologically by persistence of fracture lines. Iliac bone grafting was done for both patients. Regarding range of motion, 18 patients showed full shoulder and elbow range of motion. One patient showed limited elbow extension (flexion deformity 10 degrees), another patient showed limited shoulder abduction (70 degrees abduction). One patient suffered post operative radial nerve palsy that improved spontaneously after 3 months.

At the final follow-up after full union, functional assessment was done using the DASH and Rodriguez-Merchan scores. The mean DASH was 31.08 ± 3.97. Rodriguez-Merchan score was excellent in 10 patients, good in 7 patients and fair in 3 patients (**table 2**).

Table 2: Results of Rodriguez-Merchan score.

Rodríguez– Merchán score	Number of patients	Percentage
Excellent	10	50%
Good	7	35%
Fair	3	15%

Discussion

Non-operative management is still the best treatment method for most humeral diaphyseal fractures, with expected high union rates.[11] When operative management is indicated, plate osteosynthesis remains the gold standard method of fixation.[3]

Choice of the approach for fixation of humeral shaft depends on the level of the fracture. The anterolateral approach is convenient for proximal and middle third fractures while the posterior approach is best suited for distal third fractures.

The whole humeral shaft can be exposed through the Henry anterolateral approach, without the need to visualise the radial nerve.[12] However, placement of the plate on the lateral surface carries a risk of iatrogenic radial nerve injury mostly due to the blind use of soft tissue retractors to improve visualization.[13,14]

The anteromedial surface of the humerus has no relations to the radial nerve which passes posterior then lateral to the humerus before it pierces the lateral intermuscular septum. So, the anteromedial surface is considered a safe corridor for plate osteosynthesis.[15.16]

Many studies were conducted to assess the incidence of radial nerve injury during anteromedial plating and they reported no cases of postoperative radial nerve palsy in their series.[3,8,17]

In this study, we encountered one case of postoperative radial nerve palsy and was managed by observation only with spontaneous complete resolution after 3 months.

Anterolateral plating frequently requires plate contouring with deltoid stripping on the lateral surface. In anteromedial plating, plate contouring is not needed because of relatively flat anteromedial surface which decreases the operative time and blood loss.

Kirin et al (2011) compared the results of anteromedial and anterolateral plating and the mean operative time for anterolateral plating was 74.61±10.74 minutes and for anteromedial plating 55.45±10.56 minutes.[4]

In this series, the mean operative time was 57.5 ±15.12 minutes. The mean intraoperative blood loss was 239.5 ± 68.5 cc.

Regarding biomechanical strength of anteromedial plate fixation, Zheng and colleagues (2016) concluded in their study that anteromedial plating was superior to anterolateral and posterior plating in most of the mechanical tests.[18]

Conclusion

Anteromedial humeral plate osteosynthesis is easy, safe for radial nerve, rigid, less time-consuming method with good functional outcome.

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Revision surgery for developmental dysplasia of the hip (DDH), midterm result

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Abstract

Background
The aim of treatment of DDH is to obtain a stable concentric reduction of the head of the femur inside the acetabulum. There may be many factors to be mentioned causing failure of reduction of the hip either related to the surgery or the patient. We analyzed the different causes of failure to maintain stable concentric reduction in the first surgery and discuss the clinical and radiological outcomes after revision surgery.

Patients and Methods
This study included 52 patients (44 females and 8 males) treated at orthopedic surgery department, Mansoura University Hospitals between 2007 and 2014. The mean age at primary surgery was (26.08 ± 11.77) months and the mean age at revision surgery was (34.73 ± 12.69) months. All cases were given at least 6 months before revision surgery to allow physiotherapy to restore the range of movements. The mean follow up period is (53.3 ± 7.29) months.

Results
All cases were assessed clinically using Ponseti grading and 21 patients are asymptomatic. All cases were assessed radiologically using Severen grading and only 4 cases were sublaxed. Avascular necrosis was diagnosed according to criteria of Kalamachi and Mc Ewen and 14 cases had no avascular necrosis.

Conclusion
We concluded that technical and surgical errors are the main causes for redislocation of femoral heads after reduction.

Keyword
Revision Surgery, DDH, Redislocation

Introduction

The aim of treatment of DDH is to obtain a stable concentric reduction of the head of the femur inside the acetabulum. About 3-8% of failure of reduction in DDH occurs by using the anterior approach. [1] It is essential to early diagnose and start treatment of developmental hip dysplasia as the acetabular remodeling occurs during the first 18 months of life. [2] There may be many factors to be mentioned causing failure of reduction of the hip either related to the surgery or the patient. [3, 4] In this study we present our experience with 52 patients who presenting to us with redislocation following previous open reduction. We will analyze the different causes of failure to maintain stable concentric reduction in the first surgery and discuss the clinical and radiological outcomes after revision surgery.

Patients and Methods

This study included 52 patients (44 females and 8 males) treated at orthopaedic surgery department, Mansoura University Hospitals between 2007 and 2014. All cases had been treated initially at other hospitals except 6 cases which were treated in our hospital. We included all cases with typical DDH and excluded cases with neuromuscular or any other congenital disorders. (Figure 1-2)

All cases of revision were unilateral whether the patients had unilateral or bilateral dislocation. The mean age at primary surgery was (26.08 ± 11.77) months ; the mean age at revision surgery was (34.73 ± 12.69) months.

All cases are treated in the primary surgery by open reduction, 17 cases had additional adductor tenotomy, 16 cases had additional Salter osteotomy and 8 cases had additional femoral osteotomy. (Table1)

The mean follow up period is (53.3 ± 7.29) months ; we did not use preoperative traction for any case. All cases were given at least 6 months before revision surgery to allow physiotherapy to restore the range of movements.

Table 1: patient details and surgical findings. LT ligamentum tere ; PUL pulvinar tissue PSOAS T psoas tendon; TAL transverse acetabulum ligament; FIB.SHELL fibrous shell; OR open reduction; ADD T adductor tenotomy; SO salter osteotomy; DRO derotation osteotomy

case	Gender	Age at first surgery	Surgical technique	Age at revision	Findings during revision					
					L.T.	PUL.	PSOAS.T.	T.A.L	FIB.SHELL	DEFORMED HEAD
1	M	18	OR-ADD.T	25	-	+	-	-	-	-
2	F	25	OR-ADD.T	35	-	+	-	-	-	-
3	F	19	OR-ADD.T	25	-	+	-	-	-	-
4	F	23	OR-SO	30	-	+	+	-	-	-
5	F	26	OR-SO-ADD.T	40	-	+	+	+	-	-
6	F	34	OR	42	-	+	-	-	-	-
7	F	60	OR-SO-ADD.T	69	-	+	+	+	+	+
8	M	23	OR-ADD.T	30	-	+	+	-	-	-
9	F	27	OR	40	-	+	+	-	-	-
10	F	37	OR	45	+	+	-	-	-	-
11	F	18	OR-SO	28	-	+	-	-	-	-
12	F	12	OR-ADD.T	20	+	+	-	-	-	-
13	F	42	OR-SO-DRO	55	-	+	+	+	-	+
14	F	38	OR-ADD.T	48	-	+	+	+	-	+
15	F	19	OR	31	-	+	-	-	-	-
16	F	27	OR	35	-	+	+	-	-	-
17	F	29	OR-ADD.T	42	-	+	-	-	-	-
18	F	21	OR-SO	31	-	+	+	-	-	-
19	M	25	OR-DRO	32	-	+	-	-	-	-
20	M	20	OR-ADD.T	26	-	+	-	-	-	-
21	F	19	OR	27	+	+	-	-	-	-
22	F	17	OR	26	-	+	-	-	-	-
23	F	14	OR	21	-	+	+	-	-	-
24	F	15	OR-ADD.T	21	-	+	+	+	-	-
25	F	21	OR-SO-ADD.T	30	-	+	-	+	-	-
26	F	27	OR-DRO	41	-	+	-	-	-	-
27	F	13	OR	22	+	+	+	+	-	-
28	F	20	OR	29	-	+	-	+	-	-
29	F	24	OR-ADD.T.	32	-	+	-	+	-	-
30	F	21	OR-ADD.T.	30	-	+	-	+	-	-
31	F	39	OR-SO	47	-	+	+	-	-	+
32	F	16	OR-SO	23	-	+	+	+	-	-
33	M	32	OR-SO	41	-	+	-	-	-	-
34	F	31	OR-SO	39	-	+	-	-	-	-
35	F	58	OR-ADD.T.-DRO	69	-	+	+	-	+	+
36	F	14	OR	23	-	+	+	+	-	-
37	F	19	OR	27	-	+	+	-	-	-
38	F	16	OR	22	-	+	-	+	-	-
39	F	31	OR-DRO	38	-	+	-	-	-	-
40	M	28	OR-DRO	36	-	+	-	-	-	-
41	F	24	OR-SO	30	-	+	-	-	-	-
42	F	22	OR-ADD.T.	30	-	+	+	+	-	-
43	F	16	OR	25	-	+	+	+	-	-
44	F	15	OR	25	-	+	+	+	-	-
45	F	56	OR-SO-DRO	69	-	+	-	-	+	+
46	F	19	OR	25	-	+	+	-	-	-
47	F	52	OR-SO-DRO	61	-	+	-	-	+	+
48	F	20	OR	27	-	+	+	+	-	-
49	M	27	OR-SO	34	-	+	-	-	-	-
50	F	48	OR-ADD.T.-SO	56	-	+	-	+	+	+
51	F	17	OR	23	-	+	+	-	-	-
52	F	22	OR	28	-	+	-	-	-	-

Surgical technique

All cases were revised using Bikini incision and using anterior approach.

Dissection between the Sartorius and tensor fascia lata, identifying the lateral cutaneous nerve of the thigh and keep it retracted with Sartorius.

We prefer to dissect the space between the dislocated head and the tensor muscle and fill this space by small towel for further dissection. Splitting the iliac apophysis from proximal to distal and maintain the space medial and lateral by towels which help in dissection and hemostasis. Dissect the rectus femoris from the capsule and cut its tendon below the anterior inferior iliac spine and retract it distally. Identify and cut the iliopsoas tendon medially after rolling it against the pubic bone ,you may do figure of four to the limb to better identify it, and be cautious that the tendon may not totally cut as sometimes there is more tendinous part still intact. Dissect the capsule from lateral, posterior, medial and anterior from all adherent muscle fibers or soft tissue. Make the T cut ensuring your upper cut is away from the labrum and it is better to leave more capsular tissue in the lateral half of the vertical cut than the medial for further capsular covering. Track the ligamentous teres if still there to reach the true acetabulum and cut it flush with the bone and sometimes there is bleeding from its artery which has to be cauterized. Palpate the transverse acetabular ligament and put a plunt hohmann behind it which make the acetabulum more obvious then cut the ligament and remove all the tissues inside the acetabulum and reduce the head then assess if you need to do either femoral or pelvic surgeries. Close the capsule and keep the reduction by k wire fixing the head to acetabulum which removed after applying spica. [5] All cases started with adductor tenotomy to help head reduction easily. Salter osteotomy was done in 10 cases of revisions to cover the head anteriorly and laterally. Femoral shortening was done in 20 cases in which reduction cant obtained at all or the head was reduced under tension which may cause avascular necrosis. Femoral derotation was used in cases with excessive antiversion or cases which found to be dislocated posteriorly after primary surgery. Dega osteotomy was done in 11 cases and it helps coverage of the head from anterior to posterior direction. All cases are splinted in hip spica in flexion, abduction and internal rotation for 10 to 12 weeks depending on additional surgery to open reduction. Physiotherapy was advised after 2 weeks of spica removal to allow ROM regaining.

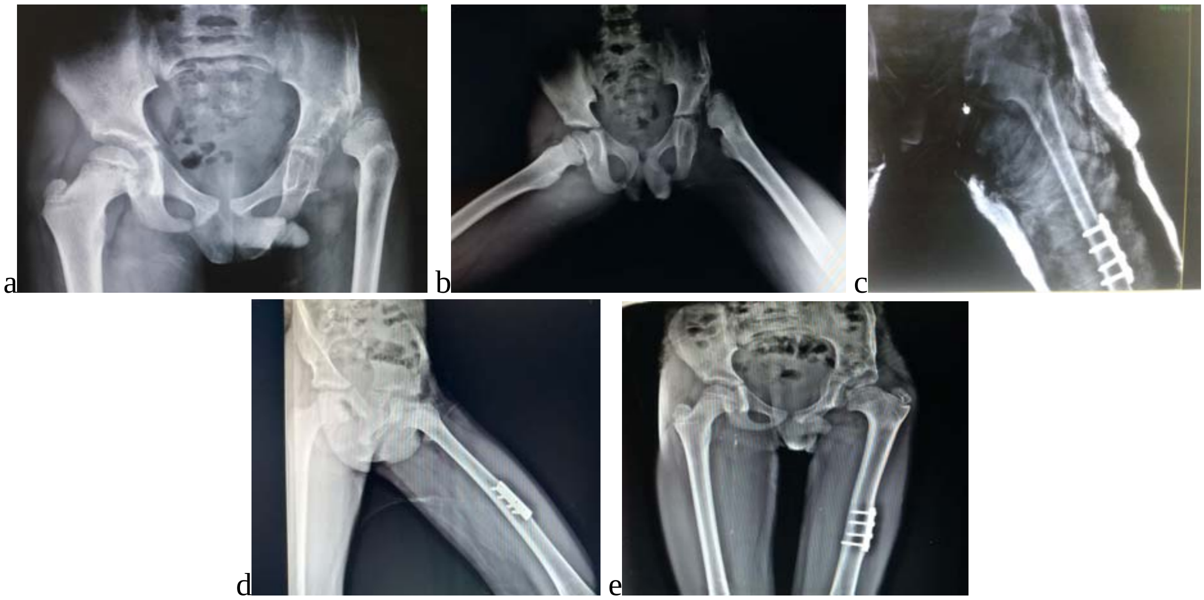

Figure 1: 8 years boy had first surgery at age of 2 years. a-b: Presented at age of 5 years. c: Revision surgery (open reduction,derotation and Dega osteotomy). d-e: Follow up 4 years.

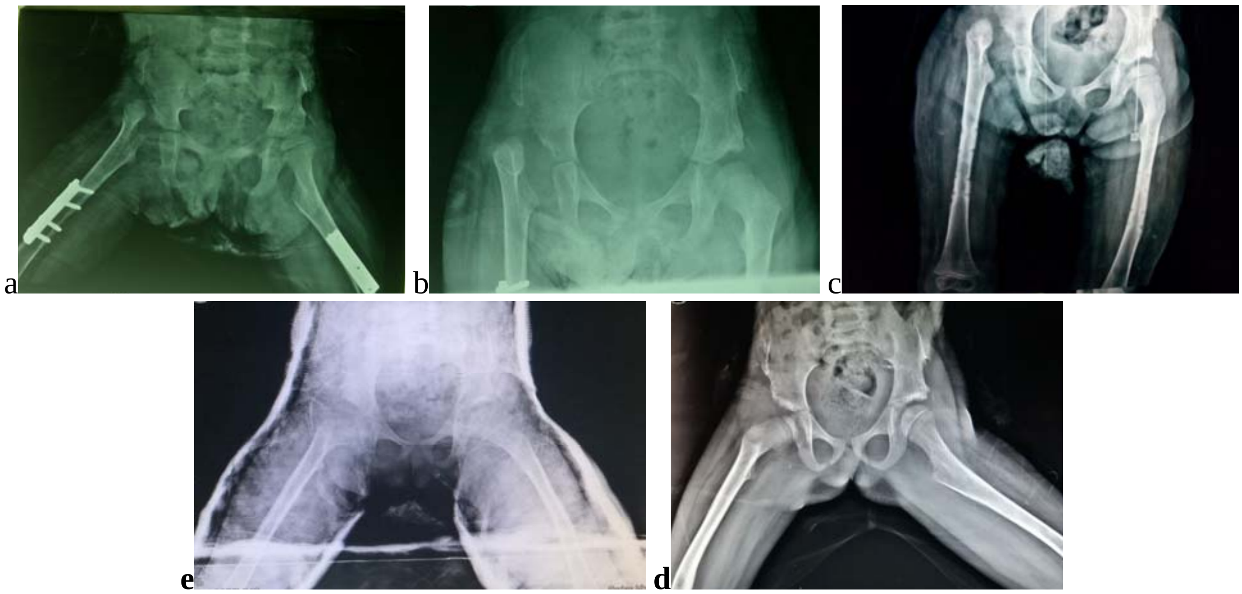

Figure 2: 6 years girl had bilateral DDH done at age of 2 years. a, b: presented with right dislocation at age of 4 years c: plate removed, start physical therapy d: Revision with open reductionand Dega osteotomy e: Follow up 2 years

Table 2: Revision and clinical results. TRED Trendelenberg ; LLD leg length discrepancy; FU follow up

CASE	REVISION SURGERY	F.U.	TREND.	LLD	CASE	REVISION SURGERY	F.U.	TREND.	LLD
1	OR-ADD.T-SO	30	-	0	27	OR	60	-	0
2	OR-ADD.T-SO	45	-	0	28	OR	51	-	0
3	OR-ADD.T	36	-	0	29	OR-SO	55	+	0
4	OR-ADD.T	65	-	1CM	30	OR-SO	33	-	1CM
5	OR-DRO	72	-	0	31	OR-DRO-DEGA	24	+	1CM
6	OR-DEGA	90	+	2CM	32	OR	30	-	0
7	OR-DRO-DEGA	88	+	3CM	33	OR	85	+	0
8	OR	63	-	1CM	34	OR	80	-	0
9	OR	54	-	0	35	OR-DEGA	72	+	1CM
10	OR-ADD.T	56	+	0	36	OR	48	-	0
11	OR	38	-	0	37	OR	43	-	2CM
12	OR	24	-	1CM	38	OR	54	-	0
13	OR-DEGA	28	+	0	39	OR-DEGA	36	+	0
14	OR-SO	46	+	0	40	OR-DEGA	32	+	3CM
15	OR-ADD.T	96	-	0	41	OR	28	-	0
16	OR-ADD.T-SO	83	+	0	42	OR-SO	50	-	0
17	OR-SO	26	-	1CM	43	OR	44	-	0
18	OR	37	-	0	44	OR	33	-	0
19	OR-DEGA	47	-	2CM	45	OR-DEGA	26	+	2CM
20	OR	62	-	0	46	OR	90	-	-
21	OR	67	-	0	47	OR-DEGA	70	+	1CM
22	OR	55	-	0	48	OR-SO	73	-	0
23	OR	43	-	0	49	OR	66	+	0
24	OR	80	-	0	50	OR-DRO	28	+	2CM
25	OR	77	-	2CM	51	OR	36	-	0
26	OR-DEGA	62	+	3CM	52	OR-SO	55	+	0

Statistical Analysis

The collected data were coded, processed and analyzed using the SPSS (Statistical Package for Social Sciences) version 15 for Windows® (SPSS Inc, Chicago, IL, USA). Qualitative data was presented as number and percent. Comparison between groups was done by Chi-Square test. Quantitative data was presented as mean ± SD and range. Student t-test was used to compare between two groups. Non parametric data was presented as min – max and median. Mann-Whitney test was used for comparison between groups. Spearman's correlation coefficient was used to test correlation between variables. $P < 0.05$ was considered to be statistically significant.

Results

Between 2007 and 2014, 52 cases were revised in Mansoura University hospitals (Table 2). The mean age at first surgery was (26.08 ± 11.77), and the mean age at revision was (34.73 ± 12.69).Table 3

Table 3: Age

	Range	Mean ± SD
age at first surgery	12 – 60	26.08 ± 11.77
age at revision	20 – 69	34.73 ± 12.69

At the final follow up, all cases were assessed clinically using Ponseti [6] grading

Ponseti classification of clinical outcome. (Table 4)

1-Asymptomatic
2-Slight hip pain after long walks
3-Limp, free motion and no pain
4-Limp and limitation of motion, no pain
5-Limp and pain
6-Limp, limitation of motion and pain

All cases were assessed radiologically at the final follow up using Severen [7] grading:

Severin grading of radiological outcome. (Table 4)

1- Normal

2- Moderate deformity of femoral head or neck or acetabulum

3- Dysplastic, not subluxed

4- Subluxed

5- Head articulating with the secondary acetabulum in the upper part of the original acetabulum

6-Dislocated

7-Arthritis

Avascular necrosis was diagnosed according to criteria of Kalamachi and Mc Ewen. [8]

Kalamchi classification of avascular necrosis. (Table 4)

1-Changes affecting the ossific nucleus

2-Lateral physeal damage

3-Central physeal damage

4-Total damage to the head and physis

Table 4: Radiological and clinical outcomes

	No	%
Ponseti		
1	21	40.4%
2	22	42.3%
3	7	13.5%
4	2	3.8%
Severin		
1	0	0%
2	38	73.1%
3	11	21.2%
4	3	5.8%
Kalamachi		
0	14	26.9%
1	3	5.8%
2	23	44.2%
3	6	11.5%
4	6	11.5%

There was positive correlation between the age of the patient and the three scores but it was significant only with Kalamachi score. **(Table 5)**

Table 5: Correlation of age with outcome scores

	age at first surgery		**age at revision**	
	r	P	R	P
Ponseti	0.186	0.186	0.211	0.132
Severin	0.235	0.093	0.237	0.090
Kalamachi	0.290	0.037*	0.297	0.033*

* Significant P < 0.05

Trendelenburg test was positive in 18 cases; there were LLD in 17 cases ranging from 1cm to 3 cm, limb equalization not required to any case with LLD.

There was significant positive correlation between the age of the patient and positivity of trendelenberg test. **Table 6**

Table 6: Correlation of age with Trendelenberg test

	Negative Trend (n=34)	**Positive Trend (n=18)**	**T**	**P**
Age at first surgery	19.82 ± 4.58	37.89 ± 12.22	6.052	<0.001*
Age at revision	28.24 ± 5.71	47.00 ± 13.28	5.723	<0.001*

Discussion

In searching for causes of failure of the primary operations and trying to know the reasons of re-dislocations after reduction of the heads we found that failure to achieve primary stable concentric reduction could be contributed to some errors.

- Inadequate soft tissue release: We found during revision surgery in 3 cases there was a ligamentum teres that had not excised and 9 cases of transverse acetabular ligament that is still present impending good reduction of the head. 11 cases there was intact psoas tendon causing hour glass constriction of the capsule. Sometime the capsular release was insufficient especially inferiorly making the movement of the head restricted during reduction. The study of kamath and Bennet [9] reported this factor.
- Coincident Salter osteotomy and femoral derotation make the head liable to dislocate posteriorly

due to low coverage of the posterior acetabular wall. Kershaw et al [10] and Wegner et al [11] emphasize the role of bony factors in redislocation of hips after reduction surgery.

- Excessive derotation of the femur allows the head to dislocate posteriorly.[12] Capsular failure either due to insufficient tightening of the capsule with heavy duty sutures or failure to remove the redundant superolateral part of the capsule making it lax.[13]

- In their study concluded that inadequate soft tissue release and capsular failure are causing factors for redislocation. Sankar et al [14] noticed during revisions that head dysmorphism and femoral anteversion are the common causes lead to dislocation. Some cases due to non compliance of the patients there were problems with spica cast leading to early removal and dislocation.[15] Due to all these previous causes we think that failure of primary hip reduction is mainly a technical error and if we tried to avoid these errors by improving the surgical technique we can easily obtain safe stable concentric reduction.

We have some recommendations during doing DDH cases:

Bikini incision is more cosmetic one that allows full exposure of the head.Full exposure of the capsule as far medialy as possible can allow better acetabular exposure. Make sure to find the tendon of iliopsoas muscle and cut it totally by rolling it against the pubic bone. After capsulotomy it is better to take to heavy duty sutures of the medial capsule to make it easy capsulorraphy after reduction. Put a plunt hohman retractor behind the transverse acetabular ligament to make it easier to cut. Sometimes there was a fibrous sheet of tissues covering the true acetabular making the reduction difficult. We have to remove it. By making Salter osteotomy with derotation osteotomy the head may become less covered posteriorly so, we recommend Dega osteotomy instead to cover the head posteriorly. We take the decision of derotation of the femur if more than 45 degree of internal rotation of the femur needed to reduce the head. Usually we use k.wire for temporarly fixing of the head inside the acetabulum then we remove it after applying the spica.

Conclusion

We found that most of the primary open reductions were insufficient either due to inadequate acetabulum exposure and soft tissue release and presence of tendons and structures impending stable reduction. We found that technical errors are the most causes of failure of open reduction and that DDH cases need well trained surgeon expertise in this type of surgery.

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Tibialis posterior tendon transfer for correction of drop-foot in common peroneal nerve palsy

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Abstract

Background
Common peroneal nerve palsy has been reported to be the most frequent lower extremity palsy characterized by a supinated equinovarus foot deformity and foot drop. Dynamic tendon transposition represents the gold standard for surgical restoration of dorsiflexion. In this study the results of tibialis posterior tendon transfer for correction of drop-foot in common peroneal nerve palsy were reported, with fixation into an osseous tunnel in the lateral cuneiform.

Patients and Methods
During 2011-2014, tibialis posterior tendon transfer was performed at our department on 20 ankles in 20 patients with common peroneal nerve paralysis (20 men), median age 24 (9-45) years. All the patients had had a drop-foot for more than 1 year. All patients had a traumatic common peroneal nerve paralysis. All patients had complete preoperative dorsiflexion motor deficit, and electromyogram (EMG) The mean time of the operation was 2 years. In all cases the tibialis posterior tendon were grade 5, one patient (9y old) the exploration of the nerve was done and direct neurophy was done.

Results
The gait was assessed according to Hall (1977), 12 patients were extremely satisfied, sex patients were satisfied and two patients were dissatisfied. The patients who were dissatisfied had ankle arthritis with pain that affected the result. No patients reported pain related to operative intervention. All patients had active dorsiflexion. Postoperatively All patients were able to walk without assistive devices. Ten patients (50%) were able to run, and ten patients (50%) were able to walk without assistive devices.

Conclusion
The results of this paper indicate that Posterior tibial tendon transfer for cases of drop foot showed good results and provide improved function.

Keywords
Common peroneal nerve, peroneal nerve palsy, Drop foot, Tibialis posterior tendon, Tendon transfer.

Introduction

Common peroneal nerve palsy is the most common mononeuropathy of the lower extremity and may resolve spontaneously. However, irreversible nerve damage can occur, with historically poor outcomes [1]. Patients present with dorsal foot sensory loss, as well as loss of ankle dorsiflexion from the tibialis anterior and loss of foot eversion from the peroneus longus and brevis. The unopposed pull of the tibialis posterior and Achilles results in an equinovarus foot deformity, while the loss of the foot dorsiflexors results in a foot drop, with characteristic foot slap during heel strike and a steppage gait [2].

Common peroneal nerve palsy has been reported to be the most frequent lower extremity palsy characterized by a supinated equinovarus foot deformity and foot drop. Dynamic tendon transposition represents the gold standard for surgical restoration of dorsiflexion of a permanently paralyzed foot [3], a tendon transfer is superior to a simple tenodesis since tenodesis would reduce function, especially during activities that require a large range of motion and a fast switch from extension to flexion of the involved joint[4], the technique most commonly used is through the interosseous membrane to the dorsum of the foot, with fixation of the transfer into an osseous tunnel or with a bone-anchor in the lateral cuneiform or third metacarpal. [5]

Patients and methods

During 2011- Sep 2014, tibialis posterior tendon transfer was performed at our department, Alzhraa university hospital, on 20 ankles in 20 patients with common peroneal nerve paralysis (20 men), median age 24 (9-45) years. All the patients had had a drop-foot for more than 1 year. All patients had a traumatic common peroneal nerve paralysis, 14 cases because RTA, four cases because firearm injury, and two cases because cut injury. All patients had complete preoperative dorsiflexion motor deficit, and electromyogram (EMG) results on all patients showed complete absence of common peroneal nerve function. The mean time of the operation was 2 years from onset of trauma. All cases were operated in Alzhraa university hospital.

Table 1: Demographics

Patients	**Total 20 patients**		
Age	24y (9-45)		
Gender	20 patients (Male)		
EMG	Negative in all cases		
Cause	14(RTA)	4(fire arm)	2(stab wound)

Each patient was continued by the physiotherapy to enhancement of the tibialis posterior muscle independently, cuff muscle, Patients with passive dorsiflexion of the ankle for stretching exercises of the Achilles tendon for several weeks. All cases were supple joints of ankle, and midfoot joints, and tibialis posterior tendon was grade V in all cases.

All patients managed by tibialis posterior tendon transfer and in all cases the tibialis posterior tendon were grade 5, one patient (9y old) the exploration of the nerve and direct neurophy was done.

Surgical technique

Under general anesthesia in six cases, and spinal anesthesia in 14 cases, The patient is positioned supine with flexion knee 45 degree, the hip is bumped to create a neutral position of the foot. A posteromedial incision is done over the tibialis posterior tendon just distal to the medial malleolus; the tendinous insertion on the navicular is dissected subperiosteally and released more distally to preserve length (Fig. 1). A second 5 cm incision is made at mid leg just posterior to posteromedial border of the tibia; the saphenous vein and nerve are protected and expose the fascia of the deep posterior compartment.

The soleus and flexor digitorum longus (FDL) are retracted posteriorly, and the tibialis posterior tendon is identified to ensure that the neurovascular bundle lying is spared. The tendon is delivered proximally with manipulation for more length (Fig. 1).

A 5cm anterolateral incision is made about 15cm proximal to ankle joint dissection of anterior compartment with protection of anterior neurovascular bundle, and incision of the interosseous membrane. Then the tibialis posterior tendon is then passed from the third incision through the distal anterolateral incision by sliding the tendon against the posterior tibia to avoid the neurovascular bundle (Fig. 2).

A 3cm longitudinal incision is made over the dorsal surface of foot overlying the lateral cuneiform after fluoroscopic confirmation. The tibialis posterior tendon is then passed subcutaneously from the third incision through the dorsal foot incision. A 6.5mm drill hole is then placed in the lateral cuneiform (Fig. 2).

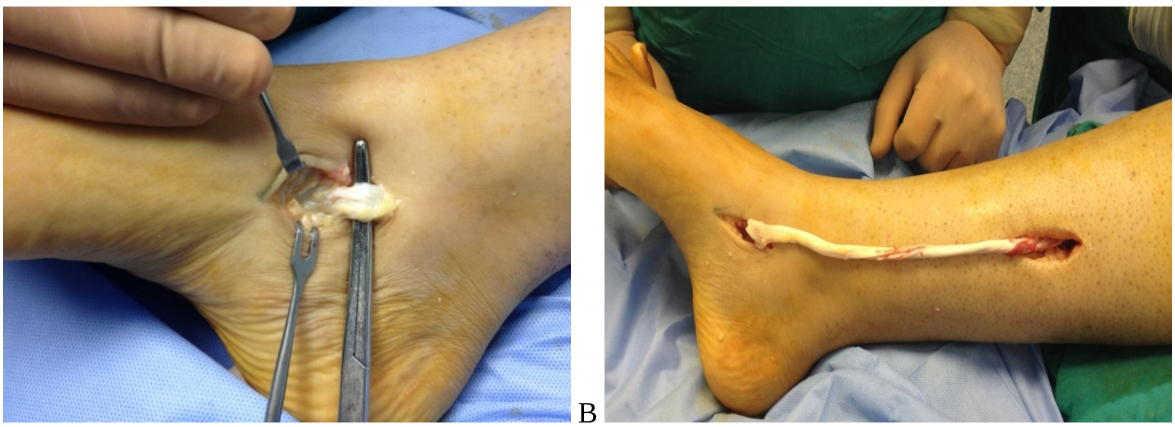
A  B

Fig. 1: A) posteromedial incision over the tibialis posterior tendon **B)** posteromedial border of the tibia

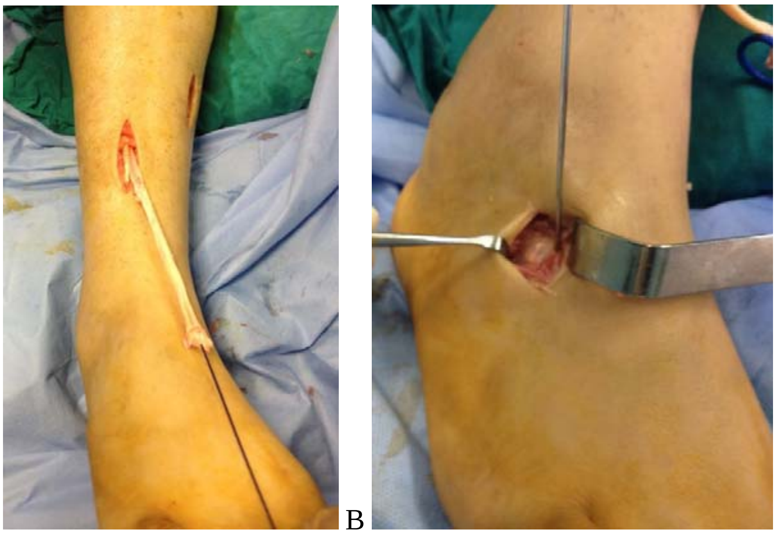


Fig. 2: A) anterolateral incision and the tibialis posterior tendon passed through the interosseous membrane from posterior to anterior. **B)** K-wire passed through the lateral cuneiform after fluoroscopic confirmation.

The tibialis posterior tendon was placed under maximal tension with the foot held in dorsiflexion. We are suturing the tendon with Vicryl suture size 2 then the tibialis posterior tendon was passed through the hole in the lateral cuneiform and sutured to button. The tendon is tensioned with the foot held in neutral inversion to avoid excess strain on the posterior tibial tendon transfer. Fixation is performed with multiple figure of eight nonabsorbable sutures to itself and to the periosteum of the cuneiform.

The patients are kept no weight-bearing in a cast for 6-8 weeks; physical therapy was begun without passive plantar flexion. At 3 months, activity is advanced as tolerated with the exception of impact activities, which begin at 6 months. The patients are kept in an Ankle foot orthosis (AFO) at night for the first 3 months**.** [6, 7, 8]

Postoperative treatment and follow-up

The ankles putted in high blow knee plaster cast for 6 weeks. The patients were allowed to walk with full weight-bearing after removal of the plaster, but physiotherapy was started early for optimal results for 4-6 months. At final follow-up after median 2 years, the ability of gait and active dorsiflexion of the ankle was assessed.

Results

The gait was assessed according to Hall (1977) [9];

- Good, the patient walks naturally;
- Fair, the patient walks well, but there is still an obvious difference between the operated foot and a normal foot on the other side;
- Poor, the patient still tends to drag his foot, although there is some improvement in the position of the foot;
- Bad, the operation has not at all improved the patient's gait or the position of the foot.

The maximum angle of active dorsiflexion and plantar flexion at the ankle, and the range of movement (ROM) of the foot were measured. All angle measurements were brought to the nearest 5°. Active dorsiflexion to 0° and more was classified as excellent outcome, between -10°and 0° as good, and between -20°and -10°as fair outcome. [10]

12 patients were extremely satisfied, sex patients were satisfied and two patients were dissatisfied. The patients who were dissatisfied had ankle arthritis with pain that affected the result. Two patients reported pain associated with traumatic ankle arthritis. No patients reported pain related to operative intervention. All patients had active dorsiflexion. All patient had 4/5 strength.

Postoperatively, all patients reported diminished sensation at dorsum of the foot; there were no ruptures of the transferred tendons or infections. All patients were able to walk without assistive devices. Ten patients (50%) were able to run, and Ten patients (50%) were able to walk without assistive devices.

All the patients had postoperatively active dorsiflexion of the foot; 12 cases had an excellent, eight cases were good at end-result. The active dorsiflexion was 5.5° (- 5 to 20°), the active plantar flexion was 34.9° (30 - 45°) degrees, and the total range of movement was 44° (35- 50°). (Table 2) (Fig. 3).

Table 2: The Results

Cases	DF	PF	ROM	Gait
1	10	40	50	Good
2	20	30	50	Good
3	-5	45	40	Fair
4	10	35	45	Good
5	5	40	45	Good
6	-5	45	40	Good
7	20	30	50	Good
8	-5	40	35	Fair
9	-5	45	40	Good
10	10	35	45	Good
11	10	40	50	Good
12	20	30	50	Good
13	-5	45	40	Fair
14	10	35	45	Good
15	5	40	45	Good
16	-5	45	40	Good
17	20	30	50	Good
18	-5	40	35	Fair
19	-5	45	40	Good
20	10	35	45	Good

DF (dorsiflexion), PF (planter flexion), ROM (range of motion).

Fig. 3: Male patient 23 years old, with history of stape wound to posterior aspect of the knee, the patient was neglected for 3 years, the exploration was done to the common peroneal nerve with loss of long part of the nerve, tendon transfer was done, and postoperative casting for eight weeks, then removal of the cast, and the patient start physiotherapy as early as possible, the range of motion was 20 degrees dorsiflexion and 30 planter flexion, he can wake without support, and returned to his normal work. **A)**Site of the stab wound **B)** One year postoperative with neutral position **C)** postoperative planter flexion **D)** postoperative Dorsiflexion **E)** Both feet post operative without affection of right foot after harvesting of the tendon.

Discussion

The superficial location of the nerve as it courses around the fibular neck exposes the nerve to injury from penetrating and blunt trauma, or from external compression, and the decreased blood supply to the common peroneal nerve compared to the tibial nerve may explain the increased susceptibility to injury and poor results with nerve repair[11]. All patients in this paper had a traumatic common peroneal nerve paralysis without intervention more than one year.

Tendon transfer surgery is commonly used to correct neurogenic foot deformities. Whether the tendon of a muscle transferred to another site can provide an active substitution has always been a matter of concern, especially when the muscle is normally an antagonist to the one requiring support, the mean time of the operation were 2 years [12]. In contrast, early tendon transfers in the upper extremity have historically been widely accepted for ulnar and radial nerve palsies, while serving as an internal splint to prevent flexion contractures [13]. Tendon transfers in patients with ankle pathology are contraindicated. Unless the ankle is additionally addressed, the patient is likely to have a poor outcome, so in this paper all patients were chosen with supple joints, except one patient was has ankle pain.

It is important to give the patients a preoperative training program, with exercises for the tendon to be transferred and stretching exercises of the Achilles tendon for better passive dorsiflexion [5]. It is recommended to lengthen the Achilles tendon, when passive dorsiflexion to at least 20" above the right angle is not possible [9,14]**,** Delayed tendon transfer is that many of these patients develop rigid equines contractures and Although an Achilles shortening so in this search all patients recommended to start early physiotherapy to restore the functional motion, so in this paper no patient need for Achilles lengthening or correction of equines, because early physiotherapy which started early in all cases.

Posterior tibial tendon transfer has been used in a variety of disorders with weakness of dorsiflexion of the ankle to restore a normal heel-toe gait [15].The tibialis posterior has an excursion of only 2 cm, whereas the dorsiflexors (tibialis anterior and extensor hallucis longus) have excursions of from 3-5 cm, Therefore, the degree of tension between the transposed muscle and the sutured tendons is important [5]. The passive arc of movement on the operated side is always less than the normal side; this suggests that tenodesis must play a role. Mechanically, the different techniques vary only marginally, regarding range and strength of dorsiflexion of the ankle.

Many surgeons fix the transfer into an osseous tunnel in the tarsal or metatarsal bones. The tendon of the tibialis posterior can be brought to the dorsum of the foot by two routes; the interosseous or the subcutaneous route [9].The subcutaneous route has bad cosmetic result, adhesions are likely to form, and it is more difficult to fix to bone without tendon graft, in this search The interosseous route with adequate window was preferred to the subcutaneous route even though it is more technically demanding because it is more direct and produces less pronation and achieve greater dorsiflexion [16]. The tibialis posterior tendon is routed superficial to the extensor retinaculum to increase dorsiflexion efficiency by increasing the moment arm and to avoid impingement the dorsi flexor tendons[17].

In this paper fixation of the tendon was fixed by in out suture without using interference screw, vicryl suture size 2 was used to made stitches through periosteum of the cuneiform and the tendon, to made secure fixation. Cut of the suture was done after 6 weeks to allow complete healing of soft tissues, after removal of the cast the patient started early physiotherapy to enhance muscle power and help sable joints.

Leiv M Hove and Per T Nilsen (in 1998) [5] reported all patients could walk without an ankle foot orthosis. There were no ruptures of the transferred tendons. In this search the same results were founded, all the patients had postoperatively active dorsiflexion of the foot, all patient had 4/5 strength; 12 cases had an excellent; eight were good at end-result.

Conclusion

The results of this paper indicate that Posterior tibial tendon transfer for cases of drop foot showed good results and provide improved function.

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The results of varus derotation subtrochanteric femoral osteotomy in children with coxa valga

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Abstract

Introduction
Increased femoral neck shaft angle is known as Coxa valga. Most of these patients usually have underlying neuromuscular or skeletal disease. Proximal femoral varus derotation osteotomy is usually performed for these cases. This study was done to evaluate the results of proximal femoral varus derotation osteotomy over 2 years follow up in children with coxa valga using the Dynamic condylar screw.

Patients and methods
A retrospective study of sixteen children with coxa valga. They all underwent proximal femoral varus derotation osteotomy. The osteotomy was fixed with dynamic condylar screw. Patients were followed up for at least two years. Their mean age was 9 years. All complications, and subsequent outcomes, were recorded.

Results
Patients were followed up for two years. In 14 patients bilateral VDRO were done. So the total number of osteotomies was 30 osteotomy. The patients fell into three groups: neuromuscular/CP, hip dysplasia and LCPD. The type of osteotomy performed was lateral open wedge varus derotation osteotomy. There were 10 patients with cerebral palsy, five patients with hip dysplasia, and only one case with Perthes disease. The mean neck shaft angle improved from preoparative value of 147.32 degrees to 123 degrees postoperatively with p value < 0.05. There were no implant failure in all 30 osteotomies.

Conclusions
Proximal femoral varus derotation osteotomy is a powerful option for patients with coxa valga with little postoperative complications.

Introduction

Increased femoral neck shaft angle is defined as Coxa valga. It is usually seen in patients with underlying neuromuscular or skeletal disease. Spasticiy of the adductor muscles may lead to that deformity with bilateral adductor contractures. [1]

Proximal femoral varus dertoation osteotomy (VDRO) is one of the most widely performed reconstructive operations for management of hip subluxation secondary to neuromuscular disease such as cerebral palsy [2] and spina bifida, [3] Legg–Calvé–Perthes disease (LCPD) [4] as well as dysplasia of the hip.[1]

The aim of this surgery is to increase the containment of the femoral head into the socket by decreasing the neck-shaft angle, thereby providing a good environment to heal the disease. [4]

Multiple implants have been used for osteotomy fixation. These include the Coventry screw, [5] blade plate, [6] crossed Steinmann pins, [7] external fixation[8] and a two-piece sliding hip screw construct, such as the Richards hip screw and DCS. [9]

The most commonly used are 90 degrees fixed angle blade plate or Richards' hip screw. [10] The blade plate is considered to be the standard implant for fixation, but it can be technically demanding, and the device is sometimes undersized or oversized.

Studies have shown that this technique has serious complications, including infection (2.5%), loss of fixation (1%), wound dehiscence (1%) and fracture (1–4.5%). [6,11]

Sliding hip screws are a more current option for the fixation of PVDO. This is due to the familiarity and their safety profile. [9] The prospective benefits of this implant compared with the blade plate are a simple technique for insertion and removal, and greater intraoperative flexibility in the fine-tuning of the neck shaft angle. [12]

Disadvantages of the sliding hip screw include the danger of losing position because of turning of the proximal femur around the lag screw.[9] Also, the use of hip spica post-operatively is an undesirable feature. [9, 12]

A modified technique using Richards' hip screw was used by Wilkinson et al [10] The modification was to improve stability of fixation by introducing a second point fixation at an angle that would provide for a 'crossed fixation construct' in order to improve the stability of fixation, prevent loss of position at the osteotomy site and reduce or reduce the need for hip spica cast immobilization in cerebral palsy children.[10]

The usual removal of the implant after PFO is common practice, as nearly 40% of patients may need total hip replacement in later life. The complication rate of hip screw removal is 5%. [12, 13]

The aim of the present study is to evaluate results of PFVDO performed by single surgeon series over 2 years follow up. The purpose is to study the incidence of complications and outcomes following PFVDRO in children with coxa valga using the dynamic condylar screw.

Patients and Methods

We retrospectively reviewed the results of 16 children with coxa valga who underwent PFVDO over period of two years follow up. Patients included in the study were patients with increased neck shaft angle with either neuromuscular disease, perthes disease or with hip dysplasia due to another cause who underwent proximal femoral osteotomy.

Their mean age was 9 years (range; 5 to 14 years). Cases were fixed either by Dynamic condylar screw either pediatric or adult size. We excluded cases who underwent fixation by angled blade plate, DHS or locked plates. Patient diagnosis and demographic details were recorded.

Patients were followed up using neck shaft angle. Blood loss was recorded. The use of spica casting post operatively was documented. All complications, and subsequent outcomes, were recorded. (Figures 1-4)

Figure 1: preoperative radiograph of 14 years old patient with 142 degrees coxa valga in the right side and 140 degrees in the left side.

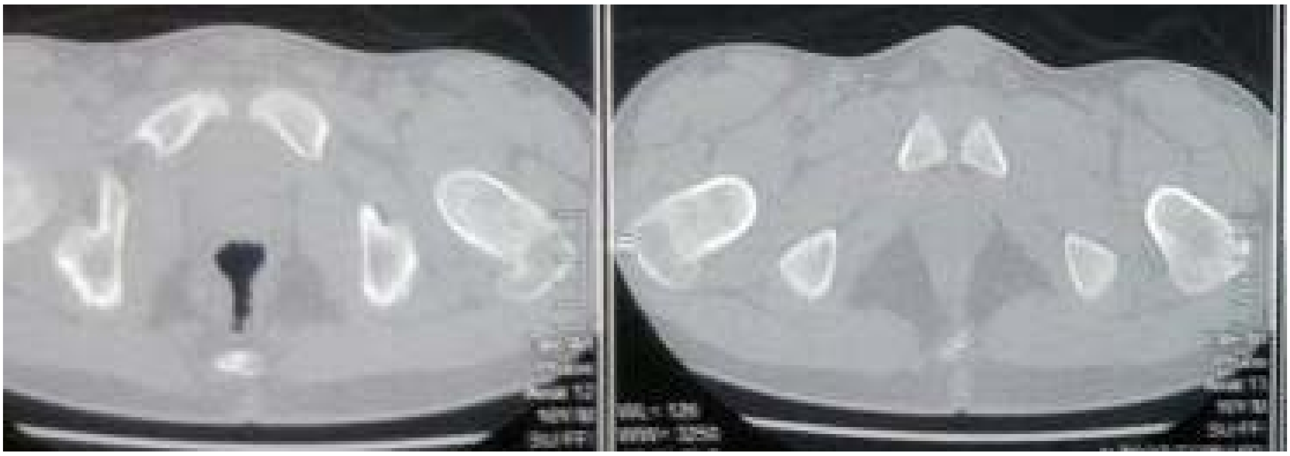

Figure 2: preoperative CT scan showing deficient acetabular coverage and increased femoral anteversion angle.

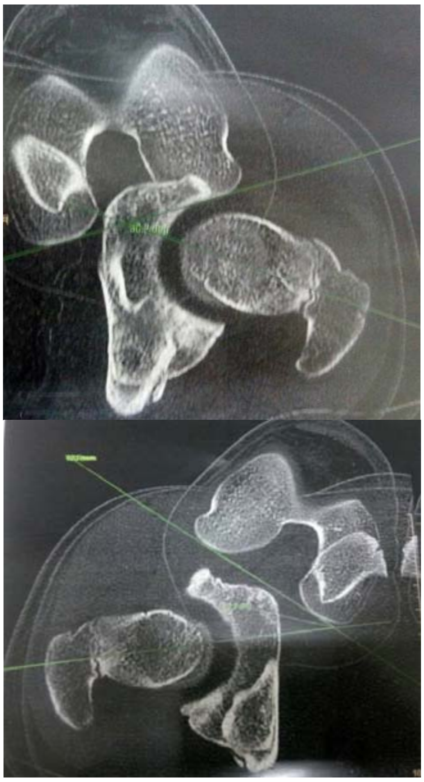

Figure 3: preoperative measurement of anteversion angle bilaterally (40 degrees bilaterally)

Preoperative planning:

The planning was based on desired correction of neck shaft angle to be 120 degrees. (Figure 4) The desired angle is subtracted from NSA of the patient. The resulting angle is added to DCS angle. The final angle is the lag entry angle on DCS guide. It is applied to the patient x-ray template to determine best entry point and the correct path that will achieve the right correction.

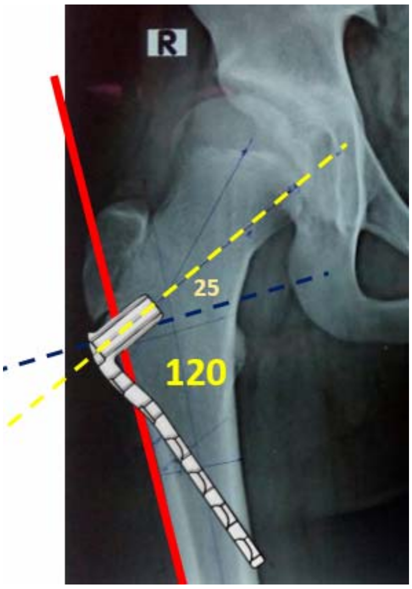

Figure 4: preoperative planning of entry point and correction angle and wedge angle.

Operative technique:

Patients were placed supine on the traction table. Conventional C-arm fluoroscopy was used. A lateral approach from greater trochanter downwards was used. Vastus lateralis was elevated anteriorly. The guide wire was inserted into femoral neck under C arm control. The variable degree guide of DCS plate was used to determine the degree of desired neck shaft angle. The entry point was determined according to preoperative planning. A lateral view was obtained to ensure central wiring. (Figure 5)

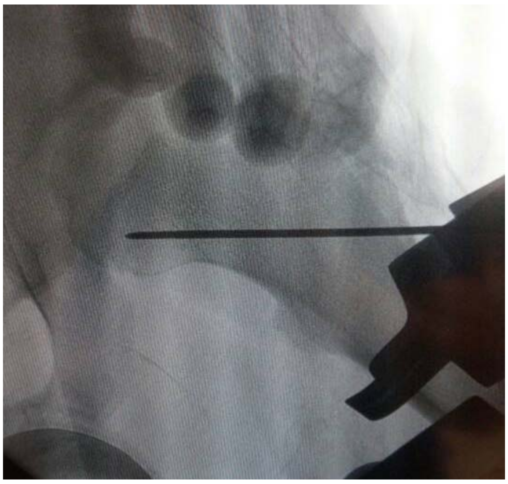

Figure 5: insertion of the guidewire under C arm guidance as determined by preoperative planning.

After reaming, a lag screw was inserted a few mm proud of the cortex for simple plate introduction over it. (Figure 6) Two wires were inserted along the anterior cortex below and above desired osteotomy line to assess correction of anteversion. (Figure 7) The intention was to return the femur to a physiological degree of anteversion. The bone was marked with a drill for quick rotational reference during the operation.

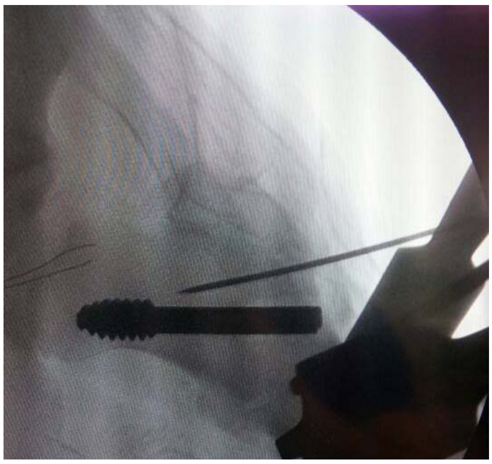

Figure 6: insertion of the screw over the guidewire.

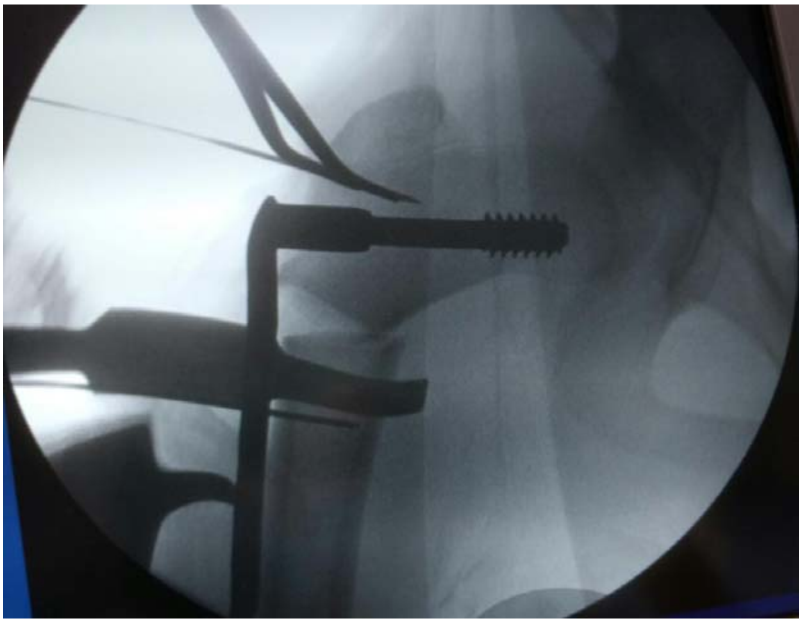

Figure 7: correction of the anteversion using the 2 wire technique before fixation of the osteotomy.

Periosteal stripping was avoided. The osteotomy was done just below lesser trochanter to avoid effect of psoas muscle on the distal fragment and allow free derotation of the osteotomy.

Osteotomy was done using preliminary two or three drill holes through lateral femoral cortex then it was completed using sharp saw blade. The osteotomy was then opened using an angled osteotme. Opening wedge osteotomy was done with medial hinge. Derotation was achieved as planned evident by the translation occur in the sagittal plane at the osteotomy site. (Figure 8) The plate was inserted over the hip screw after that and the osteotomy was evaluated for stability and alignment using anteroposterior and lateral fluoroscopy. There was no need for bone graft in all cases.

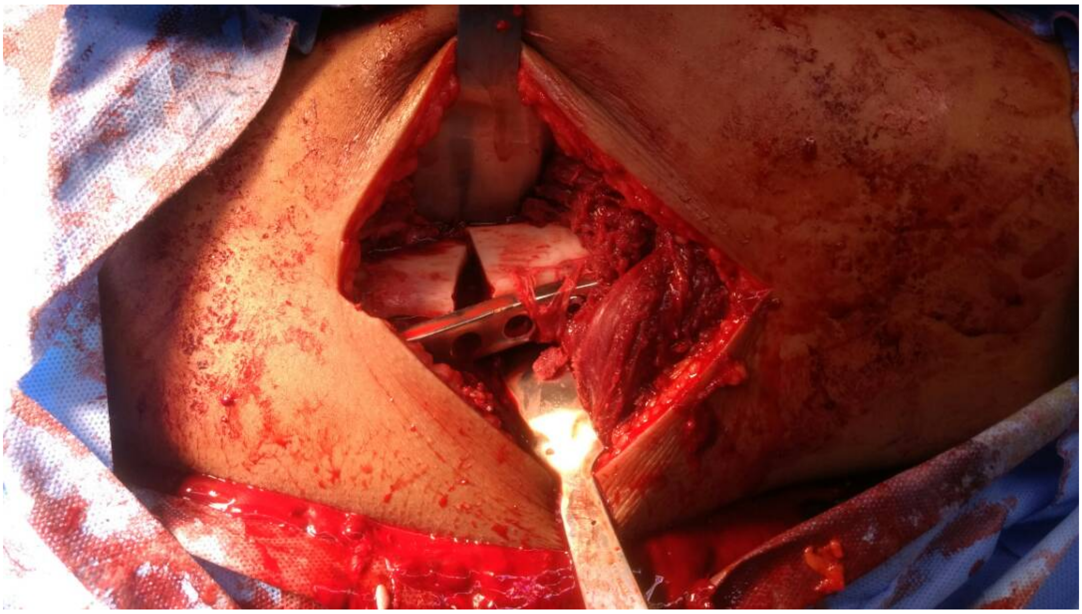

Figure 8: intraoperative radiograph showing translation and derotation at the osteotomy site.

In all cases containment was achieved, the angle of abduction necessary to produce containment (the anticipated osteotomy angle) and the presence of at least 20 of ‘abduction reserve’ beyond the containment position. (Figure 9,10)

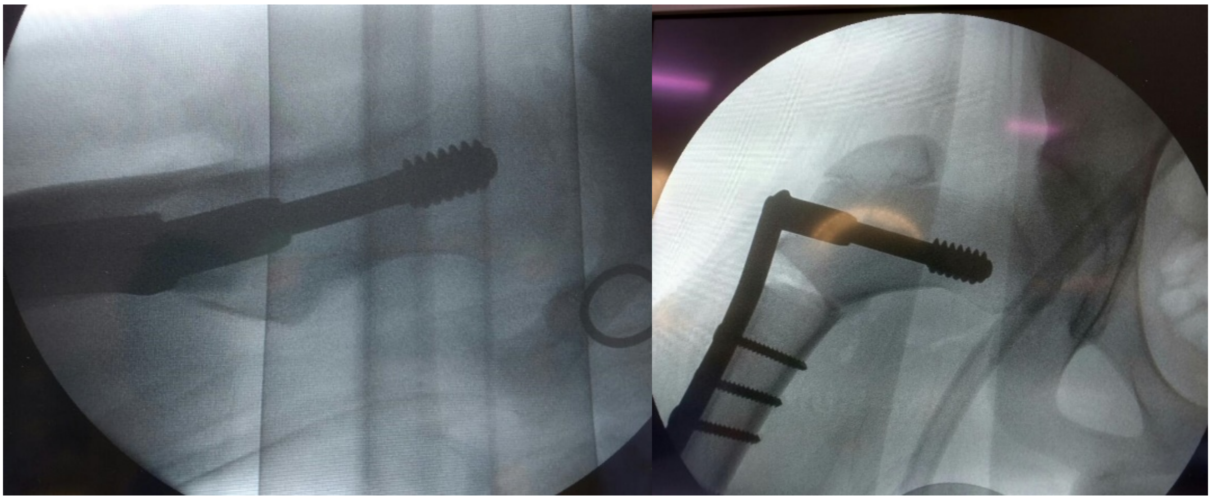

Figure 9: final view under the C arm with NSA of 120 degrees.

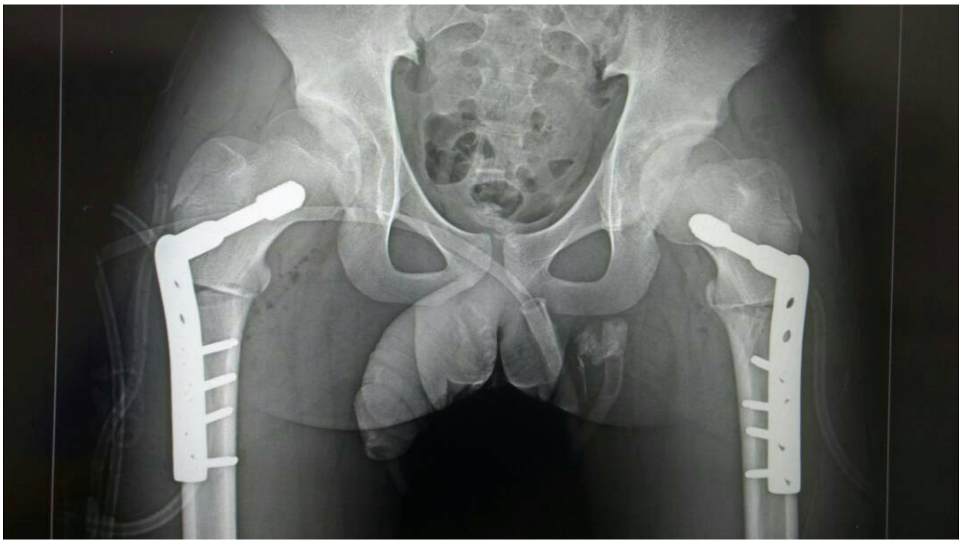

Figure 10: postoperative xray.

We intend to leave the medial periosteum intact and bend the medial cortex like the spine of a book. This offers more stability to the osteotomy. Hip spica casts were required in the some of patients (most cases of CP group), mainly to prevent the risk of displacement at the osteotomy site. The decision whether to use a hip spica or not was made after completion of the osteotomy, with the internal fixation device in place. The hip was then moved through a full range of motion and the osteotomy site was inspected directly and under fluoroscopy for the presence of any excessive movement, before closure of the incision. A radivac was inserted in all cases and was removed after 48 hours postoperatively.

Case presentation:

A five years old boy with Diplegic cerebral palsy. He was able to walk independently with bilateral hip pain, difficult squatting, and difficult upstairs. His weight was 20 kg. His preoperative neck shaft angle was 165 degrees on the right side and 167 on the left side. He had 38 degrees femoral anteversion on the right side and 39 degrees on the left side. The patient was submitted to bilateral proximal femoral varus derotation osteotomy. The osteotomy was fixed by pediatric DCS. The postoperative NSA was 123 degrees on the right side and 125 degrees on the left side. Hip spica was done till ostoeomy had united. Full union was achieved by 2 months. There was no hip pain and patient walked with normal gait. The plate was removed after one year of implantation. There was no postoperative complications reported. (Figure 12: a-e)

A

C

E

G

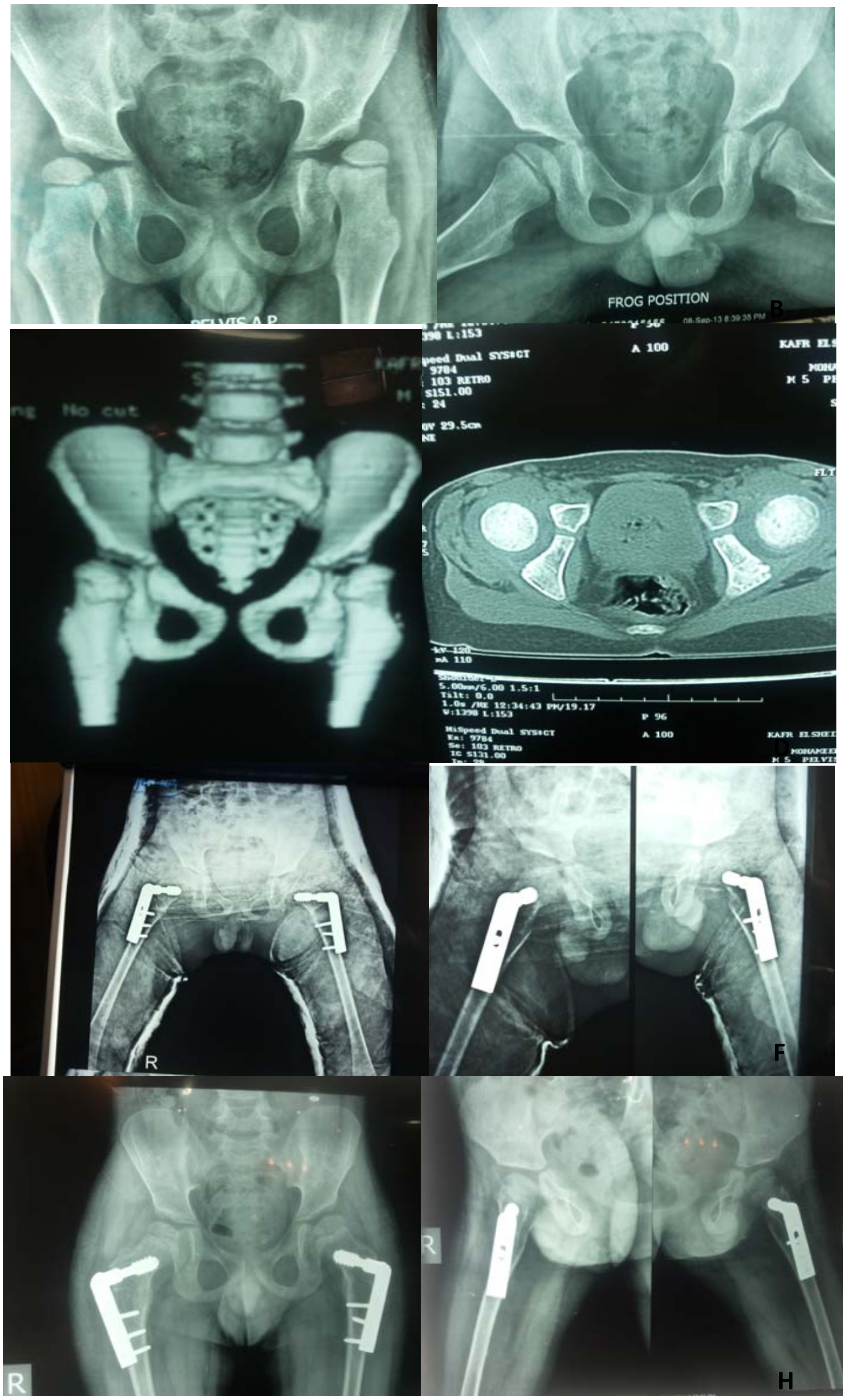

Figure 11: (A & B) : preoperative AP/ Lateral View, **(C & D)** : preoperative CT
(E & F) : Immediate Postoperative X-Rays, **(G & H)** : 6-Months Postoperative X-Rays

Results

We followed up 16 patients for a minimum of 2 years follow up. In 14 patients bilateral VDRO were done. So the total number of osteotomies was 30 osteotomy.

The patients fell into three groups: neuromuscular/CP, hip dysplasia and LCPD. The type of osteotomy performed was lateral open wedge varus derotation osteotomy. Concomitant procedures was performed in some patients such as adductor/ psaos release. Table 1 shows patients demographics.

Table 1: Patients' demographics:

Group	number	osteotomies	M to F ratio	Follow up
CP group	10	19	9 to 1	2-4 years
Hip dysplasia	5	10	5 males	2-2.5 years
LCPD	1	1	1 male	2 years
Total	**16**	**30**	**15 to 1**	**Min 2 years**

The mean neck shaft angle improved from preoperative value of 147.32 degrees to 123 degrees post-operatively with p value < 0.05. The mean change in the neck shaft angle was 24.32 degrees. The mean decrease in migration percentage was 43%. The mean intra-operative estimated blood loss was 500 cc. (Table 2, Figure 13)

Table 2: Improvement of the neck shaft angle in the 3 groups

	Preop NSA	Postop NSA	P value
CP	162.26	125	<0.05
Hip dysplasia	145.7	122	<0.05
LCPD	135	120	<0.05
mean	**147.32**	**123**	**<0.05**

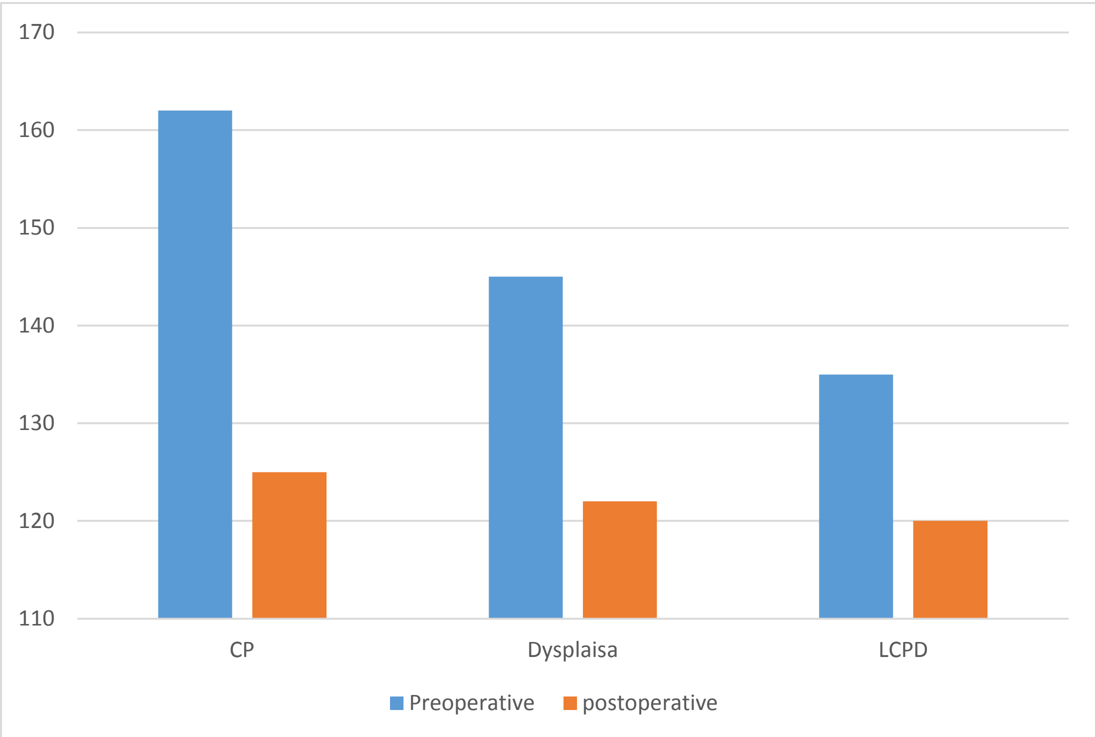

Figure 12: the change in the neck shaft angle among the three group of patients.

There were no implant failure in all 30 osteotomies. The most serious complication immediately post-operatively in one patient with sudden melena and drop in Hb to 5.4 g/dl. Non-steroidal and anticoagulants were stopped and pharmacological therapy for stress ulcer was given for 8 days with proper transfusion therapy. All of our patients received our standard antibiotic prophylaxis of 3rd generation cephalosporin on induction, with two subsequent IV doses on the ward in the postoperative period. No patients developed deep wound infections. There were no fractures. No patients developed nerve palsies. No patients developed wound breakdown.

All osteotomies united with 2-3 months interval. All implants were removed one year after original surgery. The overall complication rate was 4% with zero percent reoperation rate. Two patients developed a superficial infection, requiring antibiotics. On attempting to remove the metalwork in one patient, a screw was broken and retained. One patient developed a wound haematoma, which resolved spontaneously.

The majority of patients were discharged the day after surgery. One patient required post-operative transfusion.

Table 3: Preoperative deformities, intraoperative corrections, outcomes and complications:

ID	Age	side	WT	sex	Diagnosis	NSA	version	PO NSA	FU	Comp	healing
1	5	R	20	M	CP diplegic walker	165	40	128	4 y		2m
		L				160	39	125			
2	13	R	33	M	Hip dysplasia	142	50	120	2y	superficial infection	2.5m
		R				150	49	125			
3	14	L	55	M	Hip dysplasia	147	35	122	2.5 y		2m
		R				153	38	127			
4	9	L	38	M	LCPD	135	25	120	2y		3m
5	6	R	20	M	CP diplegic walker	162	40	123	3 y		2m
		L				159	35	122			
6	7	R	22	M	CP diplegic walker	155	42	122	3.5y		2.5m
		L				157	42	121			
7	11	L	40	M	Hip dysplasia	143	36	120	2y	wound hematoma	3m
		R				153	39	122			
8	12	R	45	M	Hip dysplasia	141	55	123	2y		2.5m
		L				145	51	122			
9	5	L	22	F	CP diplegic walker	162	40	121	3y	superficial infection	2m
		R				168	48	125			
10	6	L	25	M	CP hemiplegic walker	151	39	120	2.5y		2m
11	5	R	20	M	CP diplegic walker	165	38	123	3y		2m
		L				167	39	125			
12	8	R	30	M	CP diplegic walker	160	40	122	4y		2.5m
		L				168	42	126			
13	6	R	23	M	CP diplegic walker	151	50	123	4y		2m
		L				169	52	126			
14	14	R	63	M	Hip dysplasia	141	36	120	2y	PO melena Hb 5.5g/dl	2m
		L				142	39	122			
15	8	R	26	M	CP diplegic walker	159	52	125	3y		2.5m
		L				167	49	127			
16	8	L	40	M	CP diplegic walker	157	56	120	3.5y		3m
		L				162	55	127			

Discussion

PVDO play an important role in the management of many hip disorders in children. The aim of varus derotation osteotomy is to improve containment of the hip by reducing the femoral neck-shaft angle. The hip must be mobile in more than 90° flexion. Abduction more than 15° is necessary for varus correction. [14]

During many of the varus osteotomies, the distal fragment was externally rotated with respect to the proximal fragment to correct the excessive femoral anteversion. [11]

This type of osteotomy can be fixed by either 90^o angled blade plate, AO anterior plate, locker proximal femoral plate, Richard hip screw or Dynamic condylar screw. It may or may not be associated with femoral derotation. In cerebral palsy diseased hips, femoral shortening relaxes the muscles and the joint. [12]

The reference for rotation is defined by two lateral pins: one at the tip of the greater trochanter, the other below the distal part of the plate. The reference pin for the cutting guide is inserted below the lesser trochanter then into the femoral neck and centered on the coronal and sagittal planes. [14]

For the 90 degrees angled blade plate, to achieve 20° varus, the pin should be at an angle of 70° (90—20°) in relation to the femoral shaft. To prevent fracture or a secondary fracture line, the entry point of the blade chisel is prepared with a drill. The chisel is advanced under fluorscopic guidance on the frontal and sagittal views in the femoral neck axis without fracturing the growth cartilage. It is positioned in strict profile to avoid unplanned sagittal displacement during the varus osteotomy. On the coronal plane, it is at a 110◦ angle in relation to the femur. [15, 16]

Angled blade plates have been the standard fixation devices used for proximal femoral varus osteotomy in children. Nevertheless, problems remain with this technique, such as the plate being an unsuitable size for some children and the technical skill required for its insertion. [4]

For the Locking Plate (LCP) Osteotomy specific instruments are used to determine the position of the two proximal screws depending on the plate used. [17-21]

For varus osteotomy with an anterior locking plate. Anterior placement of the plate on the proximal fragment is defined by a bone groove. The angle of varus correction corresponds to the position of the plate and the femoral shaft, the two proximal holes are placed on the groove.[14]

Termino-lateral varus osteotomy is a simple technique to obtain significant varus correction with automatic shortening of the femoral neck in dislocations and subluxations of neurological hips. It is only indicated in neurological subluxated or dislocated hips with the ‘‘candlestick’’ shaped proximal femur due to significant coxa valgus. Locking plate fixation provides better stability, and avoids postoperative cast immobilization. [22]

In this study, Dynamic condylar screw was used in all cases. The planning was based on the patient NSA minus the desired correction of neck shaft angle (120-125 degrees). So the angle of DCS (95 degrees) was inserted on preoperative template to determine best entry point and correct path that will achieve the right correction angle.

Immediate complications are frequent in children with cerebral palsy, due to bone osteoporosis. Secondary complications include: delayed union, nonunion, fractures under the plate and periarticular osteophytes. Later complications are mainly malunion. Avascular necrosis of the femoral head may develop following a vascular injury or from varus overcorrection.[21, 23]

PVDO is a well-established procedure in the treatment of hip dysplasia associated with cerebral palsy. The purpose of the surgery is to improve hip congruity and correct excessive proximal femoral valgus and anteversion if present. Varus osteotomy also has a role in severe LCP disease, in the presence of fragmentation or for early reconstruction, in cases with malalignment but without ‘‘hinge’’ abduction. The best results are obtained when varus correction-derotation is performed during the necrotic phase, or the beginning of fragmentation, in Hering B or B/C patients and in patients above 8 years old. [24-29]

PVDO improves the intraosseous circulation, the mechanics around the proximal femoral head, and subsequently the degree of femoral head spherity after healing, and it permits the regeneration of the necrotic tissues of the femoral head. It also improve containment of the head and reduce femoroacetabular impingement

Varus osteotomy corrects acetabular dysplasia if alignment is good and if there is significant growth potential. Long term, these hips remain asymptomatic with good results in more than 70% of patients. In significant acetabular dysplasia, the association with an acetabualar osteotomy optimizes joint congruence and ‘‘containment’’.[30, 31]

Joeris et al reported using PVDO fixed with locked compression plate in 22 patients. There was hip dysplasia in 4 cases, cerebral palsy in 9 patients, idiopathic ante/retroversion in 8 cases, femoral neck fracture in three cases, Perthes’ disease in two cases, deformity after slipped capital femoral epiphysis (SCFE), congenital femoral neck pseudarthrosis, deformity after pelvic tumour resection and malunion following proximal femoral fracture (one each). The correction was achieved in all patients except one. Two patients had screw loosening. [21]

In the light of the results and our experience, the concept of the DCS necessitates exact positioning. Any inadequate placement of guide wires will lead failure of planned desired NSA. This is very important when applying this technique. This disadvantage does not seen with LCP locked plates. Considering the operative technique, the femoral head physis should generally not be perforated by the lag screws because of the risk of premature closure increases with penetration of the physis.

This study has limitations; in particular its retrospective design, its lack of a control group including existing osteotomy devices and its small sample size are relevant. Nevertheless, this initial experience encourages us to believe that the DCS will prove to be a valuable device for a broad range of indications. A larger series should be implemented to better quantify the risk of clinically relevant complications. Comparative studies reporting superiority of the device compared with other, already widely used devices are pending.

Conclusion:

Proximal femoral varus derotation osteotomy is a powerful option for patients with coxa valga with little postoperative complications.

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Minimal invasive multilevel soft tissue release for contractures in the lower extremities of patients with cerebral palsy

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Abstract

Background
Soft tissue release is usually effective treatment for lower limb contractures in patients with cerebral palsy.
A number of surgical methods have been described for soft tissue release, varying from aponeurotic lengthening, Z-lengthening and tenotomy.
This study was performed to assess the outcome of single multi-level soft tissue release for contractures in the lower limbs in CP patients.

Patient and method
Multicenter prospective study analyzed the data of 30 patients with spastic CP .The mean age was 7.76 years (range from 5 to11 years).There were 13 girls and 17 boys diagnosed as having spastic or mixed form of cerebral palsy. The mean follow-up period one and half years (range from 1 to 3 years).

Result
Postoperative improvement of hip, knee and ankle contractures of all cases .There were 15 patients with diplegia {tight hip adductors, knee flexor tightness and ankle equinus} had improved walking gait pattern, gross motor scale improved from grade four to three.
There were 10 patients with diplegia {knee flexed and foot equinus} had improved walking gait pattern, gross motor scale improved from grade three to two. There were 5 patients with quadriplegia {tight hip adductors, knee flexor tightness and ankle equinus} had improved their hygiene, gross motor scale improved from grade five to four. All cases showed satisfactory improvement of their functional ability and hygiene. Minor complications were recorded

Conclusion
Single-stage multilevel soft-tissue surgery in the lower limbs in children with spastic CP shows good results for locomotion. Significantly reduce operation time with a significantly improved time of hospitalization and mobilization. A sochio economic benefit also is of great benefit of this technique.

Key words
Minimal invasive - multilevel soft tissue release - contractures in cerebral palsy.

Introduction

Cerebral Palsy (CP) is a disorder of movement and posture that appears in infancy or early childhood due to non-progressive injury to the immature brain leading to peripheral motor dysfunction. [1]

Neuromuscular manifestations are restricted movement leading to contractures of muscles, joint deformities and reduced quality of life. [1].

Conservative (non-operative) management of the spastic CP involving the lower limb includes physiotherapy in the form of stretching and range of motion exercise and use of special therapies, e.g., neurodevelopmental therapy, serial corrective cast, oral antispastic medications like baclofen, and management of focal spasticity with use of injection of botulinum toxin.[2]

These non-operative methods may not be helpful in cases of static deformities in lower limbs with spastic CP and require soft tissue/bony corrective surgery, which not only corrects the static deformity but also helps in attaining upright posture, which reduces muscle and joint pain, restores muscle balance across the joint, and makes the limb amenable to orthosis.[3]

Multilevel surgeries or Single Event Multiple Level Release (SEMLR) in the lower limb are performed to improve the gait of children with spastic CP. The treatment should be individualized and planned according to the patient's needs. Maintaining hygiene and independent and balanced sitting would be the primary goal in a child with total body involvement or quadriplegia.[4]

The first what the orthopedic surgeon can and must know how to pick up the child who will have benefit from this surgery and to perform it by that way that will improve the ability of the child.[5]

Different authors have recommended different specific age for SEMLR that varies from 4–8 year to just before the period of increased growth in adolescence [6- 8].

Rationale of multilevel release:

Minimal invasive multilevel soft tissue release MIMLSTR based on the principle that multiarticular muscles, which have less antigravity activity, are hyperactive in CP. can be controlled by releasing them selectively. The monoarticular muscles, which have antigravity activity and are responsible for maintaining an upright posture, are carefully preserved. [4]

The main target for surgery is to improve patient mobility or to improvement of hygiene for severely handicapped patients.

The minimally invasive techniques included selective muscle lengthening through limited incisions and percutaneous lengthening of muscles where possible.

The minimally invasive techniques significantly reduce operation time with a significantly improved time of hospitalization and mobilization. A sochio economic benefit also is of great benefit of this technique.

Patient and methods

Multicenter prospective study analyzed the data of 30 patients with spastic CP, between November 2012 to July 2015.

The mean age was 7.76 years (range from 5 to 11 years).

There were 13 girls and 17 boys diagnosed as having spastic or mixed form of cerebral palsy.

The collected data for each patient included the physiological and anatomical types of the disease, the ambulatory status of the patient were matched using the Gross Motor Function classification system .The data of clinical assessments were collected for hips, knees and ankles of both sides. For the hip affection, the range of abduction and the presence of flexion deformity were recorded. The range of knee flexion and extension and the degree of popliteal angle were recorded. Ankle dorsiflexion range and any deformity were recorded.

All cases had been treated by single stage minimal invasive multilevel soft tissue release for contractures in the lower extremities, to attain improvement in personal hygiene, gait, and independent ambulation with assistive devices alone or with orthosis.

Regular interval analysis had been done every 6 months up to 3 years for evaluations based on pre- and post-operative clinical and functional findings. The mean follow-up period one and half years (range from 1 to 3 years).

Exclusion criteria:

- Cases with advanced spinal manifestation
- Cases with dislocated hips.
- Cases requiring bony surgeries
- Cases with severe or profound mental retardation (not trainable)

There were 25 patients had diplegia and 5 patients had quadriplegia.

Fifteen patients with diplegia (50 %) had tight hip adductors, knee flexor tightness (popliteal angle range from 60 to 90 degree) and ankle equinus. Gross motor scale grade four. Fig (1)

Ten patients with diplegia (33.3%) had knee flexor tightness (popliteal angle range from 60 to 90 degree) and ankle equinus. Gross motor scale grade three.

- There were 5 patients with quadriplegia (16.7%) had tight hip adductors, knee flexor tightness and ankle equinus. gross motor scale grade five.

All children had attained good truncal balance, dynamic sitting, and good muscle power in both the upper limbs (at least grade 3 power in quadriplegics).

A  B 

Fig 1: A: assessment of popliteal angle B: tight hip abductors)

Preoperative assessment:

Static and dynamic conditions in the lower extremities were assessed with physical examination and Gross Motor Functional Classification Scale (GMFCS) scores. [4]

Unsupported sitting, standing, and gait properties were evaluated. Soft-tissue contractures in the lower limbs were assessed with special tests and joint examinations.

Hip joint examined for flexion deformity using Thomas Test, deformities were measured using goniometer according to the neutral 0 method, hip abduction restriction in extension and in 90° of flexion was attributed to hip adductor muscle contracture, hamstring tightness was assessed using popliteal angle in supine position and the hip in 90° of flexion.

The popliteal angle is evaluated with the patient supine, the tested limb in 90° of hip and knee flexion and the contralateral limb in full extension

Ankle examined for Equinus deformity using Silverskiold Test. Gait patterns such as crouching, scissoring, toe-to toe gait, and toe-to-heel gait were noted in all the children clinically. Table (1)

Surgical procedure:

When performing classical release we start with hips then knee and ankle, but with hips adductor release only we start knee and ankle then hips.

Hip surgery:

We start correction of hip flexion contracture then Correction hip adduction contracture. Anterior approach is used, 3 cm started by oblique incision just distal to the anterior superior iliac spine, proximal rectus femoris release is performed then the psoas muscle is located between the sartorius and the femoral sheath, the tendon of the psoas is identified deep within the iliacus muscle, the tendon is then transected over pelvic brim and slide within the iliacus, thereby increasing the overall length of the iliopsoas

Correction of hip adduction contracture by open myotomy of adductors through 1cm minimal medial incision.

Knee surgery:

Correction of knee flexor tightness through medial incision which is placed over the gracilis tendon above joint line about 3-5 cm. All three medial hamstrings are first identified. After this step, the gracilis tendon and the semitendinosus tendon is lengthened with a Z-plasty.

Fractional lengthening on the semimembranosus, the aponeurosis is cut while the underlying muscle fibers are left in continuity. Usually, two cuts in the aponeurosis spaced approximately 1.5 to 2.0 cm apart are required. By gently extending the patient's knee and flexing the hip, the surgeon can perform a sliding lengthening. Fig (2)

Fig 2: (Fractional lengthening semimembranosus)

Table 1: patients, clinical findings and procedures

patients	Age	Pattern	GMFN	Deformities			Procedure Add. Iliopsoas. Hamst Ach.		
				Hip	**Knee**	**Ankle**	**Hip**	**Knee**	**Ankle**
1	6	Diplegia	4	tight hip adduc-tors	KF	AE	Adductor myotomy	Hamstring release	Achilles lengthening
2	5	Diplegia	4	tight hip adduc-tors	KF	AE	Adductor myotomy	Hamstring release	Achilles lengthening
3	4.5	Diplegia	3	-	KF	AE		Hamstring release	Achilles lengthening
4	5.6	Diplegia	4	tight adductors	KF	AE	Adductor myotomy	Hamstring release	Achilles lengthening
5	7	Diplegia	4	tight adductors	KF	AE	Adductor myotomy	Hamstring release	Achilles lengthening
6	8	Diplegia	3	-	KF	AE		Hamstring release	Achilles lengthening
7	11	Quadriplegia	5	Hip flexors, tight adductors	KF	AE	Iliopsoas, Adductor myotomy	Hamstring release	Achilles lengthening
8	6	Diplegia	4	tight adductors	KF	AE	Adductor myotomy	Hamstring release	Achilles lengthening
9	7	Diplegia	4	tight adductors	KF	AE	Adductor myotomy	Hamstring release	Achilles lengthening
10	8.4	Diplegia	3	-	KF	AE		Hamstring release	Achilles lengthening
11	6	Diplegia	4	-	KF	AE		Hamstring release	Achilles lengthening
12	7	Diplegia	4	tight adductors	KF	AE	Adductor myotomy	Hamstring release	Achilles lengthening
13	7	Diplegia	4	tight adductors	KF	AE	Adductor myotomy	Hamstring release	Achilles lengthening
14	6	Diplegia	4	tight adductors	KF	AE	Adductor myotomy	Hamstring release	Achilles lengthening
15	5	Diplegia	4	-	KF	AE		Hamstring release	Achilles lengthening
16	8	Diplegia	3	-	KF	AE		Hamstring release	Achilles lengthening
17	9	Diplegia	4	tight adductors	KF	AE	Adductor myotomy	Hamstring release	Achilles lengthening
18	10	Quadriplegia	5	tight adductors	KF	AE	Adductor myotomy	Hamstring release	Achilles lengthening
19	11	Quadriplegia	5	tight adductors	KF	AE	Adductor myotomy	Hamstring release	Achilles lengthening
20	11	Quadriplegia	5	Hip flexors, tight adductors	KF	AE	Iliopsoas, Adductor myotomy	Hamstring release	Achilles lengthening
21	7	Diplegia	3	-	KF	AE		Hamstring release	Achilles lengthening
22	6	Diplegia	4	tight adductors	KF	AE	Adductor myotomy	Hamstring release	Achilles lengthening
23	8	Diplegia	3	-	KF	AE		Hamstring release	Achilles lengthening
24	10	Diplegia	4	tight adductors	KF	AE	Adductor myotomy	Hamstring release	Achilles lengthening
25	6	Diplegia	4	tight adductors	KF	AE	Adductor myotomy	Hamstring release	Achilles lengthening
26	7.5	Diplegia	4	tight adductors	KF	AE	Adductor myotomy	Hamstring release	Achilles lengthening
27	7.8	Diplegia	3	-	KF	AE		Hamstring release	Achilles lengthening
28	8	Diplegia	3	-	KF	AE		Hamstring release	Achilles lengthening
29	10	Diplegia	4	tight adductors	KF	AE	Adductor myotomy	Hamstring release	Achilles lengthening
30	11	Quadriplegia	5	tight adductors	KF	AE	Adductor myotomy	Hamstring release	Achilles lengthening

KF: knee flexor tightness
AE: ankle equinus

Ankle surgery:

Surgical treatment of equinus is selective lengthening of the Achilles tendon that can be performed by percutaneous technique two or three cuts in the tendon 1cm in-between starting from calcaneous. Fig (3)

Fig 3: Achilles tendon is lengthened in percutaneous technique

Postoperative protocol:

All patients had groin-to-toe cast in the operated limb(s). 4–6 weeks with closed follow up for the first month for foot edema, cast may be changed after two weeks if needed (soaked cast) then cast removed after another 4 weeks. Children have to wear knee ankle foot orthosis (kAFOs) to protect the knee, ankle joints and keep the muscles in a good position to heal for the first 3-6 months to avoid tendency of recurrence. We followed all patients every 6 months up to 3 years, Gait training exercise and training to walk wearing orthosis with or without assistive devices.

Results

The 15 patients with diplegia {tight hip adductors, knee flexor tightness and ankle equinus} had improved walking gait pattern, gross motor scale improved from grade four to three with improved hip adduction, knee popliteal angle to 15 and improved equinus. The 10 patients with diplegia {knee flexor tightness and ankle equinus} had improved walking gait pattern, gross motor scale improved from grade three to two with improved knee popliteal angle to zero and improved equines. The 5 patients with quadriplegia {tight hip adductors, knee flexor tightness and ankle equinus} had improved their hygiene, gross motor scale improved from grade five to four with improved hip adduction, knee popliteal angle to 15 and improved equinus. Fig (4)

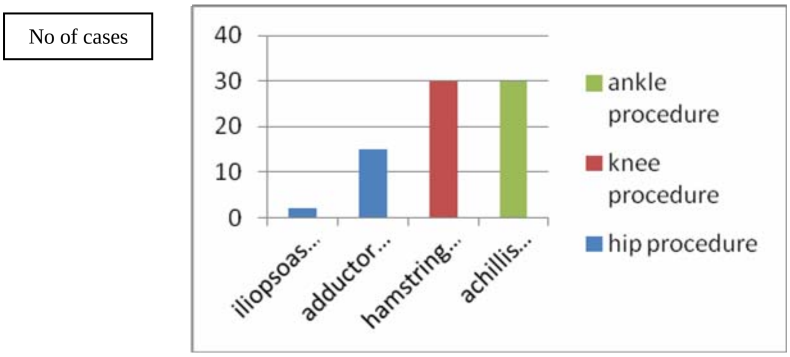

Fig 4: surgical procedures

Discussion

Spastic CP is the most common subtype of all CP cases, and diplegia, hemiplegia, and quadriplegia are the most frequent clinical presentation, in that order in the spastic subtype. Conservative management in the form of physiotherapy, as soon as the diagnosis is made in infancy/early childhood, should be the first line of management.

As complete recovery in spastic CP is impossible because of the brain lesion, surgical interventions are performed to provide, maintain, or improve musculoskeletal system function and to significantly improve the quality of life of these patients.[9] . Corrective surgery is required when the contractures are static and severe enough to interfere with movements and locomotion.[6]

In our study of 30 patients with spastic CP, had been treated by Single-stage multilevel soft-tissue surgery in the lower limbs.

Fifteen patients with diplegia {tight hip adductors, knee flexor tightness and ankle equinus} had improved walking gait pattern, gross motor scale improved from grade 4 to 3. Ten patients with diplegia {knee flexor tightness and ankle equinus} had improved walking gait pattern, gross motor scale improved from grade 3 to 2. Five patients with quadriplegia {tight hip adductors, knee flexor tightness and ankle equinus} had improved their hygiene, gross motor scale improved from grade 5 to 4.

Zwick *et al*., in a case-control study involving 20 patients with spastic diplegia, observed that patients who underwent single-stage multilevel surgery walked faster with increased stride length and considerably increased knee joint range of motion when compared with the control group. These patients had improved knee extension during the stance phase of gait, which caused improved stance limb stability and facilitate an unhindered swing phase of the opposite limb after surgery.[9]

Molenaers *et al*., in another case-control series of 52 patients with spastic CP, compared the results of single-stage multilevel injections of botulinum toxin A with that of the surgery. They concluded that both these treatment modalities should be regarded as complementary rather than mutually exclusive, with both calling for an integrated approach.[10]

Godwin *et al*., investigate, is there a relationship between level of gross motor function classification system for cerebral palsy and single-event multilevel surgery intervention over time?

The results of this investigation support the concept that interventions, especially SEMLS, can affect the stability of the GMFCS classification. The majority of children in this study showed changes in gross motor function classification as reflected by lower GMFCS scores after SEMLS intervention. We also found that changes were maintained over a period of 5 years. The results of this study suggest that certain interventions, such as SEMLS, might have an effect on the stability of the GMFCS and that effect may be level-dependent.

Consideration of age while planning corrective surgeries in spastic CP patients is very important. As cases with spastic diplegia and quadriplegia do not attain stable gait pattern before the age of 3–4 years, surgery is not advisable before the age of 4 years.[11] In our study also, no patient was younger than 4 years of age at the time of surgery.

Orthoses are frequently used to improve the gait and to correct or maintain the deformity in CP. Understanding of the biomechanics of the various joints of the lower limb during normal gait, the pathophysiology and pathomechanics of gait disruption in children with CP, and the biomechanical characteristics of various orthoses is imperative to prescribe appropriate splint. Design, indications, and cost should be considered when choosing an orthosis.[12]

Preoperative and postoperative (and the follow-up) GMFCS scores were used to assess the functional improvement in the patients after surgery. This is a commonly used and validated scale for functional assessment in CP [13]

Conclusion

Single-stage multilevel soft-tissue surgery in the lower limbs in children with spastic CP shows good results for locomotion.

The minimally invasive technique significantly reduce operation time with a significantly improved time of hospitalization and mobilization, a sochio economic benefit also is of great benefit of this technique, all children showed satisfactory results with minimal complications after corrective surgery, and their functional ability improved significantly.

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Short-term results of cementless metal on polyethylene hip replacement in young adults

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Abstract

Background

The surgical management of end-stage hip disease in patients aged ≤ 30 years remains a challenge. Improvements in fixation methods and in bearing surfaces have extended the indication to include younger patients. The aim of this study was to report the Short-term results of uncemented metal on UHMWPE THR in young adults lower than 30 years.

Patients and Methods

From June 2013 to October 2015, 30 primary cementless THRs were performed on 27 patients , the mean age was 28.4 years (range: 24–30 years). The study included 19 males and 8 females. The most common diagnoses were AVN (56.7%) and inflammatory diseases (23.3%). Assessment of the Clinical and radiographic outcomes were at a minimum of two years.

Results

At a mean duration of follow-up of 2.8 years (2-4 years), The mean HHS improved from a pre-operative score of 20.5 (15 to 75) to 84.4 (48 to 100) at final follow up., 23 hips (76.6%,) were rated as excellent or good, 4 hips (13.3%,) were fair and 3 hips (10%,) were poor. The average VAS pain score was 72 (range: 25–100). the WOMAC score 80 (range: 35–100).

Complications

The complications recorded in this study were as follow: superficial infection in one hip, calcar crack in four hips, dislocation of one hip representing, leg length discrepancy was reported in four hips, aseptic loosening of acetabular components in two hips, while revision was done to one case.

Conclusion

Although the short-term results of uncemented metal on UHMWPE in young adults ≤ 30 years were encouraging, a further long- term follows up and comparisons with alternative bearing procedures are awaited.

Introduction

The causes of joint disease leading to the need for arthroplasty in very young patients varies. In the past,most published series have centered on patients in whom total hip replacement (THR) was performed for the management of rheumatoid arthritis (RA).[1]

A recent case series have reported the causes of end stage hip disease in younger patients undergoing THR. In these series, the foremost cause of hip failure was AVN and secondary OA witha lesser contribution from RA and chondrolysis.[2]

The success of THR has resulted in extending its indications to younger and more active patients.[3] Due to the activity levels and high demands in the younger population, rates of revision are higher in this group than those of older patients.[4] The main modes of failure are aseptic loosening and osteolysis.[5]

Outcomes of THA with cemented components have demonstrated inconsistent longevity in the younger patient population. The fixation method of choice for acetabular and femoral components involves the utilization of press-fit porous components.[6],[7]

Improvements in bearing surfaces available for THR have contributed to the increasing number of these procedures done in very young patients. The introduction of highly cross-linked polyethylene has resulted in wide reduction in polyethylene wear rates and osteolysis at midterm follow-ups.[8][9]

The aim of this study was to report the Short-term results of uncemented metal on polyethylene THR in young adults lower than 30 years.

Patients and Methods

From June 2013 to October 2015, 30 primary cementless THRs were performed on 27 patients were performed in Bni Sueif university hospital . The mean age was 28.4 years (range: 24–30 years), 19 males and 8 females. The most common diagnoses were AVN (56.7%) and inflammatory diseases (23.3%). Assessment of the Clinical and radiographic outcomes were at a minimum of two years.

Inclusion criteria were: adult Patients aged less than 30 years of age at the time of arthroplasty, Unilateral or bilateral hip disease. Exclusions criteria were: age greater than 30 years at the time of the THR, psychomotor retardation, neuropsychiatric disorders, serious Comorbidities such as decompensated heart disease.

The study included 19 men (70.4%) and 8 women (29.6%) with a mean age of 28.4 years(24 to 30). In all, 14 procedures (46.7 %) were righ sided and 16 (53.3 %) left sided. Bilateral staged THRs were performed in 3 patients. The follow up ranged from (2-4) years and the mean follow up duration was 2.8 years. All patients were followed up at the same hospital.THR was undertaken for disabling pain in all patients, the pre-operative

diagnoses are shown in Table I.

Table 1: Pre-operative diagnosis for primary total hip replacement.

DIAGNOSIS (N, %)	N = 30 HIPS
Secondary OA due to avascular necrosis	17 (56.7 %)
Inflammatory diseases (RA, SLE, AS)	7 (23.3%)
Secondary OA due to pediatric conditions	3 (10%)
Failed internal fixation of neck femur fracture	3 (10%)

In all cases we used a straight stem designed for press fit insertion (Innovation Ortho Line LTD, United Kingdome).The femoral component was made of grit-blasted TiAl6V4, and the outer surfaces were plasma-sprayed proximally with HA. In all cases we used a cup made of TiAl6V4 and coated with HA (Innovation Ortho Line LTD, United Kingdome).We used stems of sizes 10–14 and cups of sizes 48–58. The head was made of stainless steel with a diameter of 28 mm in all cases. The polyethylene (PE) liner was made of UHMWPE and designed with anti-dislocation rim. The technical data were provided by the manufacturer and reported to fulfil ISO 9001 standards.

Surgery was standardized, using the direct lateral approach, without trochanteric osteotomy. postoperatively, Partial weight bearing was allowed during the first six weeks with progression to full weight-bearing as tolerated.

Clinical and radiographic data on all patients were collected prospectively. Patients evaluated (clinically and radiologically) for early complications (including lower limb DVT, early dislocation, hematoma and surgical site infection) and late complications (including aseptic loosening, dislocation, osteolysis and revision) at 2 and 6 weeks postoperatively and at 3, 6 and 12 months after surgery and then annually. All patients were followed for a minimum of two years or until failure of the prosthesis. Follow-up averaged 35 months (range 24 to 48 months) both clinically and radiographically. No patients were died or lost to follow-up.

Clinical outcome was measured with use of the Harris hip Score [10]. The outcome was categorized as excellent or good (hip score ≥80 points, no use of a walking aid, and a nonpainful hip), fair (hip score of 70 to 79 points, occasional use of a walking aid and/or mild hip pain), or poor ≤ 70. In addition, pain was measured on a visual analogue scale (VAS) from 0 (strong pain) to 100 (no pain). The WOMAC score was used toassess the functional results [11]. WOMAC is a wellvalidated,24-item instrument which assesses pain (five items) on a scale of 0 (best outcome) to 8 (worst possible outcome), stiffness (two items) from 0 (best) to 8 (worst possible outcome) and physical function (17 items) from 0(best) to 68 (worst possible outcome), with a total score from 0 (worst) to 96 (best).

Serial radiographs made before and after the hip arthroplasty were evaluated to assess component positioning, osseointegration, gross wear and loosening.

Results

The mean HHS improved significantly from a preoperative score of20.5 (15 to 75) to 84.4 (48 to 100) at final follow up(p <0.001). A total of 30 hips, 23 hips (76.6%,) were rated as excellent or good (80 to 100), four hips (13.3%,) were rated as fair (70 to 79) and three (10%,) rated poorly(< 70 points) (Fig. 1). The average VAS pain score was 20 (range: 0–55). the WOMAC score 80.7 (range: 35.6–100) (Table 2).

Preoperatively, all patients required aids to walk. six patients(22.2%) were wheelchair bound, 10 (37%) used a cane at all times, and 11 patients (40.7%) used a walker. At the final follow-up, 20 patients (74%) didnot need any aids for walking, 3(11%) used a cane at all times, 3(11%) used crutches full time and 1 (3.7%) used a cane for long walks postoperatively.

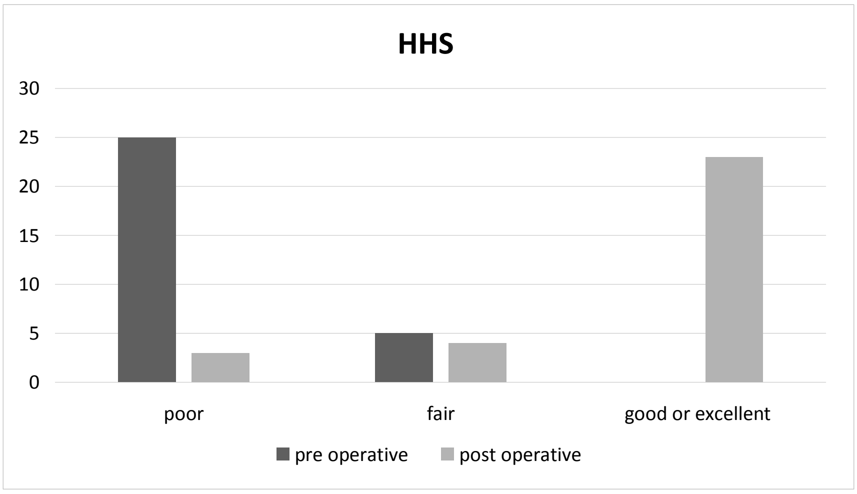

Figure1: Histogram showing the distribution of pre-and post-operative Harris hip scores.

Table 2: Clinical data pre-operative and at last follow-up.

	Harris hip score	WOMAC	VAS
Pre-operatively	20.5	28.4	80.5
Last follow-up	84.4	80.7	20
p-Value	<0.001*	<0.001*	<0.001*

*Statistically significant.

Serial radiographs made prior to and after the hip arthroplasty were evaluated to assess component positioning, osseointegration, gross wear, and loosening. The femur was divided into seven zones[12] and the acetabulum into three zones[13]. heterotopic ossification was also evaluated which was classified according to the system of Brooker et al.[14].

Follow-up radiographs were available for all patients, no patients showed any signs of aseptic loosening of femoral component throughout the study period with no evidence of subsidence or migration (fig.2).two hips (6.6%) had developed gradual progressive aseptic loosening of acetabular component, they had fair to poor results, both were rheumatic and scheduled for revision of the acetabular component.Gross polyethylene wear was not present in any hips.According to Brooker we noted the presence of 5 calcifications, 3 grade 1 (11%), two grade 2 (7.4%).

Figure 2: immediate postoperative x ray (left) and 3 years later (right) of 29 years old male with 2ry O.A. showing no signs of loosening

Complications

Nondisplaced crack in the femoral calcar occurred in four hips (13.3%); were treated by cerclage wire followed by delayed weight bearing and well united. redness and swelling appeared in the scar 6 years after the index operation (superficial infection) in one hip (3.33%); which was treated vigorously with debridement and specific antibiotic according to the culture and sensitivity. The infection resolved in three weeks however at latest follow-up there still remained suspicion of a deep low-grade infection of the implant.

Dislocation of one hip (3.33%) occurred one week after surgery due to malpositioned acetabular cup and revision was done with final Harris score of 80 point (fig.3). one case was suffering from sciatic nerve injury (3.33%)due to lengthening which partially improved over one year. Leg length discrepancy was reported in four hips (13.33%), one hips had a remaining postoperative shortening about 1.5 cm and 3 cases had lengthening ranged (1to 2cm),all cases of LLD were accepted by the patients. two hips (6.6%) had developed symptomatic aseptic loosening of the acetabular component.none of the patients developed a deep venous thrombosis, pulmonary embolism, postoperative periprosthetic fracture, deep infection or femoral stem loosening.

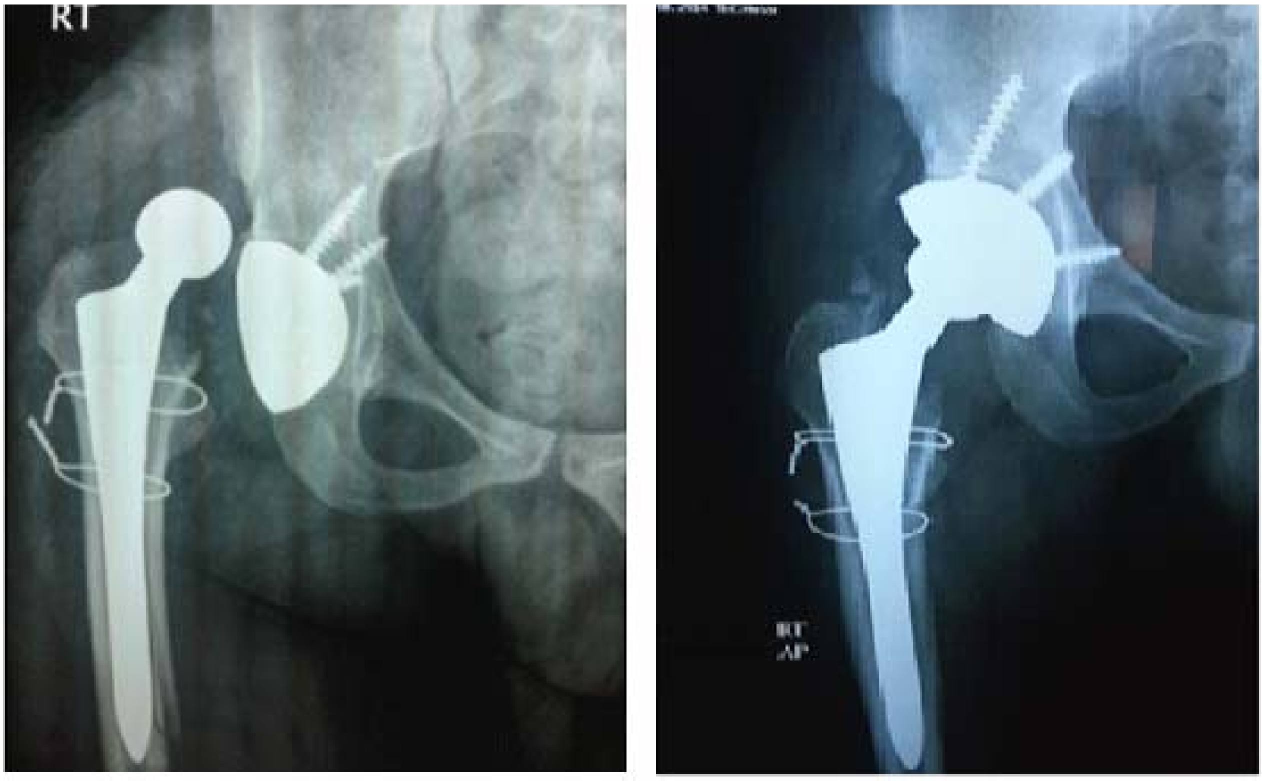

Figure 3: 27 years old male with AVN with immediate postoperative dislocation(left) due to mispositioned cup and 2 years (right) after revision showing stable prosthesis and healed calcar fracture.

Discussion

THA is occasionally necessary for end-stage hip disease in young patients. Nevertheless, the published information on contemporary THA in this age group is limited[15] and primarily focuses on cemented THA for treating patients with JRA.[16-21]

In this present study we report our initial experience of THR in young patients, our study includes 27 young adult patients (30 hips), with mean age of (28.4 years), were followed up for period mean 2.8 years after primary THR which is short term follow up. In the published series some authors performed medium term follow up and others reported long term follow up (table3).

In our study, the most frequent reason for surgical intervention was avascular necrosis (56.7 %) followed by Inflammatory diseases (23.3%), Secondary OA due to pediatric conditions (10%) and post traumatic (10%).A handful of recent case series have highlighted the causes of end stage hip disease in younger patients undergoing THR.[22-24] In these series, the most common cause of hip replacement was avascular necrosis(14% to 54%) or secondary osteoarthritis(OA) (20% to 70%) with a lesser contribution from RA (2%to 26%), chondrolysis (1%).[2]

All the patients were subjected to uncemented metal on highly cross-linked polyethylene prosthesis due to their young age which means these patients most likely will require a revision of the prosthesis in the future. Revision of a non-cemented prosthesis is technically simpler and less devastating procedure.[25]

Several studies[26, 27] in the literature report the use of cemented prosthesis in young patients with systemic diseases, this is mainly due to bone stock after prolonged treatment with steroid drugs.[28]

In our study, with a minimum follow-up at 2 years, we report good to excellent results. The mean Harris Hip Score improved from 20.5 to 84.4. The WOMAC score improved from 28.4to 80.7 points showing a good functionality of the prosthetic implant. Only one hip was revised as a result of dislocation due to malpositioned cup. All femoral stems were well fixed and only 2 acetabular cups showed radiographic loosening. Nondisplaced cracks in the femoral calcar were the most frequent complication which occurred in 4 hips.

In 2008 Restrepo[15] reported the results of 35 uncemented THRs on 25 patients with a mean age of 17.6 years, and a mean follow-up of 6.6 years. The main diagnosis was avascular necrosis. All patients had a significant functional improvement and pain relief as measured by the Harris Hip Score and SF-36 and no complications ,or reoperations were reported. Only one patient needed revision secondary to severe polyethylene wear. This study confirms our results.

Subsequently Clohisy in 2010[22] reviewed 102 hips had underwent THR, in patients 25 years or younger at surgery. The most common diagnosis was osteonecrosis of the femoral head (44%). The minimum follow-up was 2 years (range 2-16 years) and mean Harris Hip Score improved from 42 preoperatively to 83 postoperatively. Seven hips (7%) underwent revision. There were nine (9%) major complications. All femoral stems and 98% of acetabular components were well-fixed at last follow-up. The authors concluded that THA in patients 25 years of age and younger is associated with improved hip function, and secure fixation ofuncemented implants at early followup.

Kamath[29] in 2012 reported results of 21 modern alternative bearing THRs in patients younger than 21 years at a mean follow-up of 49 months. The most common diagnosis was chemotherapy-induced osteonecrosis (33%) and steroid induced osteonecrosis (29%). Articulation bearings were ceramic/ceramic (67%), metal/highly cross-linked polyethylene (29%), and metal resurfacing (5%). Harris Hip Score improved from 43.6 to 83.6. At final follow-up, there was no radiographic loosening; one THA was revised for a cracked ceramic liner. At intermediate-term follow-up, clinical and radiographic results were favorable for alternative-bearing THR in patients younger than 21 years.

D'Ambrosi[30] in 2016 reported results of 24 patients who were 20 years or younger and underwent uncemented total hip arthroplasty.Articulation bearings were ceramic/ceramic (60%), ceramic/highly cross-linked polyethylene (40%). The most frequent underlying diagnosis were JRA (33.3%). Minimum follow-up was 10 years. The Harris Hip Score improved from 36.94 points to 92.3, and WOMAC score improved from 28.45 to 84.72. All components were stable and osseo-integrated. Radiolucent lines were not present in any hips. No patient needed implant revision. The only complication was an intraoperative femoral fracture.The authors concluded that THR is a safe and reliable procedure for the treatment of end-stage arthritis in the young that provides good to excellent mid-term results.

Despite our study was performed in a single center also the surgical approach and prothesis type were standardized,there are some limitations of this study. First, the followup is only short-term with some patients having only2-year data. Clearly, additional followup is needed to assess the long-term durability of the prosthesis. Second, grouping patients with different diagnoses may not be ideal because the functional improvement (Harris hip score) for THR performed for various diagnoses may vary.

In conclusion THR using uncemented metal on highly cross-linked polyethylene is a safe and reliable procedurefor the treatment of end-stage arthritis in the young patients under 30 years, that provides good to excellent results inthe short term. THR is the only acceptable surgical procedure that allows good mobility, a return to activity of daily living and high quality of life in end stage hip diseases. Clinic and radiographic short-term follow-up, report promising results of uncemented metal on HCLPE prosthesis in younger adults.

Study	Kamath et at.[29]	Costa et al.[31]	Clohisy et al.[22]	Restrepo et al.[15]	D'Ambrosi et al.[30]	Girard et al.[23]	Wangen et al.[24]	Current study
Year of pub	2012	2012	2010	2008	2016	2010	2008	
Mean age (range)	18 (13-20)	20(13-30)	20(12-25)	17.64 (13,5-20)	19.7	25 (15-30)	25 (15-30)	28.3 (24-30)
Patients (hips)	17 (20)	40 (53)	88 (102)	25 (35)	24 (30)	34 (47)	44 (49)	27 (30)
Mean F/U	4.1 years	4.6 years	5 years	6.6 years	12.5 years	9 years	13 years	2.8 years
Surgical approach	100 % post	100% AL	Post and AL	100 % AL	100% posterior	100% Post	Post and DL	100% DL
Cementless stems	95%	100%	95%	100%	100%	94.3%	100%	100%
Cementless cups	100%	100%	100%	100%	100%	100%	100%	100%
Articulation	70% COC 30% MOXLP	100% MOP	45% MOXLP 29% MOP 14% COC 7% COXLP 5% MOM	63% COXLP 31% MOP 6% COC	60% COC 40% COXL	100% MOM	100% MOP	100% MOP
Results (HHS)	43.6 to 83.6	42 to 93	42 to 83	51.9 to 77.3	36.9 to 92.3	NA	88	20.5 to 84.4
Infection	0%	1.9%	1%	0%	0%	4.3%	Unknown	0%
Dislocation	0%	0%	3.9%	0%	0%	2.1%	6.1%	3.3%
Femoral aseptic loosening	0%	0%	0%	0%	0%	0%	0%	0%
Acetabular aseptic loosening	0%	1.9%	2.9%	0%	0%	4.3%	49%	6.7%

Post: posterior approach. Al: anterolateral approach. Dl: direct lateral approach.
COC: ceramic on ceramic. MOXLP: metal on highly cross-linked polyethylene.
MOP: metal on polyethylene. COXLP: ceramic on highly cross-linked polyethylene.
MOM: metal on metal NA: not available

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Early results of anatomical locked plate in proximal humeral fractures

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Abstract

Introduction
Obtaining stable fixation has been a challenge in proximal humerus fractures. Locking plates achieve stable fixation and enable early postoperative mobilization especially in osteoporotic proximal humerus fracture.
Aim of the study
The aim of the current study was to evaluate and compare the results of treatment of proximal humeral fractures using PHILOS and anatomical locked plates.
Patients and Methods
This prospective study was conducted at the general hospital of Suez city, between July 2012 to June 2015. Thirty patients presented with three or four parts fracture of proximal humerus had been included in the study. PHILOS and Anatomical locked proximal humerus plates were used in this type of fracture applying deltopectoral incision. Clinical and functional evaluation of the treatment was assessed by constant shoulder score which depend on pain, activity level, arm positioning, strength and range of motion.
Results
Most of the studied patients (56.7%) were aging below 50 years, and the male gender was the commonest 66.7%. Three parts fracture was more common among our patients (60%). Five cases were operated using anatomical locked plate while the remaining cases were operated by PHILOS. Over all percentage of complications among the studied patients was 23.3%. Of the 30 patients, 3 cases and 1 case showed infection, 2 cases and 1 case had failure of fixation, 2 cases and 1 case had healing with Varus position in the PHILOS and anatomical plate groups respectively with no significant differences, furthermore 2 cases had avascular necrosis in PHILOS groups while no cases in anatomical plate group with significant difference. The mean final constant score was 70.76 and 72.14 in the PHILOS and anatomical plate respectively and no significant difference revealed regarding functional outcome. A significant negative correlation between final constant score and preoperative time while positive significance was encountered between final constant score and DM as the non diabetics had high final constant score.
Conclusion
Fixation with the locked plate is a near ideal technique with a high union rate in the treatment of proximal humeral fractures as well as it provides good functional outcomes in treatment of proximal humerus fractures, however, the complications are frequent, and careful surgical technique is required to ensure satisfactory results.

Key Words
Anatomical locked plate, PHILOS, Constant score.

Introduction

Fractures of the proximal humerus encompass nearly 4% to 5% of all fractures **[1-3]**. In patients over 65 years of age, they are encountered the second most common upper-extremity fracture and the third most common fracture after hip fractures and distal radial fractures **[1,4,5].** Though most of these fractures could be managed non-surgically, operative intervention is generally recommended when any of the major fracture fragments is displaced more than one centimeter or angulated more than 45° **[1,3,6]**. Open reduction and internal fixation for multi-fragmented proximal humerus fractures in adults with good quality bone are not usually a problem **[7-9]**. However in osteoporotic bones, these injuries present a real challenge **[7,10]**. The main problem is the stability of the construct; due to poor spur of screws in humeral head, there is a high risk of screw withdrawal **[11]**. Angular stable devices such as the Proximal Humerus Interlocking System (PHILOS; Synthes, Oberdorf, Switzerland) were developed by the AO Foundation. In this study we evaluated the results of treatment of proximal humeral fractures using PHILOS as well as anatomical locked plate.

Patients & Methods

This prospective study was withheld at the general hospital of Suez city, in the period between July 2012 to June 2015. Thirty patients presented with three or four parts fracture of proximal humerus had been included in the study. PHILOS together with anatomical locked proximal humerus plate were used in this type of fracture applying deltopectoral incision. A data collection form was used to record information regarding patient demography, mechanism of injury, fracture classification, technical details of surgical procedure, post-operative rehabilitation protocol and follow-up assessments. All surgical maneuvers were operated by a single surgeon. Follow-up clinical examination in the outpatient department involved assessment of wound healing, fracture union, shoulder function and pain. Clinical fracture union was defined as fracture site becoming painless, non- tender and stable. Shoulder function was evaluated using Constant and Murley scoring system **[12]**. This score entails points for pain, muscle strength, activities of daily life and range of motion, and is graded as poor (score 0-55), moderate (56 to 70), good (71-85) and excellent (86-100). Follow-up radiographic evaluation comprised of assessment of adequacy of fixation, status of the plate and screws, and radiological fracture union in terms of bridging of fracture gap and external callus. All fractures were classified according to AO classification **[2]**. Operative technique was performed under general anesthesia with the patient in beach chair position. An image intensifier was applied for dynamic fluoroscopic monitoring of the operation. Deltopectoral surgical approach **[14,15]** was used, taking care to conserve the axillary nerve and the periosteal/muscular attachments to the bone fragments. The supraspinatus tendon was tagged with multiple #2 braided non absorbable sutures. These tagging sutures were applied to bring the tuberosity fragments to the lateral cortex of shaft fragments, that way indirectly decreasing the head fragments to the shaft. In fractures where the medial hinge was disrupted, trial to restore the medial hinge **[15]** was done. If head fragments were impacted on the shaft, a periosteal elevator was used to dis-impact the head and thus restore the medial portion of calcar. A minimum of four screws were placed in the proximal segment.

Results

Of the 30 studied patients (56.7%) were aging below 50 years; male gender was the commonest accounting 66.7% **(table 1)**. The most common type of fracture among studied patients (60%) was the 3 parts fracture with predominantly right sided fracture 56.7%. Among all studied patients 30% was complaining of either HTN or DM.

Nearly 87% of the studied patients waited less than 2 weeks before operation. Five cases were operated using anatomical locked plate while the remaining cases were operated by PHILOS. Over all percentage of complications among the studied patients was 23.3%, consisted of 3 cases (1 superficial and 2 deep infection) versus 1 case of superficial infection, 2 cases versus 1 case of failure of fixation and healing with varus position in PHILOS and anatomical plate groups respectively with no significant differences, furthermore 2 cases had avascular necrosis (AVN) in PHILOS groups while no cases in anatomical plate group with significant difference **(table 2)**.

Table 1: shows Baseline data of the studied patients

		Studied patients N= 30 patients	
Age (years)	< 50 years	17	56.7 %
	≥ 50years	13	43.3 %
Gender	Male	20	66.7 %
	Female	10	33.3 %

Comparison between 2 subgroups regarding all constant score parameters were shown in table 3. The mean constant score was 70.76 and 72.14 in PHILOS and anatomical plate groups, respectively. Good functional outcome was achieved in 17 cases and 1 case in PHILOS and anatomical plate groups, respectively.

The 3 parts fracture showed significant correlation with forward flexion, arm position, preoperative time and final constant score. The patients waited less than 2 weeks preoperatively achieved high final constant score. Additionally, the non diabetics patients had highly significant final constant score than diabetic patients **(table 4)**.

In our study we did not find any difference between PHILOS and anatomical locked plate, as both demonstrated good fixation in proximal humeral fractures, and did not disturb blood supply, provide acceptable functional results and good constant score, however high infection rate that may influence plate stability and increase risk of AVN was prevalent.

Table 2: shows distribution of postoperative complications among studied patients

		Group with PHILOS plate N= 25 patients		Group with Anatomical plate N= 5 patients		p-value
Infection	Super-ficial	1	4%	1	20%	0.764 NS
	Deep	2	8%	0	0%	
Failure of fixation	Present	2	8 %	1	20%	0.421 NS
	Absent	23	92 %	4	80%	
Healing with Varus position	Present	2	8%	1	20%	0.532 NS
	Absent	23	92%	4	80%	
Avascu-lar necro-sis	Present	2	8%	0	0%	0.01*
	Absent	23	92%	5	100%	
Total		5	29%	2	40%	0.02*
Total complication among all patients		7		23.3%		

Table 3: shows parameters of constant score among studied patients

		Group with PHILOS plate N= 25 patients	Group with Anatomical plate N= 5 patients	p-value
Forward flexion	Mean ±SD	136.5±37.6	133.1±32.3	0.13 NS
	Range	20 - 165	19 - 162	
Abduction	Mean ±SD	135.3±38.05	131.6±33.01	0.32 NS
	Range	20 - 165	19 - 164	
Internal rotation	Mean ±SD	7.46±1.96	7.12±1.14	0.07 NS
	Range	2 - 10	2 - 9	
External rotation	Mean ±SD	7.66±2.29	7.43±1.76	0.11 NS
	Range	2 - 10	2 - 9	
Arm posi-tion	Mean ±SD	7.23±0.87	7.60±1.99	0.32 NS
	Range	2 - 9	2 - 10	
Activity	Mean ±SD	7.14±1.45	7.86±1.96	0.65 NS
	Range	2 - 9	2 - 10	
Strength	Mean ±SD	13.85±2.78	14.00±3.56	0.07 NS
	Range	2 - 17	2 - 18	
Pain	No	6 (24%)	3 (60%)	0.01*
	Mild	13 (52%)	1 (20%)	
	Moder-ate	3(12%)	1(20%)	
	Severe	3 (12%)	0 (0%)	
Final con-stant score	Mean ±SD	70.76±21.38	72.14±19.16	0.43 NS
	Range	22 - 93	22 - 95	
Final con-stant score classes	Excellent	3(12%)	3(60%)	0.64 NS
	Good	17 (68%)	1 (20%)	
	Fair	3(12%)	1(20%)	
	poor	2(8%)	0(10%)	

Table 4: shows relation between Final constant score and age, gender, preoperative time, DM, and HTN

	Studied patients N= 30 patients Final constant score	
	r	p
Age	- 0.304	0.103 NS
Gender	- 0.120	0.528 NS
preoperative time	- 0.620	0.01 *
DM	0.951	0.002 *
HTN	0.027	0.886 NS

Discussion

The use of locked plating in the treatment of displaced proximal humerus fractures is becoming more prevalent. Much knowledge together with experience of the surgical technique is required to maximize clinical outcomes, including appropriate preoperative and postoperative management.

While this emerging technique has shown promise to date, surgeons should be cautious for the complications that can arise. Overall complication rates have been reported as high as 81% in the literature, depending on the definitions used, but significant variability has been present across studies **[10,13,15]**

According to age, our patients were divided into 2 subgroups, and most of them (56.7%) were aging 50 years and older, beside that the male gender was the commonest through our studied patients.

Muhammad. A et al, reported in his study that of the 10 patients evaluated, 3 were males and 7 were females. The majority of the patients were elderly or middle aged. The average duration of follow up was 23±3 (range 16-24) weeks. Uneventful fracture union was demonstrated in eight patients with an average duration of 11.6±0.8 weeks **[16]**.

The time from injury to operation was assessed in our study where the majority of the studied patients (26 patients) had to wait less than 2 weeks before surgery. The average radiological union time is 20 weeks.

Waleed M Ewais, et al. claimed in his study that three patients (12.5%) developed Varus malunion, mainly the patients who were operated upon in the beginning of the study and those who had four-part fractures. Secondary procedures for implant removal was required in five patients (21%) (due to impingement of a superiorly placed plate in four patients and due to avascular necrosis of the humeral head in one). Nine patients (37.5%) showed complications which included avascular necrosis of the humeral head in two patients (8%), varus malunion of the humeral head in three patients (12.5%), and subacromial impingement in four patients (17%); subacromial impingement was mainly caused by the superior plate position **[17]**.

Neil Rohra. et al, declared in his study that the overall complication rate was 20%. The main complications were varus malunion in 3 patients, and fixation failure in 1 patient. Fixation failure required reoperation with bone grafting and plating **[18]**.

Egol et al observed only one case of acute infection in their series of 51 patients who mainly had 3- and 4-part fractures **[19]**. **Gardner et al** reported superficial wound dehiscence in one patient and **Moonot et al** reported one superficial infection that healed with oral antibiotic treatment **[15,20]**.

In the past, incidences of AVN have been reported in a wide range, 4%-75% of cases **[21]**. **Hertel and his colleagues** evaluated risk factors for humeral head avascular necrosis following intracapsular proximal humerus fracture. They noted that most important predictor was the length of the dorsomedial metaphyseal extension (<8 mm), the integrity of the medial hinge (defined by greater than 2-mm shaft displacement in any direction), and fracture with an anatomic neck component (types 2, 9, 10, 11 and 12 in their binary description system). When three of these criteria were present, the positive predictive value for ischemia was 97% **[22]**.

Björkenheim et al reported 26.3% of the fractures having 2-, 3- and 4-part united in slightly varus position after open reduction and internal fixation with locking plate **[23]**. **Agudelo et al** considered primary varus reduction to be an important risk factor which may cause poor results **[24]**.

In the present study, mean final constant score was 70.76 points, according to this score, 13.3% had excellent outcome, 66.6% had good functional outcome, 10% had fair outcome and 10% had poor outcome. When the score was related to the type of fracture, the mean score was much higher in the 3 parts than in the 4 parts fracture with significant difference. Risk factors that could modify the score were assessed which revealed negative non significant correlation between the score and age, gender or the preoperative time. However a highly significant positive correlation was denoted between the score and the DM.

The previous finding could be emphasized that the patients with DM had poor functional outcomes owing to the DM increases fracture risk, interferes with bone formation, and impairs fracture healing due to several features that affect the bone including hyperglycemia and increased advanced glycation end product (AGE) formation, reactive oxygen species (ROS) generation, and inflammation. These factors affect both osteoblasts and osteoclasts leading to increased osteoclasts and reduced numbers of osteoblasts and bone formation. In addition to fracture healing, DM impairs bone formation under conditions of perturbation such as bacteria-induced periodontal bone loss by increasing osteoblast apoptosis and reducing expression of factors that stimulate osteoblasts such as BMPs and growth factors.

Type of fracture was correlated with other features in the study; the 3 parts fracture had significant higher range of forward flexion and arm position than the 4 parts, while the preoperative time combined with other parameters of constant score had no significant relation with type of fracture.

In our study, the pain grades were reviewed among our patients where there were significant findings, as the male gender showed less pain than females, patients aged less than 50 years old had suffered less pain than patients older than 50 years old. We could support our findings with abundant evidence from recent epidemiologic studies clearly demonstrates that women are at substantially greater risk for many clinical pain conditions, and there is some suggestion that postoperative and procedural pain may be more severe among women than men **[25]**.

The mean Final constant score was also assessed among all grades of postoperative pain which revealed that although no significant difference was detected between moderate and severe pain, patients with no and mild degree of postoperative pain had significantly more score than the patients with severe pain, added to that the patients with no pain had the higher range score among all patients in the study.

Comparison between patients with 3 parts and 4 parts fractures revealed according to the final constant score that the 3 parts fracture showed more score than 4 parts with significant difference.

In appropriately selected cases, PHILOS appears to provide adequate stability of the fracture fragments and acceptable functional outcome.

Conclusions

Fixation with the locked plate is a near ideal technique with a high union rate in the treatment of proximal humeral fractures as well as it provides good functional outcomes in treatment of proximal humerus fractures, however, the complications are frequent, and careful surgical technique is required to ensure satisfactory results.

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Arthroscopically assisted fixation of lower third femoral fractures with retrograde intramedullary nail: Operative technique

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Abstract

Introduction
The use of retrograde interlocking intramedullary nails has been described for the treatment of selected lower third femoral fractures. Although a closed technique of nail placement has been described, the risks of damaging intra-articular structures with a blind approach have precluded the use of this method. In this article, we present a simple arthroscopically assisted method for the retrograde intramedullary nailing of lower third femoral fractures.
Patients and Methods
From April 2010 to October 2011distal femur fractures of 8 patients (6 males, 2 females; mean age 28 years; range 23 to 56 years) were treated with arthroscopically assisted retrograde interlocking intramedullary nailing. all are closed fractures and not associated with other injuries. The mean time to surgery was 7 days (range 2 to 13 days).
Results: The mean time to union was 14 weeks (range 11 to 17 weeks). One patient (12.5%) had delayed union (24 weeks) who was a heavy smoker. all patients regained normal knee motions within 6-8 weeks except one patient with knee range of motion below 90 degree and he was uncooperative with physiotherapy exercises.
Conclusion
This new method, combining the advantage of arthroscope and retrograde interlocking intramedullary nail,can provide a stable and reliable fixation, and meanwhile is less invasive to the soft tissue and the knee joint , less operative time and blood loss, minimal disruption of the blood supply in fracture site. It is conductive to the fracture healing and the functional recovery of the knee joint and worthwhile to be recommended.

Key Words
arthroscopy, femoral fractures, interlocking intramedullary nail.

Introduction

Femoral shaft fractures are one of the most common injuries following blunt or penetrating trauma to the lower extremity. Femoral nailing has been shown in multiple studies to be a highly effective method of treatment with high union rates and low complications. Over the last 60 years, the technique for interamedullary nailing have been refined to include newer nail design, insertion sites, metallurgy, and interlocking options. What has remained unchanged in that intramedullary nailing of femur is still a highly technical procedure.[1] Recently, the use of retrograde interlocking intramedullary nails has been described for the treatment of selected lower third femoral fractures.[2,3] Favorable results with these devices have been reported ,and they may offer several distinct advantages over traditional plate and screws systems.[2-4] However, a medial parapatellar incision and arthrotomy with its attendant morbidity is generally used for nail placement.[5] Although a closed technique of nail placement has been described, the risks of damaging intra-articular structures with a blind approach have precluded the widespread use of this method.[4] In this article, we present a simple arthroscopically assisted method for the retrograde interlocking intramedullary nailing of lower third femoral fractures (Fig.1 a&b).

Patients and Methods

From April 2010 to October 2011distal femur fractures of 8 patients (6 males, 2 females; mean age 28 years; range 23 to 56 years) were treated with arthroscopically assisted retrograde interlocking intramedullary nailing. all are closed fractures and not associated with other injuries. The mean time to surgery was 7 days (range 2 to 13 days).

Operative technique

The patient was placed supine on a radiolucent table and prophylactic intravenous antibiotics were administered. Examination under anesthesia is essential to assess the instability at the fracture site and how mush effusion inside the knee joint. Standard arthroscopy portals were made and the arthroscope was inserted through the anterolateral portal (Fig.2). Diagnostic arthroscopy was completed first to detect any intra-articular injury. A 3.2mm full-radius resector was inserted through the anteromedial portal and the ligamentum mucosa was debrided to gain better visualization of the intercondyler notch. Next, with the knee joint flexed 90^0 , a 2mm Kirshner(K) wire was inserted through the midline of the patellar tendon (after we confirmed that, this is ideal position for our work, by insertion of a long spinal needle in the same position) to the intercondyler notch (Fig.2). Under direct visualization, the tip of K. wire was placed just anterior to the posterior cruciate ligament insertion and advanced for a short distance under C-Arm guidance into the intramedullary canal of the distal metaphyseal fragment. If the K. wire position was ideal, it should be replaced with a 7mm noncanulated reamer under C- Arm guidance (Fig.3), after enlarging the midpatellar portal (2 cm) to accept the instruments of the next steps. A 9 mm end cutting reamer was placed over the flexible guide wire (Fig.4-5) to do reaming to the estimated diameter. The wire and reamer were removed, and under C-Arm guidance, a flexible guide wire was passed in the standard fashion bridging the fracture site. Flexible reamers were used sequentially from 9 mm to desired measured diameter in 0.5 mm increments (Fig.6), and a selected nail (Fig.7) was placed in the medullary canal (over exchanged guide wire through exchanging tube) under arthroscopic visualization and C-Arm guidance (Fig.8); the guide wire was removed. Fracture reduction was judged adequate without significant shortening or malalignment. Interlocking screws were placed from the lateral aspect of the thigh in the standard fashion. The 3.2 mm full-radius resector was inserted and all loose debris and shavings from the reaming were thoroughly removed (Fig.9). The fat pad through the procedure served as a biological diaphragm providing a (water seal)that maintained adequate pressure and visualization within the knee. The paratenon was re approximated with absorbable interrupted sutures, and the skin incisions were closed in the standard fashion (Fig.10).

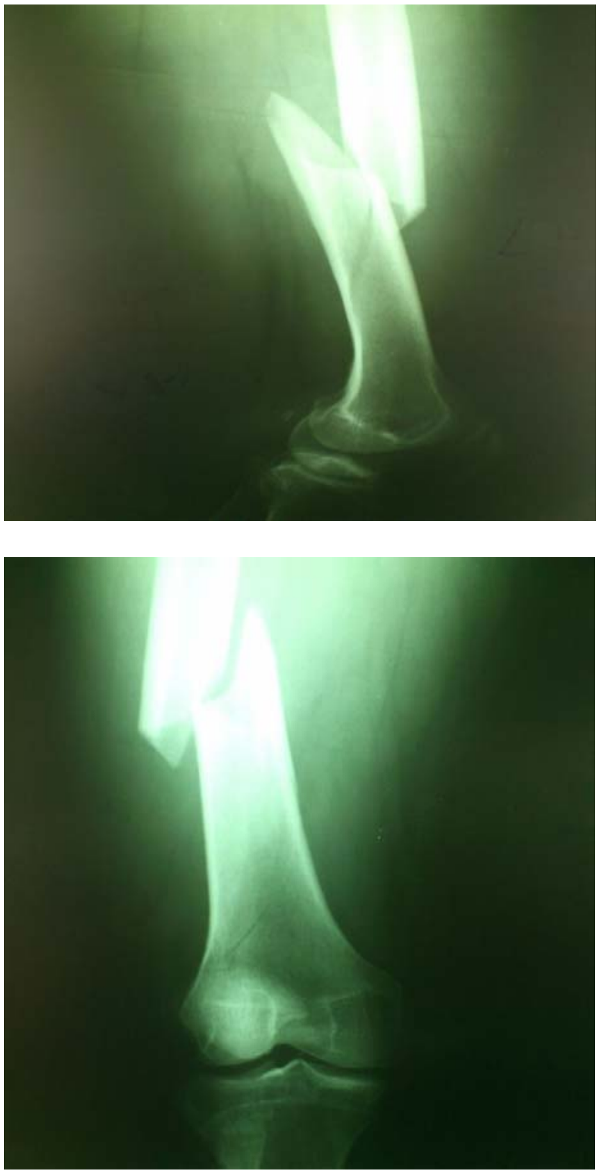

Fig.1 (a-b): Antero-posterior and lateral view of the lower third fracturefemur.

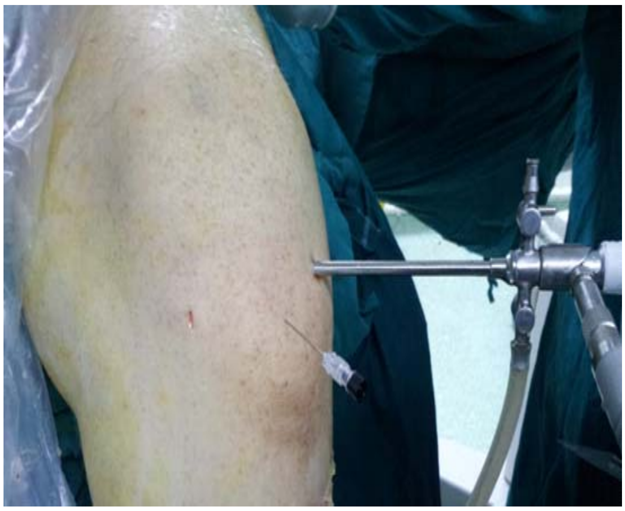

Fig 2: Arthroscope and spinal needle in their position.

Fig 3: C-Arm showing a noncanulated reamer and arthroscopic sheath

Fig 4: Flexible guide wire in the medullary canal.

Fig 5: Flexible guide wire through the patellar tendon.

Fig 6: Flexible reamer over guide wire through the patellar tendon.

Fig 7: Exchanging tube through which the guidewire is exchanged.

Fig 8: Insertion of interlocking intramedullary nail.

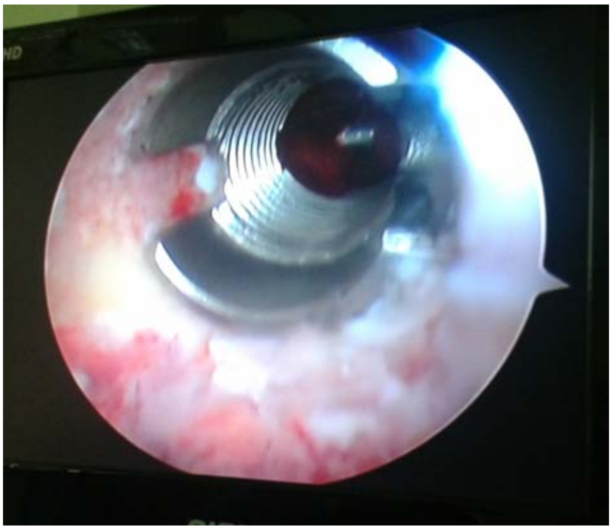

Fig 9: Arthroscopic view of the nail.

Fig 10: Sutured wound with draining tube.

Postoperative Course and follow up:

The patient was discharged from hospital on the second postoperative day with above knee posterior splint for ten days. On the second visit the splint was removed, sterile dressing was done and stitches were removed. The patient was encouraged to do active and passive range of motion as tolerated. Weight bearing was judged by signs of fracture healing.

Results

The mean time to union was 14 weeks (range 11 to 17 weeks). One patient (12.5%) had delayed union (24 weeks) who was a heavy smoker. all patients regained normal knee motions within 6-8 weeks except one patient with knee range of motion below 90 degree and he was uncooperative with physiotherapy exercises. None of the patients experienced wound site problems or infections. One patient developed deep vein thrombosis in the early postoperative period.

Discussion

Retrograde intramedullary nailing has recently been added to the therapeutic options available to the orthopaedist for the treatment of supracondyler femoral fractures. It has been advocated by some as a superior method of fixation compared with fixation with traditional method of fixation.[2-3] However, it usually requires an arthrotomy often through a non-traumatized knee joint.[4] We describe a simple, less invasive, percutaneous method for the placement of a retrograde intramedullary interlocking nial for the treatment of a distal femoral fractures using the assistance of the arthroscope. Open reduction and internal fixation with either blade plate or supracondyler screw-plate systems has become the mainstay of treating supracondylar femoral fractures.[6-7] Like the open treatment of any fractures, opening the fracture site has several disadvantages. These include devitalizing the soft tissue envelope, violating the fracture hematoma and increasing the risk of delayed union, nonunion, implant failure and infection.[6] the closed nailing of selected supracondyler fractures or lower third femoral fractures with the retrograde nail avoid all of the untoward effects of opening the fracture site. In addition, because of the decreased moment arm of the device, it has a biomechanical adventage.[2] Moreover, morselized bone from the intramedullary reaming extravasated into the fracture hematoma and thus, the need for bone grafting may also be obviated. Finally, this device has also been shown to decrease both operative time and blood loss.[3] By placing a retrograde interlocking nail under direct arthroscopic visualization, the potential benefits of intramedullary fixation of these fractures can be achieved while avoiding the morbidity and complications associated with arthrotomy.[4] This less traumatic technique also avoids the risk of injury to intra-articular structures associated with blind, closed placement. In addition, a diagnostic arthroscopy can be performed aiding in evaluating potential associated injuries and proper fracture management. The arthroscopic placement of a supracondyler retrograde interlocking intramedullary nail appear to be the most ideally suited for the treatment of fractures without intra-articular extension.

At the end of the 1980s, retrograde interlocking intramedullary nailing using the intercondyler approach became prevalent for distal femur fractures. Before that period, systems such as the 95° angled condylar wedge plate, dynamic condylar compressive screw, and condylar butress plates were used successfully. Retrograde interlocking nails began to be used after that period and have some advantages and disadvantages. [8] in our study we use the arthroscope to avoid these dis advantage associated with conventional methods and improve the insertion of the retrograde interlocking nail femur in fixation of lower third femoral fractures

The true determination of the nail entrance and maintaining that point as nontraumatic are of great importance. [8,9] we use the scope, such as in our technique , to determine the nail entrance, and internal knee structures can be evaluated. Fracture reduction before applying the nail is very important surgically, because the nail cannot perform reduction by itself.

Retrograde nailing is suitable for obese patients, because more extensive tissue dissection is needed when compared to plates. This can result in significant blood loss, longer operation times, much more scar tissue, and a higher risk of infection; [8,10] in our study no soft tissue dissection was needed as the whole procedure is done arthroscopically assisted.

It is important to remember that vascular injury or pseudoaneurysms can occur due to a squeezed popliteal artery between fracture fragments during retrograde nail application, which has been indicated as a complication.[11] None of our patients had a similar condition reported.

It is essential that the end of the nail not be in the joint space, which may limit knee range of motion. In the study of Gurkan et al, a nail could not be placed exactly in the medulla of the femur in eight patients in (Distal femur fractures of 16 patients), so the nail ends were in the joint space. This resulted in a limited knee range of motion and the results were moderate or poor, except in two cases. This situation was evaluated as a technical mistake, due to inexperience. [12] In our study, a nail entrance was done as the standard site and depth so we had no nail ends in the joint space as the nail is inserted under direct vision .

In our study no cases were infected while results of arthrotomy resulting in knee septic arthritis are about 0-14%. [13]

Conclusions

Arthroscopically assisted percutaneous placement of retrograde intramedullary nails offers many potential benefits over the standard placement using an arthrotomy including earlier ambulation and soft tissue healing, decreased risk of damage to the knee joint, earlier convalescence with decreased hospitalization time and better cosmoses.

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Semitendinosus purse stringing reconstruction for neglected rupture of middle deltoid muscle after open rotator cuff surgery

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Abstract

Purpose
Deltoid muscle detachment may occur after open rotator cuff surgery, it causes severe disability however its treatment usually is non-specific and supportive and the surgical treatment is rarely successful. The purpose of this study is to treat neglected middle deltoid detachment either missed during or occurred after open rotator cuff surgery by semitendinosus tendon auto-graft reconstruction and assesses its clinical results.

Patients and methods
Sixteen patients were collected after one year of open rotator cuff surgery at a university hospital and a private hospital and they were clinically evaluated. They had very low Constant-Murley score; they were investigated and were diagnosed as neglected middle deltoid detachment. Nine patients (group A) were scored and left without surgical interference and seven patients (group B) were scored and re-operated in the period between May 2014 and June 2015. Reattachment was done using semitendinosus tendon graft purse stringed in proximal detached deltoid to be passed in tunnel in acromion. The mean follow-up period was 28.4 months (range 24 – 37). At the final follow up at June 2017; both groups were re-evaluated by Constant-Murley score.

Results
At the end of follow up the median Constant-Murley score was improved significantly in group (B) patients from 62.00 to 85.00, while it is insignificantly increased from 64.00 to 66.00 in group (A) patients. A superficial infection affected one patient and a fracture of acromion occurred in another patient.

Conclusions
Semitendinosus purse stringing reconstruction for neglected rupture of middle deltoid muscle achieves good clinical results and could be considered a valid option of surgical treatment.

Keywords
deltoid muscle - deltoid detachment- surgical treatment
Study design
case series (Level IV evidence)
The conflict of interest
There is no any conflict of interest.

Introduction

Arm elevation is the most important functional movement of shoulder [1]. The lateral deltoid when acting alone is a powerful abductor of the arm in the plane of the scapula. Detachment of its origin weakens shoulder abduction and causes severe disability in daily living and activities [2].

Detachment of the deltoid origin is rarely reported in the literature. It may be traumatic [3, 4, 5], degenerative [6, 7, 8] or iatrogenic [3, 7]. It is the cause of continuous pain, scarce mobility [9] and poor shoulder function and leads to extremely dissatisfied patients[10].

Despite the sever disability, the treatment for deltoid rupture usually is non-specific and supportive [10]. The surgical treatment of deltoid detachment has seldom been successful and the best approach is prevention [3, 4, 10].

Akgün U et al. (2008) recommended reattachment of the deltoid muscle back to the acromion even after 1 year of detachment, but it needs sufficient amount of bone left in the acromion and EMG activity in the muscle and slow postoperative rehabilitation protocol[11].

This study describes a procedure for reconstruction of neglected middle deltoid detachment after open rotator cuff surgery using semitendinosus tendon autograft and assesses its clinical results using Constant-Murley score.

Patients and methods

The study was carried out in the period between May 2014 and June 2017. Patients had failed rotator cuff repair were excluded. Sixteen patients who had done open rotator cuff surgery since one year were collected and clinically evaluated. According to Constant-Murley score and patient satisfaction, the sixteen patients were unsatisfied.

The unsatisfied patients had very low scores, they were re-evaluated by shoulder examination (fig.1), plain x-ray and MRI shoulder (fig.2) and EMG study for axillary nerve and were diagnosed as neglected middle deltoid detachment. They were divided according to surgical interference into group (A) that included nine patients and group (B) which included seven patients.

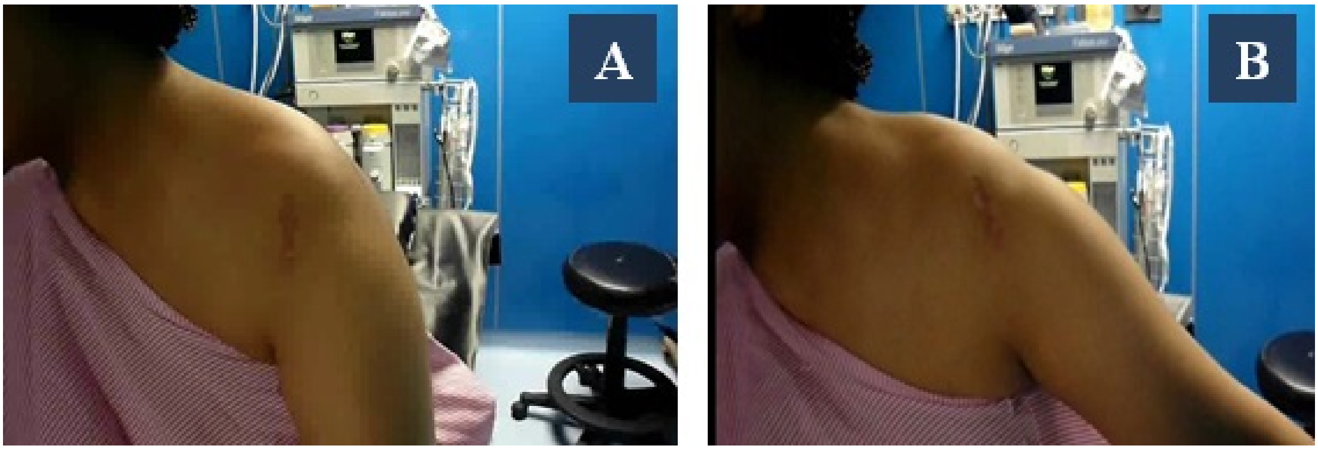

Fig. 1: Female patient after 6 months of open acromioplasty showing skin incision for acromioplasty. Fig 1-A: shows recession of deltoid attachment with loss of shoulder contour. Fig 1-B: shows limited shoulder abduction.

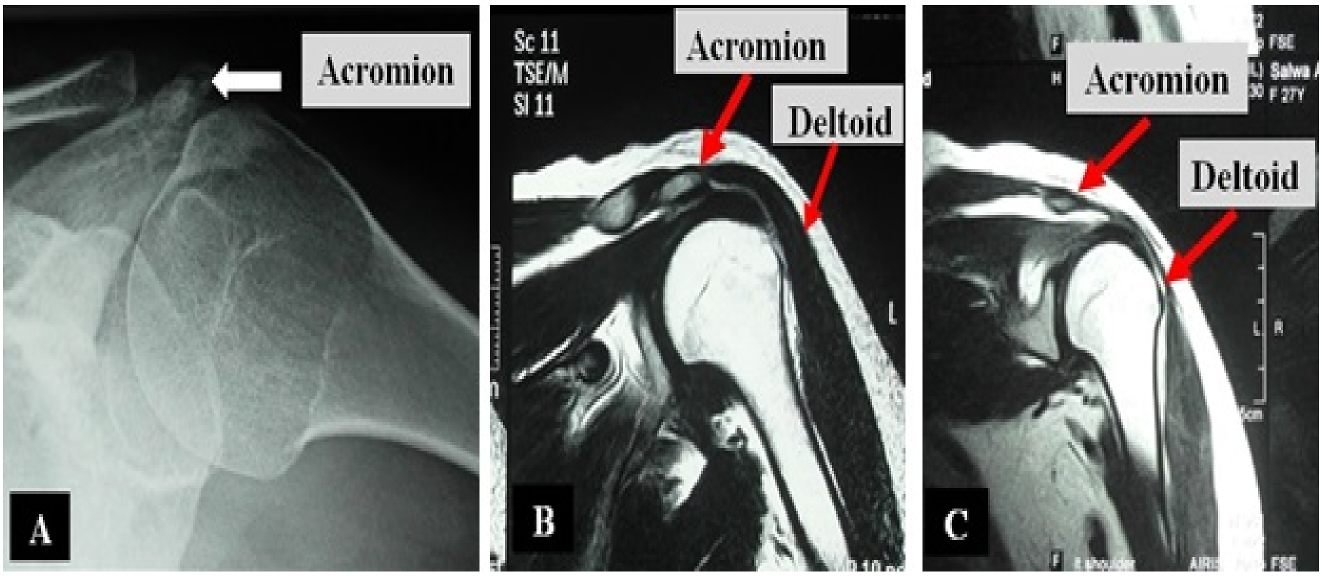

Fig. 2: Pre-reconstruction radiology. Fig 2-A: shows excessive resection of lateral acromion. Fig 2-B: shows acromion and deltoid before acromioplasty. Fig 2-C: shows acromion and deltoid after acromioplasty.

In group (A), five patients were males and four were females, the average age was 47.4 years, three patients had done open acromioplsty alone and six patients had done open acromioplsty and repair of a massive rotator cuff tear**.** In group (B), three patients were males and four were females, the average age was 44.6 years, two patients had done open acromioplsty alone and five patients had done open acromioplsty and repair of a massive cuff tear (tab.1).

Tab.1: patient demography

	group A	group B
no.	9	7
age (year)	47.4	44.6
males	5	3
females	4	4
acromioplsty alone	3	2
acromioplsty and repair	6	5

Patients of group (A) were left without surgical interference and considered a control group and patients of group (B) were re-operated in the period between May 2014 and June 2015 by open reconstruction of middle deltoid detachment using semitendinosus tendon auto-graft.

Postoperative shoulder immobilization was done for three weeks. Then active elevation was started gradually and by 45° increment every week till full elevation. Then muscle strengthening of the shoulder was started. The mean follow-up period was 28.4 months (range 24 – 37) after surgery.

The clinical evaluation was recorded at the final follow up at June 2017 using Constant-Murley score that assigns 15 points for pain, 20 points for activities of daily living, 25 points for strength and 40 points for range of motion: forward elevation, external rotation, abduction and internal rotation of the shoulder.

Surgical technique:

Under general anesthesia and beach chair position, a lazy S shaped incision from just above midpoint of lateral acromion to about 5 cm distally. The middle deltoid and the acromion are exposed. The detached part of deltoid origin is identified.

Creation of acromial tunnel:

exposure of lateral border of the acromion and part of anterior and posterior borders are done. A guide pin 2.7 mm is passed through the acromion from posterior to anterior with the help of ACL aimer. 4.5 mm reamer is passed over the guide pin creating acromial tunnel that passed from posterior to anterior just medial to lateral border of the acromion.

Deltoid dissection:

the detached part of deltoid origin is identified. Blunt dissection of the under surface of the torn deltoid is done. The harvested semitendinosus tendon auto-graft is passed similar to purse string from posterior to anterior in torn part of the deltoid 2 cm a part from its edges. The facial sheath of deltoid is kept to augment the reconstruction. Purse strings of the tendon are passed three to five times 2 cm a part (fig. 3). The free ends of semitendinosus tendon are used for traction and mobilization of torn deltoid up to acromion especially if retracted distally.

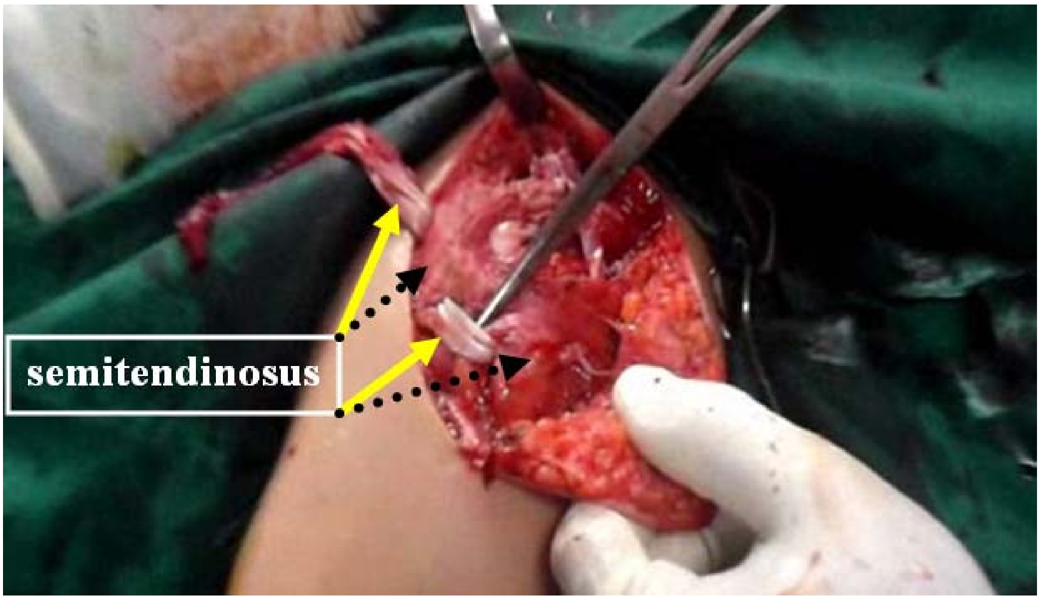

Fig. 3: Semitendinosus tendon graft reconstruction. It shows semitendinosus tendon graft passed under (dotted black arrows) then over the surface of the torn deltoid (yellow arrows) separated about 2 cm from the edges of the torn deltoid.

Fixation:

both free ends of semitendinosus tendon are passed through acromial tunnel after approximation of deltoid to its origin while the arm is abducted then sutured to tendon just outside the tunnel. An interference screw is not used for fear of acromial fracture. Additional sutures between detached deltoid edges and the periosteum of acromion were done.

Statistical analysis:

Data was analyzed using Statistical Package for Social Science software computer program version 20 (SPSS, Inc., Chicago, IL, USA). Quantitative non parametric data were presented in median range. Mann-Whitney test identifies differences and compare between two or more groups. P value less than .05 was considered statistically significant.

Results

The unsatisfied group (A) patients had a median Constant-Murley score of 64.00 and the unsatisfied group (B) patients had a median score of 62.00. At the end of follow up, the untreated group (A) patients had a median Constant-Murley score of 66.00 and the treated group (B) patients had a median score of 85.00 (tab. 2).

Tab. 2: Constant-Murley score of group A and group B

group A (control group)			group B (treated group)		
Patient no.	**baseline score**	**final score**	**patient no.**	**baseline score**	**final score**
1	71	75	**1**	57	83
2	66	66	**2**	62	92
3	56	60	**3**	59	85
4	62	69	**4**	61	75
5	70	72	**5**	72	93
6	69	69	**6**	67	80
7	54	58	**7**	71	90
8	64	66	**-**	-	
9	52	54	**-**	-	
Median	64.00	66.00	**Median**	62.00	85.00
P value	.436		**P value**	.001*	
P value	.000*				

(*: statistically significant)

The improvement of Constant-Murley score was slight, might be due to patient compensation and it was statistically insignificant (P value = .436) in the control group (A) patients. While the improvement of the score is displayed and statistically significant (P value = .001) when comparing between baseline and final scores in the surgically treated group (B) patients (tab. 2).

Also the improvement of the score is apparent and statistically significant (P value = .000) when comparing between the final scores of both groups (tab. 2).

Semitendinosus purse stringing reconstruction for neglected rupture of middle deltoid muscle improved the shoulder pain, abduction, strength and function (fig.4). It improved the Constant-Murley score significantly.

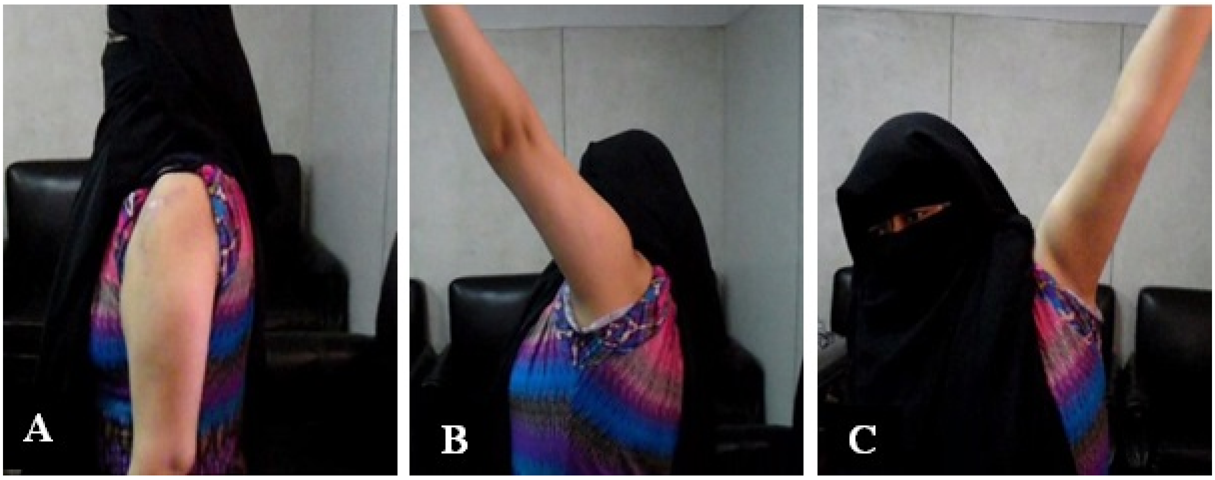

Fig.4: Female patient after 6 months of reconstruction. Fig 4-A: shows lazy s skin incision after reconstruction and improvement of shoulder contour. Fig 4-B: shows arm elevation from the side. Fig 2-C: shows arm elevation from the front.

Complications:

a superficial infection affected one patient, which responds to antibiotic therapy with complete resolution. Another patient had fracture of acromion during creation of acromial tunnel after graft passage, which is immediately fixed by two screws while maintaining the graft in the tunnel.

Discussion

Arm elevation means shoulder abduction in the plane of the scapula. The lateral deltoid is a powerful abductor of the arm, but its line of pull is such that when acting alone it abducts the arm in the plane of the scapula [12].

The anterior deltoid flexes and internally rotates the shoulder. It is unique, important, powerful and irreplaceable muscle of the shoulder [10]. The posterior deltoid extends the shoulder. Loss of function of the posterior deltoid is not a significant problem since the latissimus dorsi muscle will act as the strong synergistic muscle [12].

There have been few reports of rupture of the deltoid muscle in the literature. The traumatic rupture was reported in a man carrying a heavy rail, in a cricket player doing fast-bowling arm movements [3], and in an elderly woman playing golf [4]. Also it was reported due to seatbelt injury during a traffic accident [5]. The pathophysiological mechanism can be explained as sudden self-contraction of the deltoid and direct contusion of the shoulder. The traumatic rupture may also occur due to gunshot injury or cut trauma by sword to lateral aspect of the shoulder.

The degenerative rupture may occur secondary to repeated hydrocortisone injections around the shoulder joint [8] and chronic large rotator cuff tears due to friction between greater tuberosity and undersurface of deltoid [6, 7].

The iatrogenic detachment may occur due to aggressive acromioplasty [7] or detachment during surgical approach. Groh GI et al. [10] recorded after shoulder operations (i.e. acromioplasties, anterior shoulder reconstructions, or arthroplasty procedures) thirty three patients with lost deltoid function after loss of the origin of the deltoid muscle from the clavicle and acromion. Lateral acromionectomy or aggressive acromioplasty provides excellent surgical exposure but weakens and detaches the deltoid muscle origin. Lateral acromionectomy has long been abandoned and adequate acromioplasty is recommended [7].

Deltoid muscle detachment was associated with either acute or chronic massive rotator cuff tendon failure. In addition, deltoid muscle rupture at its origin is a recognized complication of open rotator cuff surgery [13]. But its actual prevalence, time of occurrence and the predisposing causes are still unknown [9].

In one study [13]; deltoid muscle detachment occurred in 8% of cases after 3 months of open repair of massive rotator cuff tears. The detachment occurred in patients aged 47–77 and in 44% of male subjects. But the study excluded a correlation between the detachment and patient age and gender.

Other authors observed, thirty six [10] and twelve [14] cases with deltoid detachment after open repair of massive rotator cuff tears, but no information provided on the total number of patients operated. Iannotti JP (1991) stated that muscle detachment typically occurs in the first 6 weeks after surgery, during the active shoulder rehabilitation period [15].

In this patient population having deltoid muscle detachment, functional disability, loss of strength and decreased range of motion of the shoulder are the predominant complaints. Persistent shoulder pain is usually a secondary complaint [16]. Despite this disability, the treatment for deltoid rupture usually is non-specific and supportive [10]. The surgical treatment of deltoid detachment is rarely successful [3, 4, 10].

Matsen and Arntz (1990) [17] indicate that small detachments less than 3 cm do not require surgery. However, when it is greater than 3 cm, reattachment of the muscle onto the acromion within a short period is necessary. Sher et al. (1997) [14] reported having almost 70% unsatisfactory results and only 4% excellent results after surgical treatment.

Akgün U et al. (2008) [11] recommended reattachment of the deltoid muscle back to the acromion even after 1 year of detachment, but it needs sufficient amount of bone left in the acromion and EMG activity in the muscle, and slow postoperative rehabilitation protocol.

In this study treatment of middle neglected deltoid detachment after rotator cuff surgery by semitendinosus tendon auto-graft reconstruction gives good clinical results and adds a solution for disabling deltoid detachment. And similar to Akgün U et al. (2008) it needs sufficient acromion and normal axillary nerve function [11].

Conclusions

Deltoid detachment may be neglected during or occur after rotator cuff surgery affecting its clinical results. Semitendinosus purse stringing reconstruction for neglected rupture of middle deltoid muscle achieves good clinical results and could be considered a valid option of surgical treatment.

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Is the iliac crest grafting mandatory in the medial opening wedge high tibial osteotomy (MOWHTO)? A comparative study

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Abstract

Introduction
Medial opening wedge (MOW) high tibial osteotomy (HTO) is an established operative procedure to correct varus malalignment among patients with osteoarthritis (OA) of the medial compartment of the knee. However, its popularity was limited for a long time by the need to fill the osteotomy site with bone graft harvested from the iliac crest with its associated morbidity. To address this problem, plates with integrated metal wedges and biomaterials designed to fill the osteotomy site became available.

Hypothesis
it is not mandatory to do autologous iliac crest grafting in medial open wedge high tibial osteotomy in correction of varus malalignment. Our objective to compare the bony union of MOWHTO fixed by Puddu plates in two groups differentiated only by the use or negligence of the use of autologous iliac crest grafting.

Patients and methods
This is a prospective, randomized comparative study that 50 patients divided into two groups operated upon by the same surgeon (RA) between march 2014 and November 2016. Group (A) included 26 patients, 13 males and 13 females with mean age of 36.92±-10.15 years (range 20 –55ys). They had (MOWHTO) with iliac crest grafting. While, group(B) included 24 patients, 11 males and 13 females with mean age of 29.42+ 6.58 years (range 19-42ys.They had (MOWHTO) without iliac crest grafting. Both group were corrected using Puddu plates with block diameters from 8-12mm according to the degree of correction required.

Results
The mean follow up was 53.15+5.18 weeks in group(A) while in group(B) was 48.63+4.03 weeks. The mean Lysholm-Tegner score in group (A) improved significantly from 65.00+5.34 (range 55.00-77.00) preoperatively to 82.03+2.44 while in group(B) it was 63.58+4.95 (range 55.00-73.00) and became 83.16+3.24 and this was statistically insignificant between both groups (P-value=0.182). Mean time to clinical bone union in group (A) was 13.69 weeks and14.45 weeks in group (B) and this difference was not statistically significant (*P-value* =0.827). The postoperative HKA angle in group (A) was 182.53°+1.67 (range 180.00°-186.00°) while in group(B) was 182.33°+1.12 (181.00°-184.00°) and this showed that the target of the study to achieve HKA angle of 184°+2 was fulfilled in 61.5% in group(A) and in 62.5% in group(B) and this was statistically insignificant between the two groups.

Conclusion
Correcting the varus malalignment using Puddu pate with a built-in central metal wedge without iliac crest grafting after a medial opening wedge high tibial osteotomy is a good option without the added iliac crest grafting morbidity. The osteotomy site union and the long term results are satisfactory.

Keywords
Osteoarthritis, High tibial osteotomy, Iliac crest grafting.

Introduction

Medial opening wedge (MOW) high tibial osteotomy (HTO) is an established operative procedure to correct varus malalignment among patients with osteoarthritis (OA) of the medial compartment of the knee [1,2]. The medial opening-wedge high tibial osteotomy (MOWHTO) has multiple advantages: preservation of bone stock; predictable and adjustable correction; easier exposure with avoidance of proximal tibio-fibular joint disruption; fibular nerve palsy; and compartment syndrome. It is easier to combine with other procedures such as anterior cruciate ligament (ACL) reconstruction [3]. The main drawback of

MOWHTO is the creation of a gap in the tibia, which could, in theory, cause problems, such as delayed bone union or correction loss [3]. Bone graft has traditionally been recommended in MOWHTO to avoid those problems [4]. The goal of HTO is to reduce excessive loading of the medial compartment of the knee by correcting the varus deformity, thereby reducing pain and improving function[5,6]. The indications for this procedure have been expanded and now include patients with chronic ligament deficiencies and malalignments [7], as well as patients with varus angulated knees before cartilage procedures or meniscus transplantations [8]. The autologous bone graft remains the gold standard procedure with results quite superior to allografts or bone substitutes [9,10]. Stability plays a major role in the process of bone union . Structural autologous bone graft was used not only for biological properties, but also to add stability to the construction [11]. Serial plain radiographs demonstrated that the healing process occurs progressively from the lateral hinge to the medial side of the tibia, filling the gap with callus [12]. Lateral closing wedge osteotomy, popularised by Coventry in the Anglo-American literature [13] and by Judet in France [14] was the technique of choice for many surgeons. However, although this technique seems easy to perform, it carries with it a number of issues such as the need to perform a fibula osteotomy, the risk of compartment syndrome or injury to the common peroneal nerve, malunion of the proximal tibia and the potential of inaccurate bony resection resulting in a failure to achieve the preoperative objective of correcting the deformity with acceptable precision [15]. The opening wedge medial osteotomy, described in France by Debeyre and Artigou in 1972 [16], avoids the majority of the issues associated with closing wedge osteotomy. However, its popularity was limited for a long time by the need to fill the osteotomy site with bone graft harvested from the iliac crest with its associated morbidity. To address this problem, plates with integrated metal wedges [17] and biomaterials designed to fill the osteotomy site became available. The disadvantages of locking plates are the high cost and the need for a second surgery to remove them, due to their large size [18]. Our hypothesis is that it is not mandatory to do autologous iliac crest grafting in medial open wedge high tibial osteotomy in correction of varus malalignment. Our objective to compare the bony union of MOWHTO fixed by Puddu plates in two groups differentiated only by the use or negligence of the use of autologous iliac crest grafting.

Patients and methods

This is a prospective, randomized comparative study that 50 patients divided into two groups operated upon by the same surgeon (RA) between march 2014 and November 2016. Group (A) included 26 patients, 13 males and 13 females with mean age of 36.92±-10.15 years (range 20 –55ys). There were 13 right knees and 13 left knees. Mean body mass index (BMI) was 33.25±6.53 (range 20.3 – 41.3). They had (MOWHTO) with iliac crest grafting. While, group(B) included 24 patients, 11 males and 13 females with mean age of 29.42+ 6.58 years (range 19-42ys), there were 15 right knees and 9 left knees. Mean body mass index (BMI) was 29.49 + 5.01(range 19.5 -39.2). They had (MOWHTO) without iliac crest grafting. Both group were corrected using Puddu plates with block diameters from 8-12mm according to the degree of correction required. This study was approved by the local ethics committee. All participants signed a voluntary consent form. The randomiztion was done through a computer software. The inclusion criteria were varus malalignment of the limb, associated with osteoarthritis and pain limited to the medial side of the knee that did not improve with conservative management while the exclusion criteria were age over 60 years; anterior or lateral knee pain; symptomatic patellofemoral chondrosis; limited knee motion (10° extension lag or flexion less than 90°); previous knee surgery, advanced knee osteoarthritis higher than grade 3 by the modified Albäch's classification [19,20]; inflammatory or infectious diseases; diabetes or other conditions that impair bone healing. The radiological assessment was done using AP, lateral and skyline views. For assessing the degree of arthritis, the modified Albäch staging system was used. In group(A), there were 2 stage I knees (7.7%), 8 stage II (30.8 %) and 16 stage III (61.5%) while in group(B) , there were 2 stage I knees (8.3%), 10 stage II (41.7 %) and 12 stage III (50%). The angle of axial deformity (HKA angle) was measured on weight-bearing long-leg alignment views. Preoperatively, the mean HKA angle was 170.96º + 2.44 (range166 º - 174 º) in group(A) while in group (B) it was 171.45º+1.31 (range 168º - 173º). For the functional assessment, the Lysholm-Tegner score was used preoperatively and postoperatively. The mean score in group(A) preoperatively was 65.00 +5.34 (range 55.00-77.00) while in group(B) was 63.58 +4.95 (range 55.00- 73.00)

Operative technique: The objective was to obtain an HKA angle of 184°±2°. A wedge prepared from tracing paper was used to simulate the medial opening wedge and identify the size of the central block of Puddu plate needed and superimposed over the long leg alignment radiographs having 100% magnification. The intraoperative judgement of correction was done using a plastic endotracheal tube placed over the center of the femoral head and using the image intensifier to judge the axis using the diathermy wire extending it from the center of the femoral head done to the center of the ankle. According to the size of the tracing paper wedge, we determine the size of the Puddu plate needed. If a wedge size was 10°, we used 10mm Puddu plate to open 10° and stabilize the osteotomy. The patient was placed in the supine position, underwent epidural anesthesia, and was prepared as usual. Arthroscopy was carried out for exclusion of extensive osteochondral lesion and associated meniscal tears . Bone graft was harvested from the opposite iliac crest in all patients. Osteotomy was performed according to the classical description [2], fixed using Puddu stainless steel plate and screws. Group A patients had the gap filled with impacted cancellous graft. Group B had the gap unfilled. **Postoperatively,** the limb was kept elevated and anticoagulant drugs were used. On the first day after surgery, patients started a rehabilitation program and free movement was stimulated. Non-weight-bearing movement was maintained for 6 weeks. After that, the patient was allowed to walk without crutches according to pain and tolerance. Time to bone union was assessed by two blinded investigators, according to Apley and Solomon's criteria [21], which consider a fracture united when there is absence of pain on local palpation, absence of swelling in the limb, painless walking without crutches, and radiographic presence of a bridging callus between fragments. They performed assessments separately every 2 weeks until both agreed that the osteotomy was united. Postoperative radiographs for postoperative assessment of the HKA angle and detection of lateral tibial cortex breakthrough on non-weight bearing x-rays performed immediately after surgery and 6 months postoperatively. Correction loss was considered when there was a decrease of 4° or more [22]. For statistical analysis, we used the chi-squared test or Fisher's exact test to compare the qualitative variables and the Mann-Whitnaey test to compare quantitative variables. The level of significance (p value) was 0.10. Statistical analysis was performed using SPSS (version 13.0; SPSS Inc., Chicago, IL, USA) including analysis of long-term survivorship. Univariate survivorship analysis was done according to the Kaplan-Meier method.

Results

The patients' demographic data of both groups is shown in table [1]

Table 1: showing the patients' demographic data

	Group(A) (N=26)	Group(B) (N=24)
Age	**36.92±10.15**	**29.42±6.58**
BMI	**33.25±6.53**	**29.49±5.01**
Male	**13**	**11**
Female	**13**	**13**
Right knee	**13**	**15**
Left knee	**13**	**9**
Smoker	**12**	**6**
Albäch classification Albäch 0 Albäch 1 Albäch 2 Albäch 3	-- **2** **8** **16**	-- **2** **10** **12**
Size of Puddu plate wedge 8mm 10mm 12mm	**7 (26.9%)** **10(38.5%)** **9(34.6%)**	**6(25%)** **11(45.8%)** **7(29.2%)**

The mean follow up was 53.15+5.18 weeks in group(A) while in group(B) was 48.63+4.03 weeks. The mean Lysholm-Tegner score in group (A) improved significantly from 65.00+5.34 (range 55.00-77.00) preoperatively to 82.03+2.44 while in group(B) it was 63.58+4.95 (range 55.00-73.00) and became 83.16+3.24 and this was statistically insignificant between both groups (P-value=0.182). Mean time to clinical bone union in group (A) was 13.69 weeks and14.45 weeks in group (B) and this difference was not statistically significant (P-value =0.827). The postoperative HKA angle in group (A) was 182.53°+1.67 (range 180.00°-186.00°) while in group(B) was 182.33°+1.12 (181.00°-184.00°) and this showed that the target of the study to achieve HKA angle of 184°+2 was fulfilled in 61.5% in group(A) and in 62.5% in group(B) and this was statistically insignificant between the two groups. Regarding the complications, in group(A) there were 4 cases (15.3%) of lateral tibial cortex disruption while in group (B) there were 3 cases (12.5%) and this had not any effect on either the postoperative rehabilitation or final result. Also, there were 6 cases of extension lag in group (A) compared to 5 cases in group(B). Delayed union occurred in 3 cases in group(A) and 2 cases in group(B) which eventually ended by complete union after delaying the weight bearing for an average of 6 weeks. 2 cases suffered from DVT in group (A) versus 3 cases in group (B) inspite of the postoperative use of the anticoagulants and they were successfully treated till recanaliztion again. Failure of fixation (screw breakage) occurred in 2 patients in group(A) as well as 3cases in group (B) with subsequent loss of correction in 2 cases in group(A) (7.7%) and and also 2 cases in group(B) (8.3%) this was due to the high BMI in these patients and not following the correct postoperative instruction and they were managed by revision surgery to correct their deformity one year later.

Discussion

Medial opening wedge high tibial osteotomy (MOWHTO) represents the gold standard treatment for medial compartment osteoarthritis of the knee in a young person. Proper patient selection with a meticulous surgical procedure provide satisfactory results. Omitting the need for iliac crest grafting in MOWHTO worth to be considered since it avoids the morbidity associated with iliac crest grafting as well as reducing the operative time. Many studies had shown the bony union of the osteotomy site without iliac crest grafting using rigid locked plates [12,18] taking in consideration the cost of the rigid locked plates and the need for the removal of such bulky hardware. The use of the Puddu plate in MOWHTO offers many advantages like the reduced cost and the small profile of the plate compared to the bulky rigid locked plates. A main point of concern about the success of Puddu plates in providing the stability at the osteotomy site is the need to keep the lateral cortex of the proximal tibia intact acting like a hinge. Our preoperative objective was to obtain HKA angle 184º+2 since the overcorrection is better than the undercorrection and this affects the longevity of the osteotomy [23,24]. In our study, disruption of the lateral cortex of the proximal tibia occurred in 4 cases in group(A) (15.3%) and 3 cases in group(B) (12.5%) however, this had not affected the postoperative rehabilitation or the final outcome. In group(A) with iliac crest grafting, the time to bone union was faster (13.69 weeks) than in group(B) (14.45 weeks) but this was statistically insignificant and did not justify the need for iliac crest grafting with its associated comorbidities. Assessment of the radiological union is a difficult issue. The use of autologous bone grafting at the osteotomy site hinders the ability to judge the internal callus formation at the osteotomy site. The use of Apley and Soloman criteria of bone union was very helpful in assessing the bone union and consoiladation [21,25]. Regarding the complications in our study , they were similar with the recorded complications [26,27] in the literature like the extension lag which occurs as a result of the elevation of the tibial slope inspite of applying the wedge of the plate as far posterior as possible ,the screw breakage and loss of correction were due to the high BMI and carelessness in following the strict postoperative regulation for weight bearing. Also the occurance of DVT in this study inspite of the routine use of injectable anticoagulants however this was early detected and managed. The results of our study are similar to the results obtained in some series [9,28,29,30], better than those reported in other series [31,32,33] and inferior to others [34,35,36]. Practically, it is difficult to compare different series since they are not matched and the evaluation criteria are not the same and the principal outcome is usualy variable.

A B C

Fig. 1: A: Complete osteotomy site union. **B:** Immediate postoperative osteotomy without iliac crest grafting (AP and lateral views) . **C:** Case of MOWHTO with iliac crest grafting.

Conclusion

Correcting the varus malalignment using Puddu pate with a built-in central metal wedge without iliac crest grafting after a medial opening wedge high tibial osteotomy is a good option without the added iliac crest grafting morbidity. The osteotomy site union and the long term results are satisfactory.

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Radiolucent and fracture tables in the treatment of slipped capital femoral epiphysis. comparative study

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Abstract

Background
The goal of pinning in slipped capital femoral epiphysis is to stabilize the epiphysis to the femoral neck to prevent further slippage. Both fracture and radiolucent tables can be used during fixation of the slipped epiphysis.
Patients and methods
A retrospective study on 22 patients with mild stable SCFE who undergo pinnig insitu was conducted to see if there was any difference between slips treated on a fracture table and those treated on a radiolucent table. All patients were treated by single screw fixation of stable slipped capital femoral epiphysis (SCFE), the patients were matched for age and size in each group.11 patents were treated on a radiolucent table and 11 patients were treated on a fracture table. The two groups were compared regarding the total surgery time, the anesthesia time, the time of radiation exposure and the number of images taken during surgery.
Results
The mean surgery time was (24.64 ± 5.30) minutes, the mean fluro time was (51.45 ± 8.78) seconds using radiolucent table. The mean surgery time was (27.27 ± 5.16) minutes, the mean fluro time was (58.27 ± 8.20) seconds using fracture table.
Conclusion
There is no statistical significant difference between two groups.

Key Words
Slipped capital femoral epiphysis, fracture table, radiolucent table

Introduction

Slipped capital femoral epiphysis is the most common hip disorder in the adolescent age group. The incidence is approximately 2 cases per 100,000 persons. Boys are affected more often than girls. The average age at which SCFE develops in girls is 12.1 years and in boys is 14.4 years [1]. The patient who can walk either using crutches or not is classified as stable [2]. The aim of treatment of SCFE is to stabilize the physis by epiphysiodesis and to prevent complications by using a single centrally placed screw [3,4,5,6]. The procedure can be done using either a radiolucent table or fracture table. The aim of this study is to analyze if there is significant difference from screening the hips during in situ pinning on either radiolucent or fracture table.

Patients and methods

A retrospective study of 22 patients with mild stable SCFE who undergo pining insitu with a single screw using a radiolucent table or fracture table was conducted. The patients were matched for age and size in each group.11 patents were treated on a radiolucent table and 11 patients were treated on a fracture table.Table1

Operative Technique

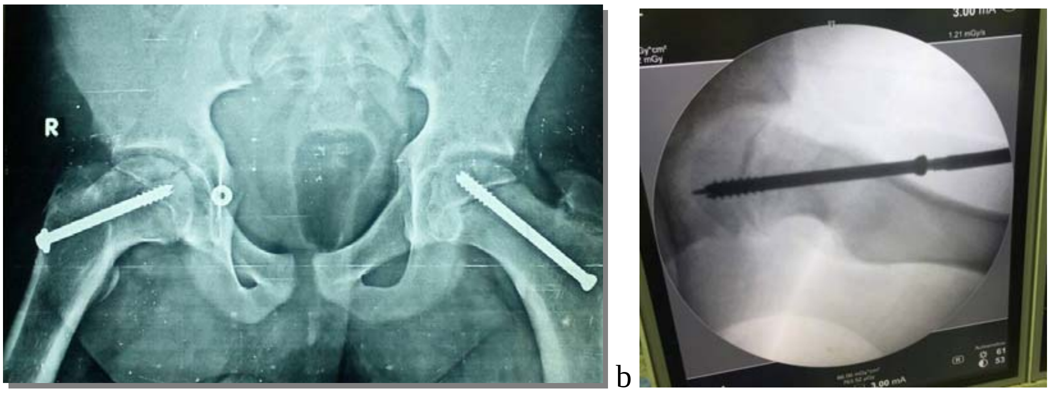
The patient is placed on either the fracture table or radiolucent table (Figure 1a-c), the limb is then prepared and draped, A guidewire is placed on the surface of the affected limb and the skin is marked with marker in the AP and lateral views, It is known that in SCFE, the femoral neck is relatively retroverted and the epiphysis is displaced posterior. A guidewire is inserted percutaneously at the intersection of the lines drawn on the skin and advanced to the base of the femoral neck. The location and orientation of the guidewire should be confirmed fluoroscopically. The ideal placement of a single screw is as close to the center of the capital epiphysis and as perpendicular to the physis as possible (figure 2a). The entry point of the screw must be anterior at the base of the femoral neck, and the screw is directed posteriorly into the centre of the capital epiphysis (figure 2b). With severity of the slip, the entry point will be found more superior and anterior on the femoral neck. Stabilisation using multiple screws was not found to provide advantages over pinning using a single screw. [7] The guidewire is advanced into the epiphysis, aiming at the exact center of the femoral head on both fluoroscopic views without encroaching on the joint space. The guidewire is measured and a partially threaded 6.5 mm stainless steel or titanium cannulated screw appropriate length is selected. The bone is drilled and tapped. The position must be checked by image during drilling and tapping so that the guidewire is not penetrated the joint nor withdrawn from its channel. The screw is inserted over the guidewire. After satisfactory placement of the screw has been confirmed, the guidewire is removed and the incision closed. Protected partial weight bearing with crutches is allowed as soon as the patient is comfortable. The patient uses crutches for 6 weeks. As the pain resolve completely, activities are allowed after 3 months.

Table 1: patient data

pt	age	sex	side	BMI	table	Surgery time	Anesthesia Time	Fluro images	Fluro Time
1	10	F	L	23	R	20	50	25	40
2	9.5	F	L	24	R	25	55	28	50
3	9.8	M	R	30	R	22	45	35	65
4	11	M	R	26	R	28	60	22	49
5	12.6	F	R	29	R	32	60	24	40
6	13.8	M	R	33	R	36	55	22	44
7	14.9	M	L	37	R	22	50	30	55
8	14.2	M	R	38	R	24	45	37	65
9	13	F	L	33	R	20	60	40	59
10	11.7	M	R	30	R	20	65	25	49
11	10.3	F	L	28	R	22	55	26	50
12	9.2	M	L	26	F	26	45	33	55
13	12.5	M	L	32	F	30	60	30	70
14	13.7	M	R	36	F	38	60	32	66
15	14.1	M	L	36	F	32	55	25	55
16	12.8	F	R	26	F	26	45	27	49
17	11	M	R	27	F	28	50	30	66
18	10.5	F	L	29	F	22	55	44	69
19	9.6	F	L	30	F	20	60	29	56
20	9.8	M	L	32	F	22	60	37	70
21	13.8	F	R	36	F	26	55	26	49
22	12.3	M	L	36	F	30	55	25	50

a b c

Figure 1: a: patient position on fracture table b: patient position on radiolucent table AP c: patient position on radiolucent table lateral



a b

Figure 2: a:Position of screws. b:anterior position of the screw entry.

Results

Twenty two children with stable mild SCFE were treated using insitu single screw fixation.11 children were treated on radiolucent table and 11 children were treated on fracture table.

There were 13 males and 9 females. There were 12 slips on the left side and 10 slips on the right side. The BMI was ranged from(23-38),the mean was (30.77 ± 4.46).The age of surgery was ranged from (9.2-14.9) the mean age was (11.82 ± 1.82).The surgery time ranged from (20-38) minutes, the mean time was (25.95 ± 5.28).The anesthesia time ranged from (45-65) minutes, the mean anesthesia time was (54.55 ± 5.96).The number of fluoroscopic images ranged from (22-44), the mean images was (29.64 ± 5.93).The fluoroscopy time ranged from (40-70) seconds, The mean was (55.50 ± 9.49). (Table2,3)

The Radiolucent Table

The mean age of surgery was (11.89 ± 1.92). The mean surgery time was (24.64 ± 5.30) minutes. The mean anesthesia time was (24.64 ± 5.30) minutes. The mean number of fluoroscopic images was (28.55 ± 6.20). The mean fluoroscopy time was (51.45 ± 8.78) seconds. (Table 4)

The Fracture Table

The mean age of surgery was (11.75 ± 1.80).The mean surgery time was (27.27 ± 5.16) minutes. The mean anesthesia time was (54.55 ± 5.68) minutes. The mean number of fluoroscopic images was (30.73 ± 5.73). The mean fluoroscopy time was (58.27 ± 8.20) seconds. There was no statistical significance difference between using radiolucent table or fracture table regarding all the measured variants. (Table 4)

Table 2: Patient data

	Range	**Mean ± SD**
Age	9.20 – 14.90	11.82 ± 1.82
BMI	23 – 38	30.77 ± 4.46
Surgery time	20 – 38	25.95 ± 5.28
Anesthesia time	45 – 65	54.55 ± 5.96
Fluro images	22 – 44	29.64 ± 5.93
Fluro time	40 – 70	55.50 ± 9.49

Table 3: Patient data

	No	%
Sex		
Male	13	59.1%
Female	9	40.9%
Side		
Right	10	45.5%
Left	12	54.5%

Table 4: Results with selected variables

	Radiolucent Table	**Fracture Table**	**t**	**P**
Age	11.89 ± 1.92	11.75 ± 1.80	0.172	0.865
BMI	30.09 ± 4.87	31.45 ± 4.13	0.708	0.487
Surgery time	24.64 ± 5.30	27.27 ± 5.16	1.183	0.251
Anesthesia time	54.55 ± 6.50	54.55 ± 5.68	0.0	1.0
Fluro images	28.55 ± 6.20	30.73 ± 5.73	0.857	0.402
Fluro time	51.45 ± 8.78	58.27 ± 8.20	1.883	0.074
Sex				
Male	6 (54.5%)	7 (63.6%)	χ^2=0.188	0.665
Female	5 (45.5%)	4 (36.4%)		
Side				
Right	6 (54.5%)	4 (36.4%)	χ^2=0.733	0.392
Left	5 (45.5%)	7 (63.6%)		

Statistical Analysis

The collected data were coded, processed and analyzed using the SPSS (Statistical Package for Social Sciences) version 15 for Windows® (SPSS Inc, Chicago, IL, USA). Qualitative data was presented as number and percent. Comparison between groups was done by Chi-Square test. Quantitative data was presented as mean ± SD and Range. Student t-test was used to compare between two groups. P < 0.05 was considered to be statistically significant.

Discussion

The goal of pinning in slipped capital femoral epiphysis is to stabilize the epiphysis to the femoral neck to prevent further slippage. Both fracture and radiolucent tables can be used during fixation of the slipped epiphysis.The advantages of using radiolucent table are minimal maneuvering of the image intensifier device inside the room and decrease the operation room setup by not using the traction device. It is also easier in bilateral cases, better visualization of lateral views.Easier to put the hip through a wide range of motion when assessing for pin penetration of the joint without breaking the sterile field. But there is a possibility of breakage of guide wires [8] which may increase the need for a small incision through the fascia lata to prevent this tissue from bending the guidewire when flexing and abducting the hip, and difficulty in obtaining a true lateral fluoroscopic view of the hip. The advantages of using the fracture table are there is no need to frequently adjust the limb for imaging in two planes, and there is the no need to assistant to hold the limb or move it.[9] percutaneous technique with minimal visible scarring can be used. Disadvantages include inability to move the limb freely to confirm no pin encroachment of the hip joint before the end of the procedure, potentially greater difficulty visualizing the femoral epiphysis in the true lateral position; and awkward positioning and draping procedures (usually staged) with bilateral slips.

Lee et al [10] described the insitu pinning using a radiolucent table,they proposed the advantage of minimize the overall surgery time. **Aronson et al [11]** reported series in which they used the fracture table and emphasized how they got the advantages of not manipulating the limbs and easiness of pinning. **Blaiser et al [12]** compared the use of radiolucent and fracture tables, where 36 patients were treated on fracture table and 29 patients were treated on radiolucent table.They found that using the radiolucent table is a useful tool alternative to fracture table and reported that the time spent for surgery is significantly greater using fracture tables. **Carney et al [13]** reported on their study on 20 patients that there was no significant difference between the two groups but reported that the mean anesthesia and surgery time was greater using fracture tables. **Riazuddin etal [14]** reported on their study on 51 hips that the radiation exposure doses using the radiolucent tables are less than doses exposure using fracture tables.

This study compared the results of pinning in situ in stable slipped capital femoral epiphysis,using either a radiolucent or fracture table. There were no significant difference between them regarding the total surgery time, the total anesthesia time, the number of images taken and the total fluoroscopic time.

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