

Management of intraoperative avulsion femoral condyle fractures during total knee arthroplasty.

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Abstract

Introduction

Risk factors for periprosthetic fractures include osteoporosis, anterior cortical notching, female gender, advanced age, and chronic steroid use. There is little known in the literature about intraoperative femoral avulsion fractures and their outcome. We so tried to report the incidence, probable causes, and our management of intraoperative femoral avulsion fractures in a series of cases with end-stage knee osteoarthritis reported in our center.

Patients and methods

We reviewed 997 total knee arthroplasty done at Ain Shams university hospitals between November 2015 to January 2020, We reviewed the occurrence of intraoperative avulsion fractures and described the fracture location, cause of the fracture, intraoperative management, type of the implant, and the postoperative outcomes.

Results

The overall risk of femoral condyle fractures in total knee arthroplasty was 1.7 percent. Radiological healing of the fracture was noted in the anteroposterior and lateral radiographs in all cases after a mean period of six weeks. Functional outcome score in the form of the knee society score recorded with the mean score of 85 at 3 months of follow up.

Conclusion

The risk of intraoperative avulsion femoral fractures although not that high, but may lead to a serious intraoperative complication and failure of epiphyseal femoral component fixation. Careful and gentle handling of prosthesis trialing and application also during exposure is required to avoid such complications especially in the elderly with weakened bone.

The Egyptian Orthopedic Journal; 2020 supplement (1), June, 55: 94-97

Introduction

Osteoarthritis is degeneration of the articular cartilage that occurs with age or secondary to other causes as trauma, infection, and other inflammatory diseases. With the increase in the mean age of the elderly population and an increase in patient's demands for a better lifestyle, a safe joint replacement procedure is always required in end-stage arthritis. [1-3] Various complications can occur with total knee arthroplasty as infection, periprosthetic fractures, deep venous thrombosis, prosthesis loosening, and dislocation. [4-6]

The occurrence of periprosthetic fractures in total knee arthroplasty is well known. Risk factors include osteoporosis, anterior cortical notching, female gender, advanced age, and chronic steroid use. There is little known in the literature about intraoperative femoral avulsion fractures and their outcome. Fractures can potentially occur at any stage of the total knee arthroplasty including bone preparation, placement of trial components, cementation, insertion of the final tibial and femoral components, and seating

of the polyethylene insert.

Intraoperative femoral avulsion fractures will change the method of postoperative rehabilitation and hence the postoperative outcomes: [7-9]

So, we tried to report the incidence, probable causes, and our management of intraoperative femoral avulsion fractures in a series of cases with end-stage knee osteoarthritis reported in our center.

Patients and methods

We reviewed 997 total knee arthroplasty done at Ain Shams university hospitals between November 2015 to January 2020 and reported the occurrence of intraoperative femoral avulsion fractures.

We reviewed the occurrence of intraoperative avulsion fractures and described the fracture location, cause of the fracture, intraoperative management, type of the implant, and the postoperative outcomes.

Intraoperative fractures can be treated conservatively, or with internal fixation, or with change the prosthesis from non-constraint to constraint prosthesis according to the extent of the fracture and stability of the prosthesis. All our cases treated with open reduction internal fixation using plates and screws.

We found 17 knees with intraoperative avulsion femoral fractures. The prosthesis was NexGen fixed-bearing prosthesis in twelve cases and constrained condylar prosthesis in five cases with both tibial and femoral stems.

12 patients who develop avulsion femoral fractures noticed to have osteoporosis as documented by DEXA scan, four of them were not able to walk for 3 months before the operation

All the patients had a preoperative deformity, 9 cases have varus deformity, 5 cases had combined varus and flexion deformity, while 3 patients had a valgus deformity, these deformities caused tight knee which leads to femoral condyle fractures, especially adequate soft tissue release was not done in most of the cases

Intraoperative avulsion fractures occurred within medial femoral condyle in 14 cases, while fracture lateral condyle occurred in 3 cases.

we found that 9 cases of fractures occurred during trial prosthesis, 3 cases during cementation with impaction in full extension[18], 5 cases during application of definitive polyethylene insert.

All cases were treated with open reduction internal fixation using a 3.5mm T-shaped plate. Fixation was done after the final application of definitive prosthesis. the fractures were reduced using reduction forceps clamps (fig.1) and fixed with 3.5 mm T- shaped or L-shaped plates (fig.2). Care was taken so that the direction of the plate screws was not hindered by the presence of the stem.



Fig. 1: medial femoral condyle fracture during application of definitive insert.

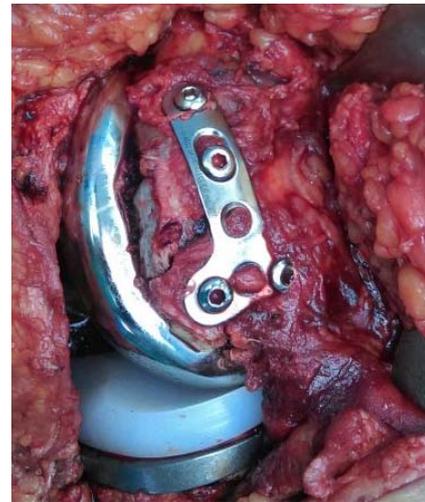


Fig.2: Fixation of condylar fracture by 3.5mm plate & screws.

As regards postoperative rehabilitation, hinged knee brace application from the first day after the operation until 6 weeks with partial weight-bearing using walker, after that full weight bearing allowed. ROM started at 3 weeks post-operative ranging 0-30 degree

- At 4 weeks 0-60 degree
- At 5 weeks 0-90 degree
- At 6 weeks 0-120 degree

Follow up done using knee society score every week till six weeks, then at twelve weeks, then at 6 months post-operative.

Radiological follow up for fracture healing was reported after antero-posterior and lateral radiographs (fig. 3).



Figure 3: X-ray showing fracture healing at follow up.

Results

There were 17 cases of intraoperative avulsion femoral fractures 13 (76.4%) females and 4 (23.6%) males with mean age 65, medial femoral condyle avulsion fractures occurred in 14 cases (82.3%), while lateral femoral condyle avulsion fractures occurred in 3 cases only (17.7%). The patients were undergoing total knee arthroplasty for knee osteoarthritis with NexGen fixed-bearing prosthesis in twelve cases (70.5%) and constrained condylar prosthesis with stems in five knees (29.5%). The mean postoperative knee society score at 3 months was 85 (table 1).

Table 1: Patient demographics and clinical data.

Number:	17 patients
Male : Female	4 (23.6%): 13 (76.4%)
Nexgen fixed-bearing prosthesis	12 cases (70.5%)
Constrained condylar prosthesis	5 cases (29.5%)
Medial condyle avulsion fractures	14 cases (82.3%)
Lateral condyle avulsion fractures	3 cases (17.7%)
Mean Knee Society score	85

The overall risk of femoral condyle fractures in total knee arthroplasty was 1.7 percent, from them, 82.3% fracture medial condyle with mean preoperative coronal alignment 15 degrees varus alignment, while 17.7% fracture lateral femoral condyle with mean preoperative coronal alignment 10-degree valgus alignment.

We found that 12 cases (70.5%) of patients who developed femoral condyle avulsion fractures had osteoporosis, four of them (23.5%) were not walking for 3 months before the operation.

Nine cases (53%) of femoral condyle avulsion fractures occurred during trial prosthesis, three cases (17.6%) of fractures occurred during cementation with impaction in full extension, while five cases (29.4%) occurred during the application of definitive polyethylene insert.

Radiological healing of the fracture was noted in the antero-posterior and lateral radiographs in all cases after a mean period of six weeks. Functional outcome score in the form of the knee society score recorded with the mean score of 85 at 3 months of follow up.

Discussion

Risk factors for intraoperative fractures include patients with weak bone due to various bone weakening

diseases either metabolic diseases as osteoporosis or inflammatory as rheumatoid arthritis or avascular necrosis of bone. [13,14] In this study, we noticed that patients with severe osteoporosis, especially those who are not walking for a long period before the operation are more liable for intraoperative fractures. Lombardi et al. reported forty cases of intraoperative femoral condyle fractures and believed the cause was the improper placement of the intercondylar box cutting jig which was placed either medial or lateral weakening the medial or lateral femoral condyle [15] Alden et al. has reported forty-nine cases of intraoperative femoral fractures with the overall incidence of intraoperative fractures of 0.39% with fractures more common in females (80%), femur (73%), and more in the medial femoral condyle (30%). [16]

The prosthesis design may influence the risk of intraoperative condyle fractures in total knee arthroplasty. As Lombardi suggested that the box cutting jig of NexGen posterior stabilized prosthesis may increase the risk of intraoperative condylar fractures. [15] The most common time for intraoperative fractures is during exposure and bone preparation (39%) and while testing the trial components is (33%) especially in the weak bone due to osteoporosis, inflammatory arthritis, and avascular necrosis of the bone as a secondary cause of knee osteoarthritis. [16]

In our case series, we reported 17 knees with avulsion femoral fractures, which is different than total condylar fractures, while total condylar fractures are considered a formal type of periprosthetic fractures which mostly occurred due to bone weakening during the surgical procedure as reported by Lombardi et al. , avulsion femoral fractures are just cortical avulsion from femoral condyle and mostly attached to the corresponding medial or lateral ligament.

The avulsion fractures were more common in females 76.5%. From the all femoral condyle fractures, 53% occurred during trialing of the femoral components in weak bones, on the other hand, 17.6% occurred during cementation with impaction in full extension, while 29.4% occurred during the application of definitive polyethylene insert.

Severe varus deformity with tight medial collateral ligament, besides, combined varus and flexion deformity are two main risks in our series that lead to intraoperative avulsion fractures especially during trial reduction or impaction of the prosthesis, it may be due to incomplete release of the medial ligament which leads to tight medial compartment.

We thought that avulsion femoral fractures are more common in Egyptian population as most of the patients are obese, less active, besides, the degree of

deformity at the time of operation in most of the cases was more than 20-degree varus, thus increase the risk of osteoporosis and difficulties of intraoperative surgical release and hence the risk of avulsion fractures.

The management of intraoperative fractures during total knee arthroplasty follows many protocols. However, the general principle of treatment is to fill the bone defect either with stable fixation of the fractured fragment or to use constrained prosthesis with an augment and stem to bypass the metaphyseal fracture with a stem to achieve diaphyseal fixation to overcome the metaphyseal weakness.

In our cases, all cases managed with plate fixation which let the fracture stable, the philosophy behind the fixation is to reduce the avulsed fragment, keep medial ligament stable until complete fracture union.

There are little data about the outcomes of the management of intraoperative fractures during total knee arthroplasty due to a little number of cases. Alden et al. reported improvement in knee society score after their management of the fractures from 34 preoperatively to 61 postoperatively. Other studies reported the improvement in mean knee society score from 46 to 80 and functional scores of 71 and 78.⁽¹⁶⁾ In our series we also reported good radiological and clinical healing of the fractures with the mean knee society score of 85. All fractures achieved radiological union by the third month postoperative with regaining the desired range of motion.

Conclusion

The risk of intraoperative avulsion femoral fractures although not that high, but may lead to a serious intraoperative complication and failure of epiphyseal femoral component fixation. Careful and gentle handling of prosthesis trialing and application also during exposure is required to avoid such complications especially in the elderly with weakened bone.

Finally, our recommendation to decrease the risk of such fracture is an adequate efficient release of the medial ligament in tight knees, together with small plastic insert during the trial may decrease stresses at medial compartment during impaction and lead to decrease the risk of fractures, the constrained prosthesis should be prepared in every case which carries the risks of intraoperative fractures.

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