Management of physeal injuries around the ankle in Children

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Abstract

Background
In children, the physis tends to be more susceptible to damage than the surrounding tissues .traumatic ankle injuries are more likely to cause injury to the physis or bone than to ligaments during childhood ankle injuries are very common in children and are second only to wrist and hand injuries in children between the ages of 10 and 15.
Patients and methods
This was a prospective randomized study carried out on 38 cases with traumatic injuries of the distal tibial epiphysis, 28 cases (74.4%) were males and 10(25.4%) were females. The age of the patients ranged from 4_17 years with a mean of 10 years and 9 months. With closed and open distal tibial physeal fracture. 6 cases Salter Harris types I, 17 cases type II, 11 cases type III, 4 cases type IV. Management of the fracture depends on its type and initial displacement
Results
Salter_Harris classification had a high prognostic value. Type I had the best prognosis, type II guarded prognosis, type III poor prognosis and type IV the worst prognosis. Open injuries have worse end results than closed.
Conclusions
Salter_Harris classification had a high prognostic value; Results of open injuries are less favourable than closed injuries regardless of its types. Reduction should be atraumatic and anatomic. Age, sex and side affected had no statistical significant effect on the prognosis.

Keywords
Ankle, physeal injuries, management.

Introduction

Hippocrates was the first to speak about separation of the epiphysis in an indefinite manner and Realdus colombus noted the possibility of occurrence of epiphyseal separation in sixteen century.[1] Hales in 1727 was the first to detect that bone grew in length at their ends and so Duhamel in 1742 and john Hunter in 1760.[2]

The distal tibial ossification centre appears at six to twenty-four Months of age. The distal tibial physis closes during an eighteen months period centrally, then medially, and finally laterally with closure complete at the chronologic age of fifteen years in girls and seventeen years in boys.[3]

Ankle fractures account for approximately 5% of paediatric fractures and 15% of physeal injuries. Most of ankle injuries are caused by an indirect mechanism. Direct mechanism is rare such as axial compression but could lead to serious sequelae.

The incidence of physeal fractures has been estimated at 17.9% of all fractures that occur in children. They are more common in older children with a peak incidence at 11–12 years of age. Salter- Harris type I displacements made up 8.5% of injuries, SH- type II fractures 73%, SH-type III fractures 6.5%, type IV fractures 12%, and type VI fractures less than 1%. Complication rates are dependent upon the type of fracture.[3]

Patients and methods

This was a prospective randomized study carried out on 38 cases with distal tibial epiphyseal injuries admitted to al talaba sporting insurance hospital in Alexandria from 1/1/2016 to 1/1/2018 with follow up period up to six months. This study included males more than female with an approximate ratio of 3 to 1. The youngest patient was 4 years old, while the oldest was 17 years old, with an average of 10 years and 9 months; the high incidence was in the age group 10-15 years. The cases were presented with pain, swelling, inability to bear weight and limitation of ankle movements. The initial treatment was done within the first 24 hours after trauma in most of the cases. 6

cases were presented with open injuries and 32 cases were presented with closed injuries. Salter-Harris type II was the most common type. Most of cases 78% were presented with displacement less than 2mm.

14 cases (36.84%) were managed conservatively. 7 cases (50%) were kept in plaster of Paris without manipulation. 7 cases (42.9%) were managed by one trial of closed reduction under general anaesthesia and only 1 case was subjected to more than one manipulation up to 2 trials. 16 cases (42.11%) were immobilized for 6 weeks, and 22 cases (57.89 %) were immobilized for 8 weeks. Most of the cases started weight bearing after pain relief which varied much among peoples, though they were instructed not to bear weight all over the period of immobilization. surgical treatment was applied for 24 cases (63.15%) ; 10 cases of them (26.3%) were of Salter and Harris type III and IV who showed displacement more than 2 mm, the remaining 14 cases (36.85%) were of irreducible type I and II. The implants used were: malleolar screw in 4 cases (10.52%), kW in 20 cases (52.63%),

Follow up period: 6 months.

Method of assessment of the results:

*** Functional and clinical assessment.**

The results was been assessed according to the method proposed by Olerud-Molander[(4)]which is a functional ankle score. This assessment will include functional clinical data, and the results will be classified into: excellent, good, fair and poor.

Radiological assessment:

a) Initial X-ray:

A-p view, Lateral view and Mortise view. To detect:

At time of trauma: Type according to Salter-Harris classification, Initial displacement and associated injuries.

b) At end of follow-up to detect: Deformity of the ankle, Residual displacement, non union and Osteoarthritis of the ankle.

Case1

Figure 1: Plain x-ray (AP, lateral and mortise views) of a 7 years with distal tibial physeal fracture SH_I associated with distal fibular fracture.

Figure 2: Postoperative x-ray (AP, lateral and mortise views) of the same patient. With the fractured fixed by closed reduction and pinning by KW.

Case2

Figure 3: Plain ray (AP view) of 10 years old male patient with distal tibial physeal fracture SH _type III.

Figure 4: Postoperative x_ ray (AP, Lateral, Mortise views) of the same patient after closed reduction and percutaneous cannulated screw.

Case 3

Figure 5: Plain ray (AP and lateral views) of 11 years old patient with distal tibial physeal fracture SH_II.

Figure 6: Postoperative x _ray of the same patient with the fracture fixed by closed reduction and pinning.

Results

Excellent results were encountered in 20 cases (52.6%), good results in 4 cases (10.5%), fair results in 13 cases (34.2%) and poor results in 1 case (2.7%).

Excellent and good results were considered as satisfactory results. While fair and poor results were considered unsatisfactory results.

The results were found to be affected by:

*** open injuries** which had (83.3% unsatisfactory results)

*** type according to Salter_Harris classification**; where SH_I had the best prognosis (83.34% satisfactory results), SH_II had a guarded prognosis (70.6% satisfactory results), SH_III had a poor prognosis (64 %satisfactory results), while type IV had the worst prognosis (100 unsatisfactory result)

*** Residual displacement**; where up to 1mm displacement in intra_articular fractures had (71.4%) unsatisfactory results and 2mm displacement had (100%) unsatisfactory results.

*** Number of manipulations:**

Cases which were casted without manipulation gave better results (100% satisfactory) than those which subjected to one trial (50%satisfactory).while those which subjected to more than one trial had less satisfactory results (100% unsatisfactory). This proved that excessive manipulation add more injury to the epiphyseal growth plat

There was no significant statistical relation between the results and sex, age and side affected.

The complications of that type of injury were studied; chronic pain was detected in 12 cases (31.6%), Limping was detected in 11(29%) cases, limitation of ankle movement was detected in 4 (10.5%) cases.

Angular deformities and limb length discrepancy were no detected due to the short period of follow_up.

Discussion

In some references, the age ranged from one year and one month to 15 years and six months, with a mean of 12 years and 5 months. The effect of age was insignificant. [10]

While in this series, the age ranged from 4 years to 17 years with a mean of 10 years and nine months. In this study, age had no significance effect on results. The end results between males and females were nearly the same (64%, 60% satisfactory results respectively). And it was found that sex had no significant effect on the results.

In some references [5,7] it was stated that the treatment should be done within a matter of hours of the accident. Other authors [6]' stated that it is wiser to accept an imperfect reduction than to risk the danger of open reduction or forceful manipulation except in intra_articular types (type III, type IV) where delayed reduction although non desirable is preferable than leaving the intra_articular fragment displaced. In this work initial treatment was done in the majority of cases (86.8%) during the first 24 hours, and only 5 cases (13.2%) were treated in the 2nd 24 hours after trauma. However, the effect of time lag was insignificant in this study.

Some authors [10] found good prognosis in Salter_Harris type I, II and type III. Type IV carries a bad prognosis unless the epiphyseal plate is completely realigned, and type V had the worst prognosis.

In this study, the type of injury had affected the re-

sults significantly. Salter_Harris type I had more satisfactory results (83.34%), because there was no affection of the growth plate. Type II had a guarded prognosis depending upon whether growth plate had been affected or not. The results in this work coincided with the pre_mentioned items. Type III and IV had unsatisfactory prognosis even if displacement is minimal (1mm).

Controversy exists about the prognosis of intra_articular types (III, IV), although some reports obtained satisfactory results when residual displacement was 2mm[7] , other obtained unsatisfactory results even if the displacement was 1 mm.[8]

The last finding had been proved in this study. This could be explained by the development of bony bar between metaphysis and epiphysis, incongruent joint surface and the affection of the growth plate itself. Paul et al,[9] stated that cases with Salter-Harris type I injuries can be immobilized in a short leg cast immobilization for 3-4 weeks with full weight bearing all over immobilization period. Cases with Salter-Harris type II, need long leg cast immobilization for 4-6 weeks with weight bearing in the latter half of immobilization period. Type III and IV, need long leg cast immobilization with the knee flexed for 4-6 weeks. Salter et al [10] stated that epiphyseal injuries do unite in about half the time required for union of fracture through the metaphysis of the same bone at the same age group. In this work, immobilization period for type I was 6 weeks, other types had a period of immobilization of 8 weeks. Rockwood et al, [5] recommended up to two trials of close manipulation. In this study, most of cases were manipulated once and those which subjected to more than one trial (7.1%) had less satisfactory results. this proved that excessive manipulation add more injury to the epiphyseal growth plat. Some authors,[5] who recommended open reduction and internal fixation in intra_articular epiphyseal fractures used a smooth pins of small diameter placed in one epiphyseal fragment in to the other or placing the pins in to the metaphyseal portion of the fracture as stated by Salter [10], other authors, published a research work of 20 cases with open reduction and internal fixation with smooth pins with net results of 95% good results and only 5% bad results which was due to the development of bony ridge. In this research work, 7 cases were managed by open reduction and internal fixation; 2 cases of them were irreducible Salter_Harris type II, 3 cases were irreducible Salter_Harris type III, 2 cases with Salter_Harris type IV. Various types of implant were used. Only 3 cases (42.85%) gave satisfactory results due to improper choice of implant, traversing the epiphyseal growth plate by implants or presence of residual gap which did not obliterated completely. It has no statistical significant effect, being small number and using various types of implants. Many authors[11]. found that open injuries had less satisfactory results and this coincided with the end results of this work, where open injuries had (16.66%) satisfactory results and this was due to the affection of vascular supply to the epiphyseal growth plate and premature growth arrest with the effect of infection on the growth plate itself.

Complications

Limitation of ankle movements: 4 cases in this thesis ended by limitation of movements more than 10 degrees.

Limping: It was recorded in 11cases (29%), which were considered as unsatisfactory cases.

Chronic pain: It was detected in 12 cases (31.6%) which were considered as unsatisfactory results. It was explained by loss of smooth joint surface.

Angular deformity: In this work, angular deformity cannot be assessed because of the short period of follow up.

leg length discrepancy: It was difficult to be detected due to the short period of follow up.

Conclusions

Salter_Harris classification had a high prognostic value. Type I had the best prognosis, type II guarded prognosis, type III poor prognosis and type IV the worst prognosis.

Results of open injuries are less favorable than closed injuries regardless of its types.

Reduction should be atraumatic and anatomic.

Age, sex and side affected had no statistical significant effect on the prognosis

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