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Retrospective observational study comparing treatment options in salter and harris type III epiphyseal fractures

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Abstract

Background: The treatment of Salter & Harris type III epiphyseal fractures remains controversial.

Methods: We undertook a retrospective observational study to compare effectiveness, safety and duration between non-operative treatment and ORIF (opened reduction and internal fixation) with K wires for Salter & Harris type III epiphyseal fractures in male and female children.

A total number of 93 children from the database of one hospital center, Hospital Doctor Peset, Valencia were considered with the diagnosis of Salter & Harris type III epiphyseal fracture with their respective treatment and its duration.

Results: According to the data that was collected and at the end of the follow-up period, patients who underwent non-operative treatment recovered significantly shorter period of time than those patients who underwent operative.

Conclusion: Patients who underwent non-operative treatment had led to a shorter recovery period in comparison to those who underwent operative treatment. The recovery for both treatment groups was good. The use of K wires for surgical treatment is a safe and reliable intervention and should be considered for patients who sustain this injury.

Keywords: salter & harris type III, epiphyseal fractures, K wire, non-operative

Introduction

S-H type III fractures are considered on the borderline between surgical and orthopaedic treatment. Considering that SH type III and IV are intraarticular fractures, we tend to propose an open reduction procedure as the most effective treatment. Our study will explore and compare the different option treatments for SH III fractures. ^[1-2]

Materials & Methods

▪ Data Source

Non-operative management was compared with ORIF (opened reduction and internal fixation) mainly with AK wires for Salter&Harris type III epiphyseal fractures in a retrospective observational study ^[3]. Patients in the study included those with confirmed diagnosis and sufficient recovery time lapse in order to compare different types of treatments applied in these fractures.

The data was obtained from the patient database of Hospital Doctor Peset, Valencia, where past clinical histories from acute-care department up to clinical follow-up from years 2013 till 2016 were screened according to precise criteria.

▪ Inclusion and Exclusion selection criteria

Inclusion criteria were an age of 0 to 15 years, both males and females, with confirmed diagnosis of Salter-Harris type III epiphyseal fracture visible in radiological images in any part of joint growth plates in the anatomy. Confirmation of the diagnosis was done by clearly outlined fracture paths in X-Ray images.

This age span was set in order to maximise the amount of patients included in the study as both genders often have open cartilage growth plates at age of 15. Prolonging the age of selection above 15 could have biased the results as most female patients have closed growth

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plates at ages of 16^[4]. The exclusion criteria were those with unconfirmed diagnosis, associated fractures that could lead to confusion, and previous fracture around the same area.

A total of 93 patients were obtained from the hospital's database from January 2013 to December of 2016. There were 43 male patients and 50 female patients.

▪ Treatment variables

We studied two types of treatment which we considered as key variables in order to compare the children's fracture recovery outcomes.

Non-operative Treatment

The patients with SH type III fractures were treated according to the site of injury. Patients with digital affectation were treated with a digital splint; patients with distal lower and upper limb fractures were treated with orthopaedic plaster cast and closed reduction of the fractures with controlled fluoroscopy imaging. Patients with iliac crest fractures were managed in a conservative way with relative bed rest with support on lower limb according to pain.

All forms of physical activity were suggested to be avoided until cast or digital splint was removed and analgesic treatment was prescribed.

The period of orthopaedic treatment was 3 weeks, followed by a check-up with the orthopaedic surgeon to evaluate pain symptoms and complete mobility.

Results

Table 1: Results comparing operative and non-operative groups.

Baseline Characteristics	Operative	Non-operative
Age at injury		
Male	-	12.0 ± 2.6
Female	11.9 ± 1.6	10.3 ± 2.0
Sex		
Male	0	43
Female	7	43
Limb Affected		
Upper	3	58
Lower	4	28
Side of Injury		
Right	1	48
Left	6	38

The operative cases of this database were all female (n=7), 4 of the 7 cases being distal tibia fractures and 3 cases of the base of metatarsal carpal of the first finger of the hand, performing a ORIF with K-wire followed by cast to protect the K-wire from further complications.

In the male group, 14 of the total 43 patients suffered left upper limb affectation and 13 of 43 suffered right upper limb affectation. 5 of the 43 suffered left lower limb affectation and 11 of the 43 suffered right lower limb.

In the female group, 15 of the total 50 patients had suffered left upper limb affectation and 19 of 50 suffered right upper limb affectation. 10 of the 50 suffered left lower limb fractures and 6 of the 50 suffered right lower limb.

Children with distal radius epiphyseal fractures were treated with a posterior cast for 3 weeks; children with distal ankle and fifth metatarsal fractures were treated with posterior sural-pedic cast for 3 weeks. There was 1 case of olecranon epiphyseal fracture which was treated with a posterior brachial-forearm cast. Also, one case of iliac crest fracture was treated conservatively with bed rest for 3 weeks.

Operative Treatment

From the database only 7 patients, all being female, were treated with surgical procedures. Operative treatment was applied according to site of injury, including K-Wire by ORIF (opened reduction and internal fixation) mainly and Lag Screws in some complicated cases where complete anatomical reduction was not possible.

These patients were, then, appointed to follow-up after a month of the surgery. The follow-up carried on until 6 weeks when these patients were appointed again for removal of K-wire.

▪ Outcomes

Various important outcomes were analysed from both orthopaedic and surgical treatment groups.

The principal outcome was the time for full recovery from the moment of the primary treatment up to the last date of follow-up or removal of the K-wires, if the patient underwent operative treatment.

Other outcomes were searched including complications during the healing period and the functional mobility recovered after the healing period.

Information was collected on a wide range of potentially confounding covariates like type of procedure, open fracture association and comorbid diseases that could affect the correct osteosynthesis of the fracture (Table 1).

Complications of Operative Group

During the follow-up of the physal fractures which required surgical treatment, the following complications arose in the all the seven female patients (Table 2):

1. Infections: mostly dermic-epidermic due to K-wires. 2 of the 7 patients suffered severe cellulitis around the K-wire, which were further tested for microbiological microorganisms with Gram and culture medium; both cases resulting positive *Staphylococcus spp*, despite prescribing antibiotic treatment before, during and after surgical procedure.
2. All patients complained about pain in a regular basis due to K-wire protruding into the skin.
3. One of the seven patients had severe limitation of complete movement of the articular joint, hence the patient underwent a vigorous rehabilitation programme to recover mobility.
4. Post removal treatment of K-wire resulting in physal plate growth disruption and affectation in growth pattern issues in one of the patients.

Table 2: Table with complications of the operative group

Complications of operative group	Complications	No.
Serious		
	Infections	2
	Limited joint mobility	1
	Disruption growth plates	1
Not serious		
	Pain	7
	Minor Scar	7

Conclusions

- Main conclusion that can be extracted is that the orthopaedic treatment may be the most appropriate approach to S-H type III fractures.
- There is a clear risk of complications involving surgical treatments in these fractures. Many of the fractures are treated at the acute emergency moment and this might rise the rate of complications.
- Female patients are often more prone to be treated with open reduction. The fact that female growth plates close earlier might push the surgeon to consider a more anatomical reduction of the fracture.
- Patients who underwent non-operative treatment had led to a shorter recovery period in comparison to those who underwent operative treatment
- Further studies with a bigger sample database are required to establish a clear treatment pathway.

Discussion

Children with SH type III may be treated following either surgical or conservative approaches. Both groups demonstrated clear benefits considering most of the physeal fractures heal quickly and functionality is mostly succeeded [5].

However, our study shows that the most common treatment to handle these fractures is mainly non-operative. This occurs in most other children-based pathologies involving bone trauma (SH I and II) [6].

If we consider other studies and case-following series involving SH III fractures, we can clearly deduce there is a strong tendency on leaving the surgical treatment in a second scene. Surgical treatment exposes the patient to an increased risk of infection and other postoperative pathologies than can potentially worsen the healing forecast of the fracture and the overall patient's health [7].

The fact that a surgical postoperative complication may compromise the children's health makes the operative treatment a second line option. Considering that the non-operative procedure is both effective and quick at consolidating the fracture we should consider SH type III fractures as no surgical pathologies [9]. This assumption can be the key in order to organise and standardise protocols on those hospitals where children fractures accounts for a big volume of the trauma pathology.

Nevertheless, surgical treatment can sometimes be considered as a first option [8-10]. The age range we are considering SH III fractures is very wide, thus the physeal growth plates have progressively less bone totipotency. Therefore, children aged above 13-15 years may bring some debate whether to treat non-operative or operative; on these cases we should individualise depending on the physical maturity of the patients. Surgical treatment may have some benefits on ager children as the anatomical reduction obtained can withstand the lesser potential growth of the physeal plate compared to those younger children were an accurate anatomical

congruency is not strictly necessary [12-13].

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