The Influence of Assisted Fixation on Pain Relief for Subtrochanteric Femur Fractures in Children

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Research article

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Abstract

Background : Subtrochanteric femur fractures of children usually recover slower than the intertrochanteric femur fracture and tends to increas the rate of deformity. The difference among treatment options in postoperative pain level should be considered as a crucial factor while tailoring patients' therapeutic schedules, but has not been paid enough attention to. This study aimed to evaluate and compare the postoperative pain level of hip spica casting, abduction brace and skin traction as assisted fixation to operative interventions.

Methods

Forty-seven children with subtrochanteric femur fractures on one side were admitted and divided into three groups according to the different assisted fixation they received. Operating time, intraoperative blood loss, follow-up time, postoperative fixation time, days in hospital, time to union, Harris scores, CHEOPS scores (before treatment, after treatment and at the last follow-up time) and VAS scores (before treatment, after treatment and at the last follow-up time) were collected.

Results

No significant difference of demographic characteristics data was found between the three groups before treatment($P > 0.05$). After treatment and at the last follow-up time, the CHEOPS scores and the VAS scores of the three groups were all significantly lower than before($P > 0.05$). But there is still no difference between the three groups($P > 0.05$).

Conclusion

Hip spica casting, skin traction and abduction brace have the same ability to relieve the pain of subtrochanteric femur fractures in children.

Background

Subtrochanteric femur fractures of children occur at the near quarter of the femur or 2–3 cm below the lesser trochanter [1–4]. It occurs less often in children with injuries relatively [2]. This type of femur fracture is usually caused by high-energy trauma in children [2, 5, 6]. Because of the special anatomical feature of the subtrochanteric region that it is not well vascularized, the recovering of this type of fracture is usually slower than the intertrochanteric femur fracture [5]. And the muscle strength tends to change the position of small fragments into a flexed, abducted and externally rotated one increasing the rate of deformity [2, 7, 8]. In pediatric orthopedics, treatment for subtrochanteric femur fractures can be divided into two main categories, operative interventions and conservative management. The former includes Elastic Stable Intramedullary Nailing (ESIN) and locking compression plate. The latter includes hip spica casting, abduction brace and skin traction [9–11]. No single management can secure a satisfactory outcome with no complication [2, 9, 12–15]. Nowadays, those management options are usually

performed at the same patient to pursue a better outcome [13, 16–18]. However, the postoperative pain management has still not been paid enough attention to [19, 20]. The difference among those management options in postoperative pain level should be considered as a crucial factor while tailoring patients' therapeutic schedules. The purpose of this study was aim to evaluate and compare the postoperative pain level of spica casting, abduction brace and skin traction as assisted fixation to operative interventions.

Methods

The patients who were admitted to the Department of Orthopaedics in authors hospital between July 2009 and July 2019 were enrolled. These patients were among the age of 1.6 to 10.9. They all suffered from subtrochanteric femur fractures on one side.

Either ESIN or locking compression plating was used as main treatment. The parents gave their formal consent for the surgery and assistant fixation which they would accept after being explained the advantages, disadvantages and the potential complications of each technique. This retrospective study was approved by ethical review board in author's institutional and all the patients' parents gave their informed consent.

All the patients were divided into three groups according to assisted fixation. And each group was divided into two subgroups according to operative management. Group cast (GC) consisted of eighteen patients, consisting of ten males and eight females with the age range of 2–9.5 years (a mean age of 4.656 years). Group traction (GT) involved fourteen patients, consisting of eight males and six females with the age range of 3.2–10.9 years (a mean age of 6.821 years). Group brace (GB) consisted of fifteen patients, consisting of eight males and seven females with the age range of 1.6–7.7 years (a mean age of 4.247 years), which are listed in Table 1.

Table 1
Demographic characteristics data of participants

	Group cast	Group traction	Group brace
Number	18	14	15
Male	10(56%)	8(57%)	8(53%)
Female	8(44%)	6(43%)	7(47%)
Average age(range)	4.66(2-9.5)	6.82(3.2–10.9)	4.25(1.6–7.7)

Twenty-nine patients received ESIN as main treatment. Standard closed nailing placement were performed after the abducted proximal fragmentand the adequate reduction of flexed, externally rotated was confirmed. Eighteen patients received locking compression plating as main treatment. For the locking compression plating group, the fracture end was achieved through the back side of the musculus

vastus lateralis. Eighteen patients received hip spica cast as the assisted fixation. With the limb in 10–15°external rotation and the hips at 20–30°of flexion, patients were applied with a one-and-a-half spicain in the operating room under general anesthesia. Physical therapy was used after the removal accordingly. Fourteen patients received skin traction as the assisted fixation. The limb should be supported in neutral alignment. Gentle manual traction should be applied when skin was extended. The skin traction should be applied to the medial and lateral sides of the limb. Fifteen patients received abduction brace as the assisted fixation. The abduction brace included a fixation frame and adjustable screws. The inner and outer plates were placed on the Steinmann Pins. The patient should be at a 30-degree-outreach position during the whole treatment.

Experienced nurses collected and completed the CHEOPS, VAS and Harris questionnaires according to patients' symptoms.

The data were presented as means and standard deviations. A one-way analysis of variance (ANOVA) was used to compare the characteristics of age, operating time, intraoperative blood loss, follow-up time, postoperative fixation time, days in hospital, time to union, Harris scores, CHEOPS scores (before treatment, after treatment and at the last follow-up time) and VAS scores (before treatment, after treatment and at the last follow-up time) between and within the three groups. A paired sample t-test was used to compare the CHEOPS and VAS scores at different time points in each group. A independent samples t-test was used to compare the CHEOPS and VAS scores at different time points between different operative management. It was considered statistically significant that P values were less than 0.05. SPSS software version 22.0 for Windows was used for statistical analysis.

Results

Forty-seven children among the age of 1.6 to 10.9 years were recruited in this study. They all suffered from subtrochanteric femur fractures on one side. Either ESIN or locking compression plate was used as main treatment. The patients were divided into three groups according to assisted fixation. Each of the three groups was divided into two subgroups according to operative management. There were no statistically significant differences in operating time, intraoperative blood loss or follow-up time between the three groups (Table 2). The age of the cast group (GC), the traction group (GT) and the brace group (GB) were 4.66 ± 1.97, 6.82 ± 2.51 and 4.25 ± 1.48, respectively. The postoperative fixation time for GC, GT and GB were 4.67 ± 0.69, 8.00 ± 0.78 and 8.00 ± 0.93, respectively (Table 2). The participants in GC were significantly younger than those in GT and GB ($P < 0.05$). The postoperative fixation time of GC was significantly shorter than that of GT and GB ($P < 0.05$). The differences result from the characteristics of the assisted fixation and the tolerance of children at different ages (including the preference of parents).

Table 2
Comparison of some data between the cast group, the traction group and the brace group

	Group cast	Group traction	Group brace	p value
OPtime(min)	78.44 ± 18.31	80.00 ± 17.01	74.53 ± 33.29	0.814
Blood loss(ml)	46.94 ± 29.30	56.21 ± 36.35	49.80 ± 28.34	0.704
Followup(m)	49.44 ± 25.53	44.21 ± 20.46	36.40 ± 19.66	0.257
Age(y)	4.66 ± 1.97	6.82 ± 2.51	4.25 ± 1.48	0.003
FixTime(w)	4.67 ± 0.69	8.00 ± 0.78	8.00 ± 0.93	0.000
HospitalDay(d)	8.22 ± 3.34	10.79 ± 6.67	11.13 ± 9.75	0.420
UnionTime(w)	12.06 ± 0.54	12.79 ± 2.19	11.87 ± 0.52	0.132
Harris	94.56 ± 1.92	93.57 ± 1.87	93.67 ± 1.95	0.274
PreCHEOPS	2.00 ± 0.00	2.07 ± 0.27	2.00 ± 0.00	0.314
PreVAS	3.78 ± 0.43	3.86 ± 0.53	3.87 ± 0.35	0.816
PostCHEOPS	1.00 ± 0.00	1.00 ± 0.00	1.00 ± 0.00	——
PostVAS	1.83 ± 0.38	1.93 ± 0.47	1.93 ± 0.26	0.695
FinalCHEOPS	0.06 ± 0.24	0.36 ± 0.50	0.13 ± 0.35	0.073
FinalVAS	0.33 ± 0.49	0.29 ± 0.61	0.27 ± 0.46	0.929

Before treatment, the CHEOPS scores for GC, GT, and GB were 2.00 ± 0.00, 2.07 ± 0.27, and 2.00 ± 0.00, respectively, and those for VAS scores were 3.78 ± 0.43, 3.86 ± 0.53, and 3.87 ± 0.35, respectively (Table 2). After treatment, the CHEOPS scores and the VAS scores for GC, GT, and GB were all significantly lower than before (Table 3). At the last follow-up time, again the CHEOPS scores and the VAS scores for GC, GT, and GB were significantly lower than before (Table 3). However, no matter before treatment, after treatment or at the last follow-up time, no significant difference was found between the three groups ($P > 0.05$), as mentioned in Table 2.

Table 3
Paired sample test of CHEOPS and VAS scores from the cast group, the traction group and the brace group

	Group cast		Group traction		Group brace	
	Mean ± S.D.	Sig.(2-tailed)	Mean ± S.D.	Sig.(2-tailed)	Mean ± S.D.	Sig.(2-tailed)
PreCHEOPS - FinalCHEOPS	1.94 ± 0.24	0.000	1.87 ± 0.35	0.000	1.71 ± 0.47	0.000
PostCHEOPS - FinalCHEOPS	0.94 ± 0.24	0.000	0.87 ± 0.35	0.000	0.64 ± 0.50	0.000
PreVAS - PostVAS	1.94 ± 0.24	0.000	1.93 ± 0.26	0.000	1.93 ± 0.27	0.000
PreVAS - FinalVAS	3.44 ± 0.70	0.000	3.60 ± 0.51	0.000	3.57 ± 0.65	0.000
PostVAS - FinalVAS	1.50 ± 0.62	0.000	1.67 ± 0.49	0.000	1.64 ± 0.63	0.000

When dividing the patients into two groups according to the operation management, the CHEOPS and VAS scores of each group before treatment, after treatment and at the last follow-up time was mentioned in Table 4. Because the follow-up time of 7 patients has not achieved the standard limit, they were not included in Table 4.There in no significant difference between the two groups ($p > 0.05$). So the operation management was no confounder to the association between the type of assisted fixation and the pain scores.

Table 4
Data of CHEOPS and VAS scores from the plate group and the ESIN group

	Group plate	Group ESIN	P value(2-tailed)	
			Equal variances assumed	Equal variances not assumed
PreCHEOPS	2.00 ± 0.00	2.06 ± 0.24	0.27	0.33
PreVAS	3.82 ± 0.40	3.89 ± 0.47	0.61	0.62
PostCHEOPS	0.82 ± 0.39	0.94 ± 0.42	0.33	0.33
PostVAS	1.82 ± 0.39	2.00 ± 0.34	0.13	0.13
FinalCHEOPS	0.18 ± 0.39	0.17 ± 0.38	0.90	0.90
FinalVAS	0.32 ± 0.48	0.33 ± 0.59	0.93	0.93

No significant difference was found between the three groups for days in hospital, time to union and the Harris scores ($P > 0.05$), as mentioned in Table 2.

Discussion

Subtrochanteric femur fractures often result from complex, high-energy causes and demand special surgical considerations[5]. Advances in operative management have resulted in improved clinical and health economic outcomes in curing subtrochanteric femur fractures [21]. But the reduction of pain in femur fracture children has not been paid enough attention to [19].

Compared with the baseline measured before treatment, pain levels of patients were significantly reduced after treatment, and decreased even more at the last follow-up time.(Fig. 1) But no significant difference was found between the three groups. This suggests all three types of assisted fixation have the same effect on pain-relief of subtrochanteric femur fractures.

Patients had the average length of stay of 10 days (range 3—45 days). No significant difference was found between the three groups for days in hospital. This outcome may result from loss of information about associated injuries. The presence of associated injuries has been proved to be a key factor in the length of hospital stay. The length of stay of children without associated injuries decreases with the age, due to an earlier discharge after surgery of younger patients. However, the correlation disappears in children with associated injuries [16].

The postoperative fixation time of GC was shorter than those of CT and GB. The differences result from the characteristics of the assisted fixation and the tolerance of children at different ages (including the preference of parents). At the basis of the equivalent pain-relief ability, hip spica cast may be preferred for its shorter postoperative fixation time.

This study had many limitations besides lack of analysis to identiry the ideal sample size and relatively low numbers of patients. One of the limitations of the study is that BMI information of patients were not collected. There are findings supporting the concept that the weight of the child should be taken into account for children over 6 years old when choosing intervention for femoral fracture [16]. The lack of randomization in the choose of both surgical and assistant fixation technique may introduce selection bias for operative treatment and assisted fixation as well. The participants in GC were younger than those in GT and GB. Study show that methods of management vary depending on anatomical location of fracture, age of patient and associated injuries [21]. There may exist selection bias in choosing operative treatment and assisted fixation.

The major limitation is that there was no control group to evaluate the positive influence of the three types of assisted fixation, compared with operative treatment only. It has been proven that operative treatment came with better outcomes considering the functional recovery of femur fractures as the measurement standard[21]. So the effect of operative treatment might outshine assisted fixation in postoperative pain-relief, causing the current result. Only four patients had skin irritation after surgery. No other severe complication appeared. The relation between pain level and postoperative complications can be studied with a larger group of patients later.

Conclusion

In summary, hip spica cast, skin traction and abduction brace show the same ability to relieve the pain for subtrochanteric femur fractures in children. But hip spica cast leads to a shorter postoperative fixation time.

List Of Abbreviations

Elastic Stable Intramedullary Nailing (ESIN)

Declarations

Ethics approval and consent to participate

The Ethics Committee of Tongji Medical College, Huazhong University of

Science and Technology (IORG No: IORG0003571) gave a final APPROVAL

for this study. Although the data were collected anonymized and centrally, all guardians of patients signed written informed consent for participate.

Consent for publication

All guardians of patients signed written informed consent for publication.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests

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Authors' contributions

X.T. and **WQ.L.** drafted and finalised the manuscript. **X.T.** and **J.L.** were responsible for literature search and study design. **Y.Z., YY.C., JX.L.** and **XY.X.** performed data collection and cases fellow up. The manuscript has been read and approved by all authors, each author believes that the manuscript represents honest work.

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Figures

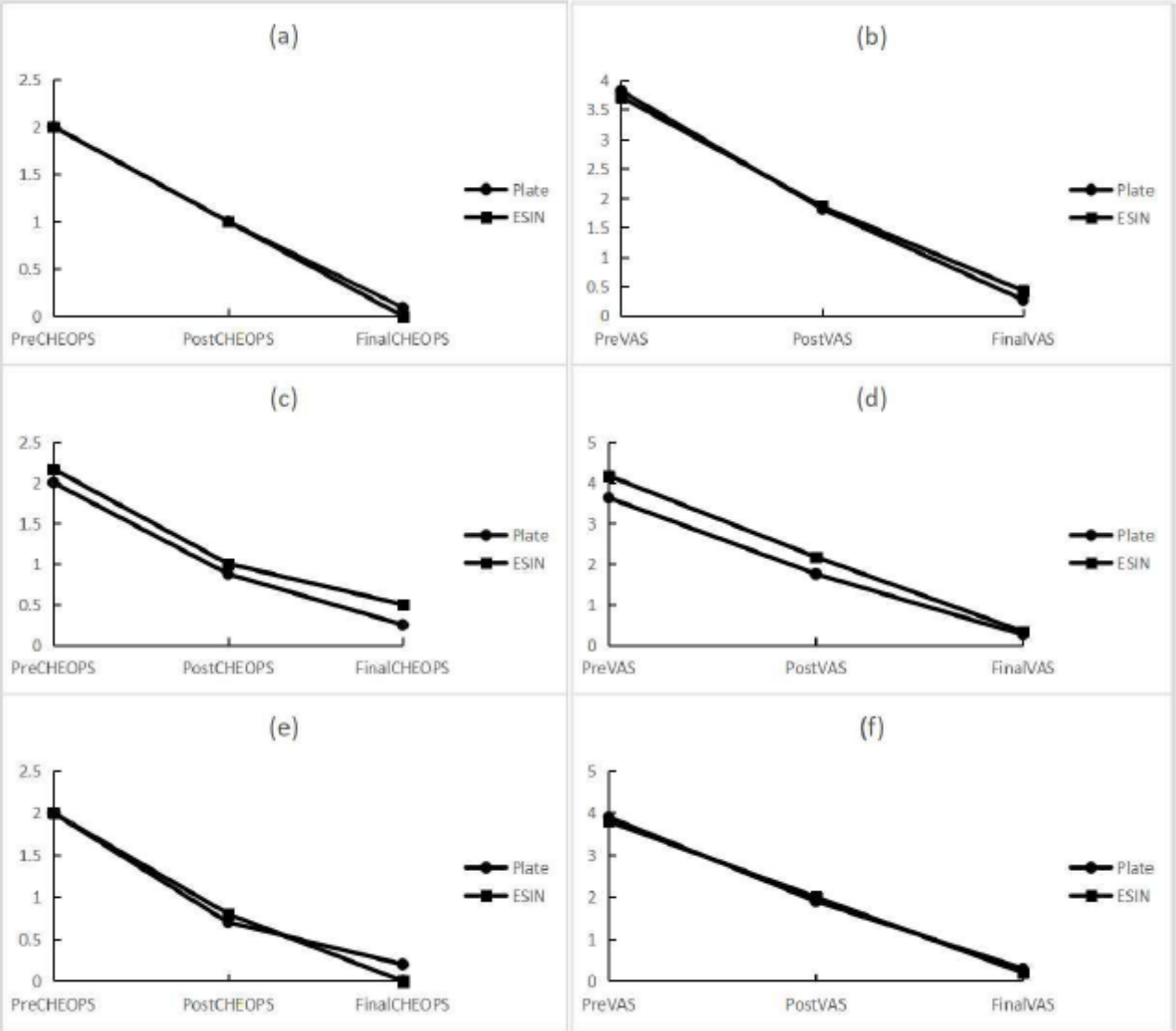

Figure 1

Comparison of the CHEOPS and VAS scores before treatment, after treatment and at the last follow-up time. (a) Comparison of the CHEOPS scores from the cast group before treatment, after treatment and at the last follow-up time. (b) Comparison of the VAS scores from the cast group before treatment, after treatment and at the last follow-up time. (c) Comparison of the CHEOPS scores from the traction group before treatment, after treatment and at the last follow-up time. (d) Comparison of the VAS scores from the traction group before treatment, after treatment and at the last follow-up time. (e) Comparison of the CHEOPS scores from the brace group before treatment, after treatment and at the last follow-up time. (f) Comparison of the VAS scores from the brace group before treatment, after treatment and at the last follow-up time.