

Original Article

Treatment of subtrochanteric fracture with an intramedullary nail by lateral recumbent position

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Abstract: Background: Subtrochanteric fractures are often communicated and difficult to fix. The influence of the body position during the operation has always been ignored. Majority of surgeons do the intramedullary nails (IMN) in a supine position on a fracture traction reduction operation table. Rare paper reported the operation could be performed on the lateral recumbent position on a radiolucent table. Materials and methods: From January 2010 to December 2012, a retrospective cohort of 77 patients suffered subtrochanteric fractures treated in our hospital was included in the study. 36 patients were treated in a lateral recumbent position on a radiolucent operation table and 41 were treated in a supine position on a fracture traction reduction operation table. Treatment methods were established on surgeons' preferences. Results: The recumbent group included 20 males and 16 females, with an average age of 42 years old (range 18-60 years). The supine group included 26 males and 15 females. The average age in this group was 40 years old (range 22-51 years). Both groups get good results in the clinical and radiographic outcome. The lateral recumbent group has a good result on the operative duration, time to access enter point and reduction, average blood loss volume, and the rate of blood transfusion. Conclusion: Both body positions lead to the satisfactory clinical result, but the lateral recumbent position shows the more convenient condition for the subtrochanteric fractures with an intramedullary nail. Level of evidence: Level III, Retrospective Cohort Study, Treatment Study.

Keywords: Subtrochanteric fracture, lateral recumbent position, intramedullary nail, retrospective study

Introduction

Subtrochanteric fractures are defined those of which part of the fracture line lies within the zone between a horizontal line even with the inferior aspect of the lesser trochanter and another horizontal line 5 cm below it. Subtrochanteric fractures are often communicated and difficult to treat. The debate about a suitable implant for subtrochanteric fractures has been going on for a long time with many studies preferring intramedullary implants [1, 2]. Nowadays, closed reduction and internal fixation with an interlocking nail for the subtrochanteric fractures is generally accepted as a "golden standard".

Although there are papers pointing out lots of problems surgeons concerned, such as nonunion, malunion, operation timing, reoperations and so on [3], the influence of the body position during the operation has always been

ignored. Majority of surgeons do the nailing in a supine position on a traction reduction operation table [4]. Rare paper has reported the operation on the lateral recumbent position on a radiolucent table.

During the long term clinical working, we found that outcomes were not the same in the two positions, and the lateral recumbent position for the subtrochanteric fractures with an intramedullary nail was better. We report here the result of a series of subtrochanteric fractures treated in two different positions during operation. The objective of this study was to evaluate the superiority of the lateral recumbent position in treatment of subtrochanteric fractures.

Materials and methods

From January 2010 to December 2012, a retrospective cohort of patients suffered subtrochanteric fractures treated in our hospital was

A different position in treating subtrochanteric fracture



Figure 1. A standard lateral recumbent position.

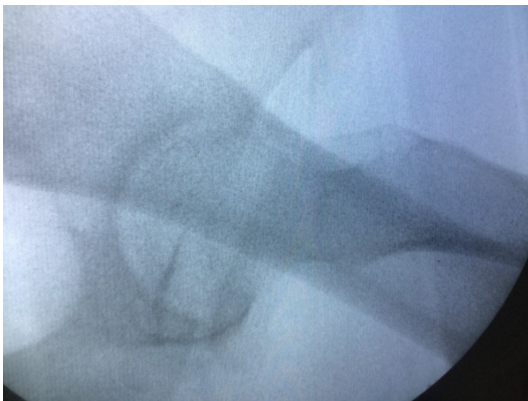


Figure 2. A standard lateral position X-ray of the hip joint.

included in the study. Inclusion criteria were skeletally mature patients (as determined by radiographs). Open and pathological fractures were excluded. 77 patients met our inclusion criteria. As per the Seinsheimer classification, there were 17 type IIIA, 23 type IIIB, 17 type IV and 20 type V cases. There was no significant differences on general conditions between these 2 groups as determined by the T test ($P < 0.05$).

The total cohort included 36 patients treated in a lateral recumbent position on a radiolucent operation table and 41 treated in a supine position on a fracture traction reduction operation table. Our study was restricted to the treatment of fresh fractures, defined as less than 1 week between the injury and the operation. The interval between injury and surgery was similar between the 2 groups, with an average of 4 days for the recumbent group (range, 0-8 days)

compared with 5 days for the supine group (range, 0-9 days). Treatment methods were established on surgeons' preferences. SPSS-21.0 was used for analysis data.

Operative techniques

The method which the patients were treated in a supine position on a fracture traction reduction table has been described by many surgeons. Intramedullary hip system (IMHS) used in the group included 18 long Gamma 3 (Stryker Inc, USA) Locking Nails, 23 TRIGEN Tan Nails (Smith & Nephew Inc, USA).

There are 36 patients treated with freehand in a lateral recumbent position on a radiolucent table. The steps were as follows: General anesthesia was recommendation. While the intravertebral anesthesia could also be chosen. A standard lateral recumbent position was necessary and the radiolucent operation table should permit the lateral position X-ray of the hip joint and the proximal femur. (**Figures 1, 2**) Hardware used in the group included 16 long Gamma 3 (Stryker Inc, USA) Locking Nails, 20 TRIGEN Tan Nails (Smith & Nephew Inc, USA).

The meterstick technique and the lesser trochanter shape sign were used intra-operatively for achieving correct limb length and rotation, respectively.

If closed reduction achieved successful anatomical realignment of the fracture, the operative plan would involve the use of a long IMHS without opening the fracture site or the use of cerclage cables.

When closed reduction techniques failed to achieve satisfactory reduction, we performed a limited open reduction. The operative plan involved an initial 10 cm incision over the fracture site; the fracture would then be temporarily reduced with the use of a clamp; and cerclage cabling of the fracture prior to the nailing with a particular emphasis on the posteromedial wall reconstruction.

Finally, a long IMHS was then inserted into the anatomically reduced femur in the normal fashion. None of the patients with subtrochanteric fractures treated with nails had simultaneous bone grafting.

A different position in treating subtrochanteric fracture

Table 1. Baseline characteristics of patients and comparison between two groups

Variable	ALL N = 77	Lateral recumbent N = 36	Supine N = 41	P
Age, years	40.9 ± 9.94	42.2 ± 11.9	39.7 ± 7.80	0.276
Sex				0.639
Female	31 (40.3%)	16 (44.4%)	15 (36.6%)	
Male	46 (59.7%)	20 (55.6%)	26 (63.4%)	
Injury type				0.587
Fall	28 (36.4%)	11 (30.6%)	17 (41.5%)	
Motor vehicle	42 (54.5%)	21 (58.3%)	21 (51.2%)	
Sports-related	7 (9.09%)	4 (11.1%)	3 (7.32%)	
Hemoglobin, g/L	121 ± 20.3	120 ± 20.6	122 ± 20.2	0.655
Injury side				0.231
Left	34 (44.2%)	19 (52.8%)	15 (36.6%)	
Right	43 (55.8%)	17 (47.2%)	26 (63.4%)	
Fracture type				0.835
IIIA	17 (22.1%)	8 (22.2%)	9 (22.0%)	
IIIB	23 (29.9%)	10 (27.8%)	13 (31.7%)	
IV	17 (22.1%)	7 (19.4%)	10 (24.4%)	
V	20 (26.0%)	11 (30.6%)	9 (22.0%)	
Pain 1 month	46.0 (0-74.0)	43.5 (3.00-70.0)	47.0 (0-79.0)	0.971
Pain 3 month	34.0 (0-57.0)	31.0 (0-54.2)	35.0 (0-67.0)	0.980
Pain 6 month	0 (0-40.0)	0 (0-34.5)	0 (0-45.0)	0.692
Satisfaction	45.0 (0-70.0)	41.0 (0-68.5)	45.0 (1.0-77.0)	0.650
LEFS 4 weeks	14.3 (7.9-21.4)	13.8 (8.7-20.9)	14.7 (7.9-21.4)	0.308
LEFS 3 month	32.3 (23.4-42.9)	33.0 (25.8-41.5)	31.6 (23.4-42.9)	0.193
LEFS 6 month	62.1 (53.7-70.3)	63.0 (53.7-69.7)	61.3 (55.0-70.3)	0.067
LEFS 12 month	72.7 (65.6-78.2)	73.1 (65.6-78.2)	72.4 (66.7-78.1)	0.345
Operative duration, minutes	81.1 ± 17.8	71.5 ± 16.0	89.6 ± 14.9	0.061
Average blood loss volume, mL	320 (100-400)	255 (100-342)	380 (200-430)	0.166
Blood transfusion				
No	64 (83.1%)	33 (91.7%)	31 (75.6%)	
Yes	13 (16.9%)	3 (8.33%)	10 (24.4%)	
Time to access enter point, minutes	7.9 (4.1-14.2)	6.7 (4.1-10.2)	9.0 (5.1-14.2)	0.425
Time to reduction, minutes	21.7 (7.8-41.6)	16.0 (7.8-25.4)	26.6 (13.4-41.6)	0.238

Postoperative period and follow-up

Patients were mobilised on the second postoperative day with only toe touch weight bearing to be allowed. Partial weight bearing was allowed after 8 weeks postoperatively and was gradually increased as tolerated. Patients were followed up at 4 weeks and 3, 6 and 12 month, evaluated with the Lower Extremity Functional Scale (LEFS).

Results

The lateral recumbent group included 20 males and 16 females, with an average age of 42

years old (range, 18-60 years). Injury mechanisms were sports-related in 4, motor vehicle/motorcycle accident in 21, and falls due to some reasons in 11. All associated injuries were on the ipsilateral side. Six patients had associated rib fractures; 2 patients had a scapular fracture which did not require surgery; and 5 patients had pelvic fractures.

The supine group included 26 males and 15 females. The average age in this group was 40 years old (range, 22-51 years). There was no significantly different between the two group ($P = 0.276$). Two patients had associated rib frac-

A different position in treating subtrochanteric fracture



Figure 3. A transverse line fracture and treated by close reduction.

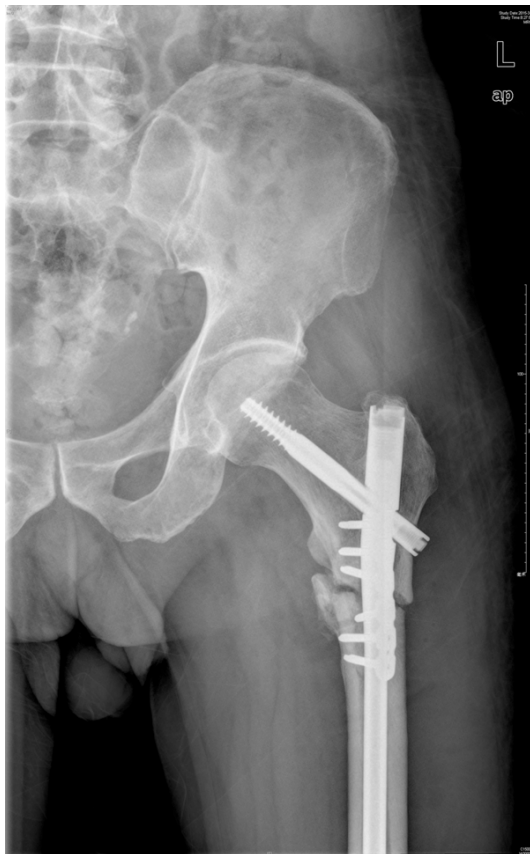


Figure 4. A reoperations including a bone graft and an added plate.

tures; 1 patient had a Colle's fracture that did not require surgery; and 7 patients had a pelvic

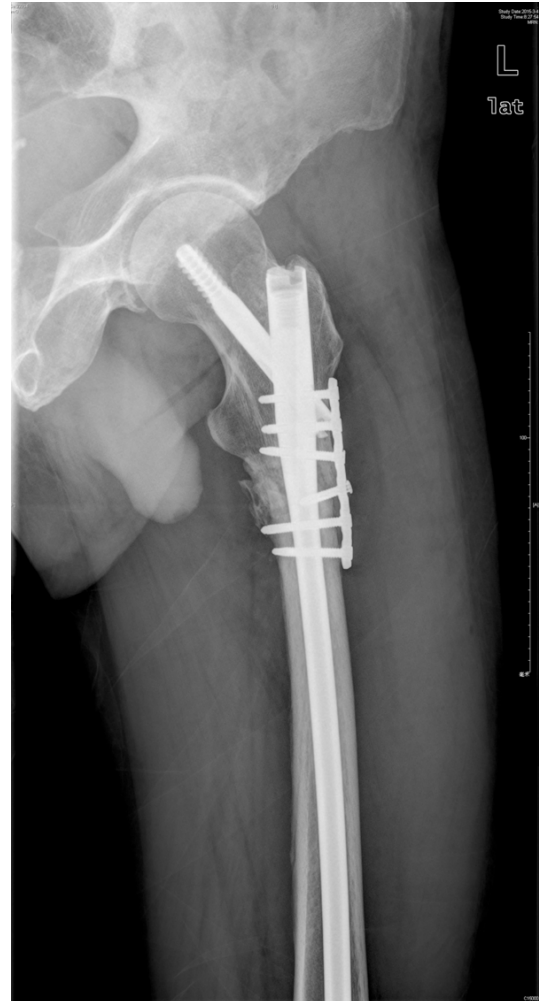


Figure 5. Fracture healing within 6 months after the reoperations.

fracture. All associated injuries were on the ipsilateral side (**Table 1**).

Both groups got good results in the clinical and Radiographic outcome. The lateral recumbent group had a good result on the operative duration, time to access enter point and reduction, average blood loss volume, and the rate of blood transfusion (**Table 1**).

Two groups get the similar outcome on pain score, independent living, LEFS (including all the follow-up time point) and radiographic outcome.

91% patients had no pain relating to the fractured femur. No patient complained pain symptoms one year after the operation. All patients returned to their previous place of residence

A different position in treating subtrochanteric fracture



Figure 6. The hip joint keeps adduction during the operation.



Figure 7. All the assistants contribute to the reduction.



Figure 8. The AP X-ray of hip joint.

following their in-hospital treatment and have remained there. They do not need to use any walking aid.

The average LEFS at four weeks post-operation was 14.3 in lateral recumbent group and 73.1



Figure 9. The lateral X-ray of distal femur, together with **Figure 8**, show the alignment of femur is accepted.



Figure 10. In this position, we overcome the difficulties in getting the lateral X-ray.

at 12 months follow-up. This equated to an average increase of 58.8 points, which was a prominent change, while an average increase of 57.7 points in supine group. No statistical differences between two groups in LEFS.

Nearly all patients were radiographically healed for 6 months except 3 cases. The 3 fractures were all transverse line and treated by close reduction (**Figure 3**). They are in different groups. We did reoperations after a mean time of 14 months. The treatment included the bone graft and an added plate (**Figure 4**). They got healed within 6 months after the reoperations (**Figure 5**).

Discussion

Subtrochanteric fractures make up to 4-18% of all proximal femur fractures [5, 6]. Intramedullary

A different position in treating subtrochanteric fracture

implants are advantageous for their percutaneous insertion, load-sharing ability and short moment arm providing both biological as well as biomechanical advantages. However, technical difficulty during insertion and secondary fracture around the tip of the implant are commonly associated with them.

It is very deep-rooted to do the operation in the supine position on a fracture reduction table [7-9]. The "reduction table" has its own merits, which include better traction effects, convenient fluoroscopy, ability to avoid the rotation easily, and so on. The shortcomings of the "reduction table" are also standing out. The first one is that the hip joint is neutral or abducted, which makes it very difficult to insert the intramedullary nail [10]. If the nail's entry point is designed on the piriform sinus, the insertion may be more difficult [11]. The second shortcoming is that the "reduction table" can only provide the axial traction power. For the subtrochanteric fractures, the muscular forces from around the hip act on the fracture fragments, leading to distraction and malrotation at the fracture site. The proximal fragment is abduction due to the pull of gluteus medius and minimus [12-14]. In addition, this fragment is forced in flexion and external rotation by iliopsoas. The adductors, on the other hand, pull the distal fragment medially into adduction thus increasing the fracture deformity [15, 16]. Furthermore, for the gravity, which will make the femur curve to the earth, we need at least one assistant to keep the anterior arch normal [17].

Fortunately, all the shortcomings can be overcome easily by applying lateral recumbent position. During the operation in this position, the hip joint keeps adduction all the time (**Figure 6**). We can recover the anterior arch of femur by putting the pad under the proximal femur. Surgeons get reduction with the proximal fragment docking to the distal one under patients in the supine position while distal part is restricted [18]. However surgeons have another option while patients in the lateral recumbent position. The proximal fragment docking to the distal one or the distal to the proximal one may be both feasible. One important merit of lateral recumbent position is that during the reduction, all the assistants can provide their contributions (**Figure 7**). They need less strength to maintain the traction and thus not

being fatigable as in the traditional operation. In addition, their X-ray exposure decreases distinctly.

Lots of surgeons refused to use the lateral recumbent position to fix the subtrochanteric fractures because they were afraid of three things. One problem is the traction strength. Though the freehand power may be smaller than the traction strength of the fracture reduction table, it is enough for the fresh fracture. The longest interval is 8 days between injury and surgery. There is no even one case which was changed to open reduction because of the length. Another problem is the alignment. Femur rotation is concerned widely when the fractures were fixed by close reduction [19, 20]. After the preparation, we checked the femur rotation by taking the X-ray of the hip joint and the distal femur. We found that in the natural status of the lateral recumbent position, the AP X-ray of hip joint and the lateral X-ray of distal femur show the alignment of femur is accepted (**Figures 8, 9**). No statistical differences exist between the two groups in LEFS, which indicates that patients who got operations in lateral recumbent position obtained as satisfied outcomes as those in supine position. The last trouble is the fluoroscopy. The traditional difficulty is the lateral X-ray of the proximal femur. We utilized the radiolucent operation table and adjust the position of C-arm machine in order to overcome this difficult (**Figure 10**). So the image we get in the lateral recumbent position is the same as on a fracture reduction table. If there is no radiolucent operation table in the OP room, we can use a table in the caudal and move the patient down.

Conclusion

Our clinical observation is based on the common view that the intramedullary nail is the first choice for the subtrochanteric fractures. Both body positions lead to the satisfactory clinical result, but the lateral recumbent position shows more convenient condition for the subtrochanteric fractures with an intramedullary nail. Our job provides a new choice for the trauma surgeons.

Disclosure of conflict of interest

None.

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