Journal of Orthopaedics and Clinical Research

Sifi N, et al., 2022- J Orth Clin Res

Research Article

Are The Lateral Wall Reduction And Ideal Tip-Apex Distance Important In Reverse Oblique And Transverse Intertrochanteric Femoral Fractures (31-A3) Treated With Gamma Nail?

Nazim Sifi*, Abdelaziz Benjelloun, Evelin Timofiev and Nicolas Van Nieuwenhuyse

Department of Orthopaedics Alpes-Léman Hospital Annemasse, France

***Corresponding Author:** Sifi Nazim, Department of Orthopaedics Alpes-Léman Hospital Annemasse, France.

Received Date: 11-02-2022

Accepted Date: 11-14-2022

Published Date: 11-30-2022

Abstract

Purpose: Reverse oblique and transverse intertrochanteric femoral fractures (31A3 AO/OTA classification) have their own mechanical and anatomical properties. The aim of our study is to verify whether the reduction of the lateral femoral wall and ideal tip-apex distance are important predictive factors in the future of these fractures treated by gamma nails in terms of healing and complication rates.

Methods: The radiological and clinical outcomes of 35 fractures of this type treated by short and long gamma nail from June 2014 to April 2021 were retrospectively reviewed. The elements considered were the quality of the lateral femoral wall reduction, the tip-apex distance (TAD), the lag screw position and overall quality reduction using the Baumgaertner criteria. Union, nonunion, cutout, screw sliding, nail or screw breakage were also radiographically evaluated during follow-up.

Results: The union rate was 97%. A significant association was not observed between the state of reduction of the lateral wall and the three types of complications considered (cutout: p=0.31; sliding screw: p=1.00; varus displacement: p=0.30), and the linear regression model obtained indicates that in subjects with a non-reduction of the lateral wall, the consolidation time is increased on average by approximately 3 months (β= 2.99; 95%CI: 1.79-4.20, p<0.001). No significant association was found between TAD and complications (cut-out: p=1.00; sliding screw: p=1.00; varus displacement: p=0.13).

Conclusion: Anatomic reduction of the lateral wall and an ideal TAD ≤ 25mm might not be as significant for 31A3 fractures treated with gamma nails. Acceptable reduction of the lateral wall and stable internal fixation are sufficient elements to achieve fracture healing and functional recovery.

Citation: Sifi N, Benjelloun A, Timofiev E, Van Nieuwenhuyse N. Are The Lateral Wall Reduction And Ideal Tip-Apex Distance Important In Reverse Oblique And Transverse Intertrochanteric Femoral Fractures (31-A3) Treated With Gamma Nail?. J Orth Clin Res. 2022;1(1):1-12.

DOI: https://doi.org/10.37191/Mapsci-JOCR-1(1)-004

Keywords: Reverse oblique intertrochanteric fracture; AO/OTA 31A3 fracture; Lateral proximal femoral wall; Tip-apex distance; Gamma nail.

Introduction

Trochanteric femoral fractures are common in the geriatric population for low-energy trauma due to osteoporosis. They are recognized as one of the major causes of morbidity and mortality in the elderly [1]. According to AO/OTA classification, trochanteric fractures are divided into three main groups: simple (31A1), multifragmentary (31A2), and intertrochanteric (31A3). The major fracture line in the first two groups reaches the medial cortex but keeps the lateral wall intact. The third group is a particularly rare and unstable variety, in which anatomical and biomechanical specificities make reduction and stabilization difficult, owing to the damage of both the medial and lateral cortex. Fractures in this group are classified as reverse oblique (31A3.1), transverse (31A3.2), and multifragmentary (31A3.3) (Figure 1). Studies have identified risk factors for nonunion or implant failure in these 31A3 fractures treated by intramedullary devices, such as the status of posteromedial support, the tip-apex distance (TAD), the position of the cervical screw, as well as the status of the lateral wall. Poor stability after fracture fixation causes mechanical failures such as cutout, screw sliding, and varus displacement. The aim of our study is to verify whether the reduction of the lateral femoral wall and ideal tip-apex distance are important predictive factors in the becoming of these fractures treated by gamma nails in terms of healing and complication rates.

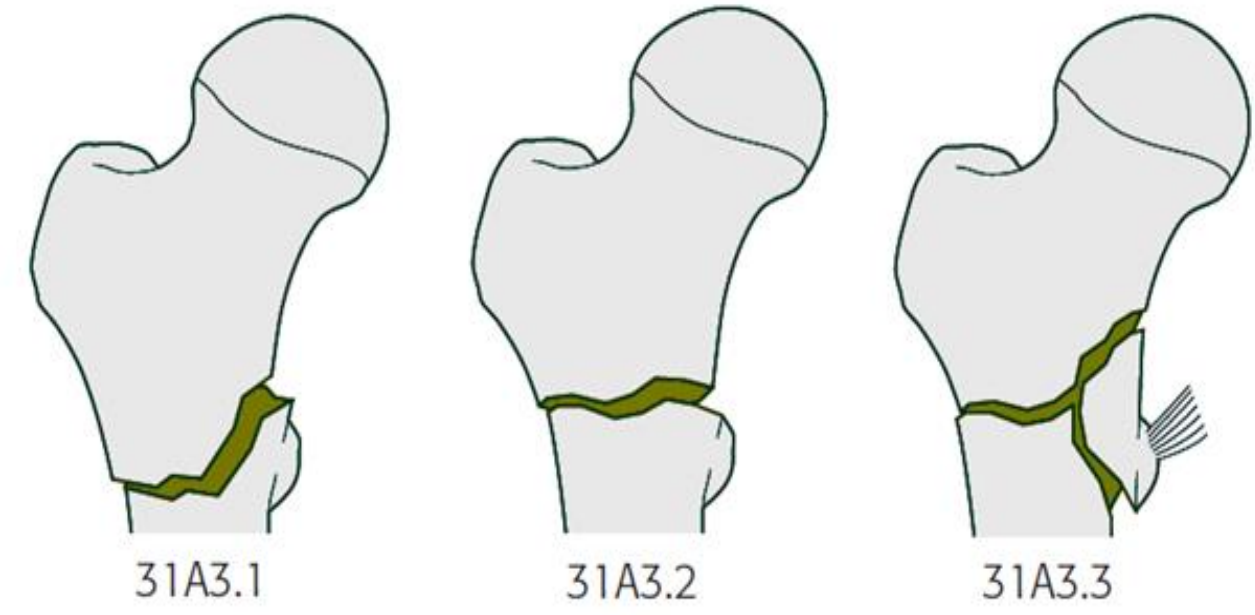

Figure 1: AO/OTA classification of reverse obliquity and transverse intertrochanteric fracture (31-A3).

Citation: Sifi N, Benjelloun A, Timofiev E, Van Nieuwenhuyse N. Are The Lateral Wall Reduction And Ideal Tip-Apex Distance Important In Reverse Oblique And Transverse Intertrochanteric Femoral Fractures (31-A3) Treated With Gamma Nail?. J Orth Clin Res. 2022;1(1):1-12.
DOI: https://doi.org/10.37191/Mapsci-JOCR-1(1)-004

Material and methods

This is a retrospective monocentric study conducted from June 2014 to April 2021, on all patients with 31A3 fractures, treated with closed reduction and gamma nail fixation, with a neck-shaft angle restored, and who were followed ≥ 12 months with a complete set of radiographs. Data collection and analysis were performed in compliance with the Helsinki declaration and the study was approved by the institutional ethics committee of Alpes-Léman Hospital. Patients with neglected fractures (more than 1-month-old), pathological fractures, multiple traumas, associated femur shaft fractures, and other periprosthetic or peri-implant fractures interfering with rehabilitation were excluded from the study. 35 reverse oblique and transverse intertrochanteric femoral fractures (31-A3) were identified. The mean age of all patients was 79 years (range, 39–97 years). All patients received standard preoperative antibiotic prophylaxis 30 minutes prior to the incision, and all surgeries were performed under spinal or general anesthesia in the supine position on a fracture table and with the use of an image intensifier. The fractures were fixed according to their type by short or long 125° and 130° angulated nails. Fractures with a subtrochanteric extension all were treated with a long nail. Postoperative management included prophylaxis for deep vein thrombosis until the patient was fully mobilized. Immediately after surgery, early mobilization with full weight bearing was recommended. Clinical and radiological follow-up was carried out at 4 weeks, 3 months, 6 months, 12 months, and yearly as needed. Postoperative radiographs were made on the first postoperative day for all patients and used to assess the quality of the lateral femoral wall reduction in the anteroposterior (AP) view. This reduction is considered good when the horizontal distance measured between the two proximal and distal cortices of the fractured lateral wall is less than 4mm (Figure 2a) and is considered not reduced if this distance is equal to or greater than 4mm (Figure 3a, Figure 4a). The normal neck-shaft angle must have been restored in both cases. The position of the extremity of lag screw in the head of the femur was assessed in the AP projection (inferior, central, superior) and in the lateral projection (posterior, central, anterior). The TAD was determined by measuring the distance from the tip of the screw to the apex of the femoral head on both AP and lateral radiographs and overall quality reduction was assessed using the Baumgartner reduction quality criteria (BRQC) [2,3]. The reduction was categorized as good, acceptable, or poor (Table 1).

Citation: Sifi N, Benjelloun A, Timofiev E, Van Nieuwenhuyse N. Are The Lateral Wall Reduction And Ideal Tip-Apex Distance Important In Reverse Oblique And Transverse Intertrochanteric Femoral Fractures (31-A3) Treated With Gamma Nail?. J Orth Clin Res. 2022;1(1):1-12.
DOI: https://doi.org/10.37191/Mapsci-JOCR-1(1)-004

Figure 2: (a) Reduced 31-A3.2 fracture. (b) Union achieved after 4 months.

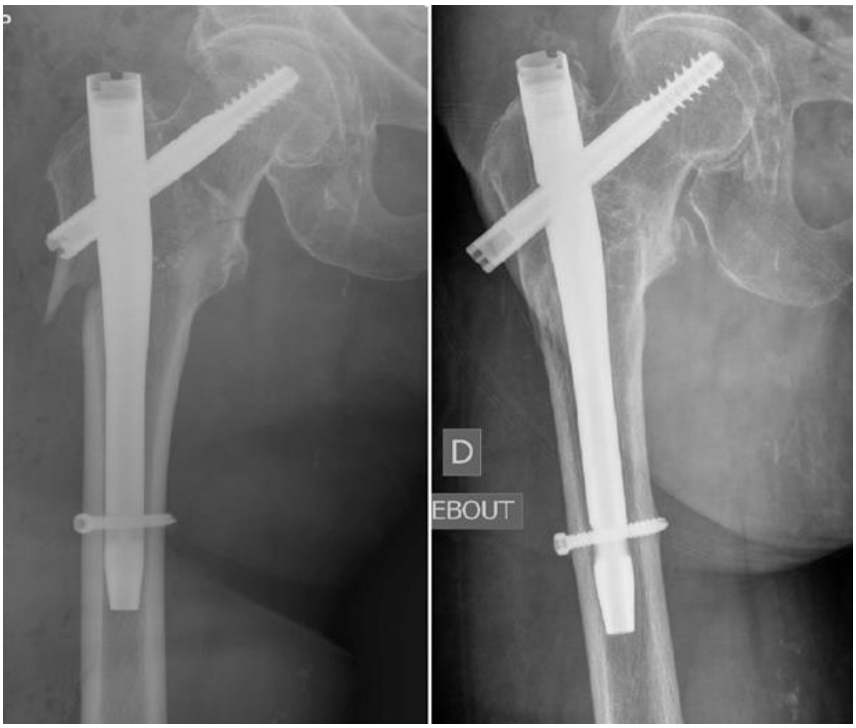

Figure 3: (a) Not reduced 31-A3.1 fracture. (b) Union achieved after 6 months.

Citation: Sifi N, Benjelloun A, Timofiev E, Van Nieuwenhuyse N. Are The Lateral Wall Reduction And Ideal Tip-Apex Distance Important In Reverse Oblique And Transverse Intertrochanteric Femoral Fractures (31-A3) Treated With Gamma Nail?. J Orth Clin Res. 2022;1(1):1-12.
DOI: https://doi.org/10.37191/Mapsci-JOCR-1(1)-004

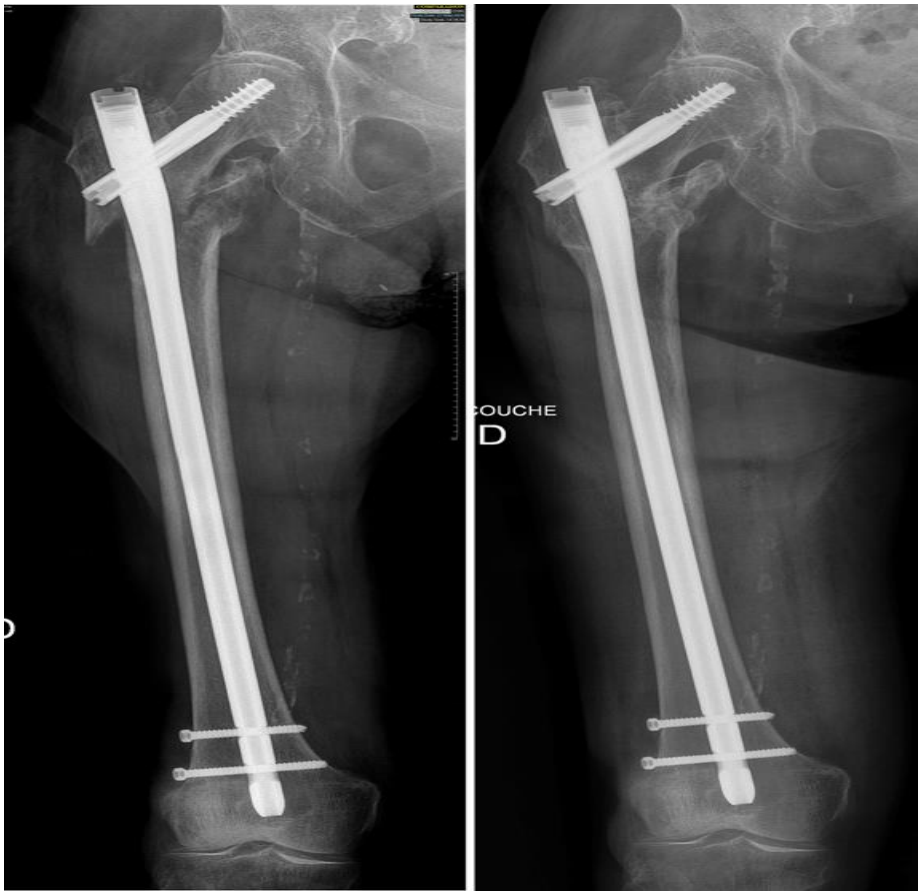

Figure 4: (a) Not reduced 31-A3.3 fracture. (b) Union achieved after 7 months.

Criteria
I. Alignment
a. Anteroposterior view: neck-shaft angle normal or slight valgus (<10°)
b. Lateral view: less than 20° of angulation
II. Displacement
a. Anteroposterior view: less than 4 mm of displacement of any fragments
b. Lateral view: less than 4 mm of displacement of any fragments
Reduction quality
Good: Both criteria met
Acceptable: only one criterion met
Poor: neither criterion met

Table 1: Baumgaertner reduction quality criteria (BRQC).

Citation: Sifi N, Benjelloun A, Timofiev E, Van Nieuwenhuyse N. Are The Lateral Wall Reduction And Ideal Tip-Apex Distance Important In Reverse Oblique And Transverse Intertrochanteric Femoral Fractures (31-A3) Treated With Gamma Nail?. J Orth Clin Res. 2022;1(1):1-12.
DOI: https://doi.org/10.37191/Mapsci-JOCR-1(1)-004

Union, nonunion, cutout, screw sliding, and nail or screw breakage were also radiographically evaluated during follow-up. Union was defined as a visible bridging callus on at least 3 cortices on anteroposterior and axial views with painless full weight bearing. Delayed union and nonunion were defined as the absence of radiologic and clinical union 5 months and 10 months after surgery, respectively. The cutout was defined as any degree of penetration of the lag screw from the femoral head into the surrounding soft tissues or hip joint. Clinical records were retrospectively reviewed and function was assessed on the basis of Activities of daily living (ADLs). Statistical analyses were performed using Jamovi (version 1.6.5). We assessed whether measurement data were normally distributed using the Shapiro-Wilk test and, depending on the result of this test, parametric Student's t-test or non-parametric Mann-Whitney test was implemented. For frequency data, the Chi-square test or Fisher's exact test was used. A p-value less than 0.05 was considered statistically significant. Patient's demographic and clinical characteristics according to the lateral wall reduction (reduced: <4mm or not reduced: ≥ 4mm) and the TAD (≤ 25mm or >25mm) are set out in Table 2.

	Total (n=35)	**Reduced LW <4 mm (n=24)**	**Not reduced LW ≥ 4 mm (n=11)**	**p-value**	**TAD ≤ 25mm (n=25)**	**TAD >25mm (n=10)**	**p-value**
Sex (n,%)							
Female	27(77.1%)	18(75.0%)	9(81.8%)	1.00*	19 (76%)	8(80%)	1.00*
Age							
mean ± SD	79.7 ± 13.7	78.7 ± 14.6	81.8 ± 11.8		77.9 ± 15.0	84.1 ± 8.8	
median (IQR:Q1-Q3)	80(75.5-89.0)	81(77-87)	77(73.5-92.5)	1	80(77-87)	86.5(75.3-91.8)	0.48
Mechanism of Injury (n,%)							
High energy	3(8.6%)	3(12.5%)	0(0%)	0.54*	3(12%)	0(0%)	
Low energy	32(91.4%)	21(87.5%)	11(100%)		22(88%)	10(100%)	0.54*
Side (n,%)							
Left	17(48.6%)	11(45.8%)	6(54.5%)		12(48%)	5(50%)	
Right	18(51.4%)	13(54.2%)	5(45.5%)	0.63	13(52%)	5(50%)	1.00*
AO/OTA Classification (n,%)							
31 A3.1	5(14.3%)	4(16.7%)	1(9.1%)		3(12%)	2(20%)	
31 A3.2	6(17.1%)	5(20.8%)	1 (9.1%)		6(24%)	0(0%)	
31 A3.3	24(68.6%)	15(62.5%)	9(81.8%)	0.64*	16(64%)	8(80%)	0.25*
Reduction Baumgaertner (n,%)							
Good/Acceptable	28(80%)	23(95.8%)	5(45.5%)		20(80%)	8(80%)	
Poor	7(20%)	1(4.2%)	6(54.5%)	0.002*	5(20%)	2(20%)	1.00*

Citation: Sifi N, Benjelloun A, Timofiev E, Van Nieuwenhuyse N. Are The Lateral Wall Reduction And Ideal Tip-Apex Distance Important In Reverse Oblique And Transverse Intertrochanteric Femoral Fractures (31-A3) Treated With Gamma Nail?. J Orth Clin Res. 2022;1(1):1-12.
DOI: https://doi.org/10.37191/Mapsci-JOCR-1(1)-004

Postero-medial Support (n,%)							
Existence	26(74.3%)	20(83.3%)	6(54.5%)		20(80%)	6(60%)	
Loss	9(25.7%)	4(16.7%)	5(45.5%)	0.10*	5(20%)	4(40%)	0.39*
Complication (n,%)	5(14.3%)	2(8.3%)	3(27.3%)	0.30*	2(8%)	3(30%)	0.13
Cut Out	1(2.8%)	0(0%)	1(9.1%)	0.31*	1(4%)	0(0%)	1.00*
Sliding screw	1(2.8%)	1(4.2%)	0(0%)	1.00*	1(4%)	0(0%)	1.00*
Varus displacement	5(14.3%)	2(8.3%)	3(27.3%)	0.30*	2(8%)	3(30%)	0.13*
Consolidation (n,%)	34(97.1%)	24(100%)	10(90.9%)	0.31*	24(96%)	10(100%)	1.00*
Consolidation Time (months), median (IQR:Q1-Q3)	4.0(4.0-7.75)	4.0(4.0-4.0)	7.7(7.0-8.0)	<0.001	4.0(4.0-8.0)	4.0(4.0-7.0)	0.73
Union Time (n,%)							
Normal	19(54.3%)	19(79.2%)	0(0%)		13(52%)	6(60%)	
Delayed	15(42.9%)	5(20.8%)	10(100%)	<0.001*	11(44%)	4(40%)	1.00*

Table 2: Patient's demographic and clinical characteristics in our study population according to the lateral wall reduction (reduced: <4mm or not-reduced: ≥ 4mm) and the TAD (≤ 25mm or >25mm). *Fisher's exact test.

Results

According to the AO/OTA classification, there were 5 types 31-A31, 6 types 31-A32, and 24 types 31-A33 fractures. The average length of follow-up was 14,6 months (range, 12-35). The 35 patients (27 women, 8 men) had a mean age of 79,6 years (range, 39-97). The right femur was operated on in 18 patients. 91% of the fractures were caused by a simple fall. 69% of the fractures were treated with a short nail and locked with 1 distal screw in static and 31% of the fractures were treated with a long nail and locked with 2 distal screws. There were no intraoperative complications and no open reduction was carried out. The lateral wall was reduced according to the fixed criterion (<4mm) in 24 patients (69%) and was not (≥ 4mm) in 11 patients (31%). The BRQR was judged good or acceptable in 28 patients (80%), and poor in 7 patients (20%). The continuity of the posterior-internal support was correctly restored in 26 patients (74%) and presented a loosening in 9 patients (16%). The position of the lag screw was 22 central-central, 8 inferior-central, and 5 slightly superior-posterior. The TAD was >25 mm in 10 patients (29%) and ≤ 25 mm in 25 patients (71%) among whom, contrary to what one might expect, a cutout was noticed (TAD=21mm). The results do not show a significant association between TAD and complications (cutout: p=1.00; sliding screw: p=1.00; varus displacement: p=0.13). However, there is a trend: a TAD greater than 25 mm increases the risk of varus displacement by about 5 times compared to a TAD less than or equal to 25 mm, but not significantly (OR=4.93; 95%CI (0.68-35.67), p=0.11). Thus, contrary to what is reported in the literature, TAD does not seem to be a pertinent predictive factor for mechanical complications. Among the postoperative complications, we recorded 15 delayed unions (42,9%), 5 varus displacements (14,3%), 1 sliding screw (2,8%), and 1 cutout (2,8%) occurring in the 3rd postoperative month and for which a revision

Citation: Sifi N, Benjelloun A, Timofiev E, Van Nieuwenhuyse N. Are The Lateral Wall Reduction And Ideal Tip-Apex Distance Important In Reverse Oblique And Transverse Intertrochanteric Femoral Fractures (31-A3) Treated With Gamma Nail?. J Orth Clin Res. 2022;1(1):1-12.
DOI: https://doi.org/10.37191/Mapsci-JOCR-1(1)-004

was done using THA with a hook plate (Figure 5). The results of our study do not show a significant association between the state of reduction of the lateral wall and the three types of complications considered (cutout: p=0.31; sliding screw: p=1.00; varus displacement: p=0.30). The global union rate was 97% (34/35). Among the patients whose lateral wall was correctly reduced (24/35), all healed on time, except for 5 patients who showed delayed union. Among the patients whose lateral wall was not reduced (11/35), 1 patient presented a cutout and was revised by THA, but all the others (10/11), despite the gap between the two cortices of the lateral wall, ended up consolidating even though they all presented a delayed union. The linear regression model obtained indicates that in subjects with a non-reduced lateral wall, the consolidation time is increased by approximately 3 months on average (β=2.99; 95%CI:1.79-4.20), compared to subjects whose lateral wall is significantly reduced (p<0.001) (Table 3). Therefore, it seems that the non-reduction of the lateral wall is not a predictive factor for non-consolidation but the reduction promotes consolidation over time, which is a very important asset for the elderly in order to achieve rehabilitation as early as possible. There were no significant differences between the pre and postoperative ADLs in 15 patients (42,9%), but they declined in 20 patients (57,1%). The logistic regression model obtained shows that subjects with a non-reduced lateral wall have approximately 5.3 times the risk higher for declined ADLs, compared to subjects with a reduced lateral wall, although this result was at the limit of statistical significance (OR: 5.32, 95%CI:0.94-29.99, p=0.058) (Table 3). Finally, no early or late infection was recorded.

Figure 5: (a) 31-A3.1 fracture. (b) Immediate postoperative AP view showing long gamma nails and acceptable reduction of the lateral wall. (c) Failure of the fixation (cutout). (d) Revision by THA with a hook plate.

Citation: Sifi N, Benjelloun A, Timofiev E, Van Nieuwenhuyse N. Are The Lateral Wall Reduction And Ideal Tip-Apex Distance Important In Reverse Oblique And Transverse Intertrochanteric Femoral Fractures (31-A3) Treated With Gamma Nail?. J Orth Clin Res. 2022;1(1):1-12.
DOI: https://doi.org/10.37191/Mapsci-JOCR-1(1)-004

Effect on consolidation						Effect on ADLs		
Predictor	**β**	**SE**	**t**	**95%IC**	**p**	**Odds ratio**	**95%IC**	**p**
Lateral wall reduction: Not reduced ≥ 4 mm/ Reduced<4 mm	2.99	0.592	5.06	1.79-4.20	<.001	5.318	0.94-29.99	0.058

Table 3: Result of the linear regression and of the logistic regression modeling the effect of not reducing the lateral wall on consolidation (in months) and on the risk of having reduced ADLs. β: linear regression coefficient; SE: standard error; t: Student test; p: Significance level; CI: confidence interval; ADLs: Activities of daily living.

Discussion

The precise definition of the lateral wall of the femur is still somewhat controversial and some teams have proposed descriptions integrating pertrochanteric features with lateral wall involvement [4,5]. For the sake of simplification, we prefer to consider the lateral femoral wall as described anatomically, namely as the lateral femoral cortex distal to the crest of the vastus. 31A3 fractures are highly unstable with a relatively low incidence whose rate varies according to the series from 5% to 23% [6]. In our study, and for a period of 7 years, they represent a cohort of only 35 patients (4.4%). The particular fracture line of these 31A3 fractures runs above the lesser trochanter medially towards the lateral wall of the trochanteric region below, leading to the involvement of both the posteromedial support and the rupture of the lateral buttress, allowing varus displacement and external rotation of the proximal fragment subjected to the attraction of the abductor and pelvitrochanteric muscles as well as medialization and ascension (shortening) of the distal fragment caused by the action of the adductor and iliopsoas muscles. This increases the lever arm and creates an area of instability within the fracture. If lateral wall integrity and reduction as a factor of stability are becoming increasingly important to the point where the AO has revised and modified its own pertrochanteric fractures classification [7], we are not aware of studies that have established a relationship between the reduction of the lateral wall and the rates of consolidation and complication in 31-A3 fractures treated with gamma nail. It is now accepted that for this type of fracture, the intramedullary devices give better results than extramedullary implants because of their short lever arm, the intramedullary position, and the proximal thick part of the nail leaning against the proximal fragment that acts as an internal buttress against the high bending stress at the fracture site and gives greater stiffness which prevents medial translation of the shaft and the axial telescoping and offers good rotational stability which resists collapsing and reduces the risk of implant failure [6,8]. In our study, we had only 2 cases of mechanical failure, representing a rate of

Citation: Sifi N, Benjelloun A, Timofiev E, Van Nieuwenhuyse N. Are The Lateral Wall Reduction And Ideal Tip-Apex Distance Important In Reverse Oblique And Transverse Intertrochanteric Femoral Fractures (31-A3) Treated With Gamma Nail?. J Orth Clin Res. 2022;1(1):1-12.
DOI: https://doi.org/10.37191/Mapsci-JOCR-1(1)-004

5,7%. One was because of a screw sliding in a patient who, due to high comorbidities, could not benefit from a new operation, and the second one was because of a cutout that was revised with a THA. For some authors, it is not only the restoration of the posteromedial support that's considered an important prognostic factor but also the anatomical reduction of the lateral wall that plays a key role in the stabilization and fixation of the 31A3 fractures by providing a lateral buttress to the proximal fragment, allowing a better impaction of the fracture followed by rotational and varus stability after fracture spike impaction occurs. The deficiency of the lateral wall would lead to excessive collapse with varus malalignment and medialization of the shaft [9]. Some authors have even gone so far as to consider that it is absolutely necessary to reduce the displacement of the lateral wall and not to hesitate to make a mini-incision to be able to use a clamp (which can also be associated temporarily with a plate [10]) so as to maintain good reduction during both reaming and introduction of the nail. Others add a cerclage cable around the bone to improve the reduction of the lateral wall [11]. Despite the techniques used and compliance with good nailing principles, it is not uncommon for the progression of the nail to cause again an opening of the lateral wall, especially when there are secondary lines heading towards the greater trochanter which can accentuate the complexity of the fracture. However, in view of our results, it seems that this has no consequences on union or complication rates. On the other hand, if the extension is done towards the subtrochanteric region, this one is less well vascularized than the trochanteric region and undergoing important constraints on the biomechanical level, it is known to provide a significant rate of non-union. This is why it is now widely accepted that in subtrochanteric femur fractures, long intramedullary nails are the most suitable implants [12]. In our patients, the long gamma nail was therefore used to fix and stabilize our 31A3 fractures with subtrochanteric extension and all healed without any nail failure. The minimally invasive nature of the surgery also preserves the vast soft tissue envelope, maintaining stability and vascularity. Although 31% of patients did not achieve radiographic anatomic reduction, they all ended up consolidating. It seems that not reducing the fracture anatomically is in no way an obstacle to consolidation, but it does increase its time. Moreover, the correlation between TAD and fixation failure was not proven in our findings. In general, a TAD <25mm is recommended to lessen the risk of fixation failure in intramedullary hip nails, although evidence for this is limited [13] and several authors have reported that longer TAD and calcar-referenced tip-apex distance (CalTAD) do not, in fact, increase cutout risk [14]. In our study, 29% of patients had a TAD >25 mm, and yet none of them presented a mechanical failure. The only cutout found concerns a patient whose TAD was 21 mm. These findings may be explained by the fact that for these 31A3 fractures, the major varus deforming force seen in standard intertrochanteric femur fractures does not play as great a role in construct stability, and an adequate lever arm is more important than TAD for successful fixation [13]. Our study has some limitations, in particular the reduced number of correlated cases due to the rarity

Citation: Sifi N, Benjelloun A, Timofiev E, Van Nieuwenhuyse N. Are The Lateral Wall Reduction And Ideal Tip-Apex Distance Important In Reverse Oblique And Transverse Intertrochanteric Femoral Fractures (31-A3) Treated With Gamma Nail?. J Orth Clin Res. 2022;1(1):1-12.
DOI: https://doi.org/10.37191/Mapsci-JOCR-1(1)-004

of 31A3 fractures. We can also mention the absence of a comparison between the outcomes in patients with 31A1-31A2 trochanteric fractures (whose lateral wall remains intact) and those with 31-A3 fractures (involving the lateral wall) treated with a gamma nail. Moreover, not all of the fractures had ideal implant placement, and many of them had additional secondary fracture lines, which were extending proximally into the greater trochanter and/or distally into the subtrochanteric region making classification and comparison between homogeneous groups difficult. We also did not consider fractures of the posterior wall as described in Babhulkar's modified OTA classification, based on 3D CT reconstruction [5]. However, despite its weaknesses, we have been able to observe that the union rate was high and the complication rate was low.

Conclusion

Anatomic reduction of the lateral wall and an ideal TAD ≤ 25mm might not be as significant for 31A3 fractures treated with gamma nails. Acceptable reduction of the lateral wall and stable internal fixation are sufficient elements for uneventful bone healing and functional recovery.

Acknowledgments

Not applicable.

Competing interests

The authors have no relevant financial or non-financial interests to disclose.

Funding

The authors declare that no funds, grants, or other support were received during the preparation of this manuscript.

Ethics approval

Ethical approval was waived by the local Ethics Committee of Alpes-Leman Hospital (CHAL-HDDS-11/09/2021) in view of the retrospective nature of the study and all the procedures being performed were part of the routine care.

Consent to participate

Not applicable (retrospective study).

Consent to publish

Not applicable (retrospective study).

Authors contribution

The study conception and design, data collection, data analysis, and the writing of the first draft of the manuscript were performed by SIFI Nazim. All authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Availability of data and materials

The datasets generated and analyzed during the current study are available from the corresponding author.

Citation: Sifi N, Benjelloun A, Timofiev E, Van Nieuwenhuyse N. Are The Lateral Wall Reduction And Ideal Tip-Apex Distance Important In Reverse Oblique And Transverse Intertrochanteric Femoral Fractures (31-A3) Treated With Gamma Nail?. J Orth Clin Res. 2022;1(1):1-12.
DOI: https://doi.org/10.37191/Mapsci-JOCR-1(1)-004

References

1. Weller I, Wai EK, Jaglal S, Kreder HJ. The Effect of Hospital Type and Surgical Delay on Mortality After Surgery or Hip Fracture. J Bone Joint Surg Br. 2005;87(3):361-6. PubMed | CrossRef
2. Baumgaertner M, Curtin S, Lindskog D, Keggi JM. The Value of the Tip-Apex Distance in Predicting Failure of Fixation of. J Bone Joint Surg Am. 1995;77:1058-64. PubMed | CrossRef
3. Baumgaertner MR, Curtin SL, Lindskog DM. Intramedullary Versus Extramedullary Fixation for the Treatment of Intertrochanteric Hip Fractures. Clin Orthop Relat Res. 1998(348):87-94. PubMed | CrossRef
4. Futamura K, Baba T, Homma Y, Mogami A, Kanda A, Obayashi O, Et Al. New Classification Focusing on the Relationship Between the Attachment of the Iliofemoral Ligament and the Course of the Fracture Line for Intertrochanteric Fractures. Injury. 2016;47(8):1685-91. PubMed | CrossRef
5. Babhulkar S. Unstable Trochanteric Fractures: Issues and Avoiding Pitfalls. Injury. 2017;48(4):803-18. PubMed | CrossRef
6. Okcu G, Ozkayin N, Okta C, Topcu I, Aktuglu K. Which Implant Is Better for Treating Reverse Obliquity Fractures of the Proximal Femur: A Standard or Long Nail?. Clin Orthop Relat Res. 2013;471(9):2768-75. PubMed | CrossRef
7. Díaz VJ, Martín IA, García JP, González CO, Doussoux PC. Does the Fracture of the Lateral Wall Affect the Degree of Collapse and the Degree of Sliding of the Cephalic Plate, in Pertrochanteric Fractures Treated by Intramedullary Interlocking? Radiological Study and Review of The Literature. Rev Esp Cir Ortop Traumatol (Engl Ed). 2021;65(2):108-15. PubMed | CrossRef
8. Hao Y, Zhang Z, Zhou F, Ji H, Tian Y, Guo Y, et al. Risk Factors for Implant Failure in Reverse Oblique and Transverse Intertrochanteric Fractures Treated with Proximal Femoral Nail Antirotation (PFNA). J Orthop Surg Res. 2019;14(1):1-8. PubMed | CrossRef
9. Gotfried Y. The Lateral Trochanteric Wall: A Key Element in the Reconstruction of Unstable Pertrochanteric Hip Fractures. Clin Orthop Relat Res. 2004;425:82-6. PubMed | CrossRef
10. Kumar A, Chouhan D, Narang A, Khan R, Mittal S. "Clamp and Plate"-A Simple Technique for Prevention of Varus Malreduction in Reverse Oblique Peritrochanteric Fractures. J Clin Orthop Trauma. 2020;11:S667-70. PubMed | CrossRef
11. Mohamed Jafarullah Z, Chellamuthu G, Valleri DP, Purnaganapathy Sundaram V, Agraharam D, Jayaramaraju D, et al. Morphology Specific Lateral Wall Reconstruction Techniques Using Cerclage Wires in Unstable Trochanteric Fractures. Indian J Orthop. 2020;54(2):328-35. PubMed | CrossRef
12. Tawari AA, Kempegowda H, Suk M, Horwitz DS. What Makes an Intertrochanteric Fracture Unstable In 2015? Does the Lateral wall Play a Role in the Decision Matrix?. J Orthop Trauma. 2015;29:S4-9. PubMed | CrossRef
13. Irgit K, Richard RD, Beebe MJ, Bowen TR, Kubiak E, Horwitz DS. Reverse oblique and transverse Intertrochanteric Femoral Fractures Treated with the Long Cephalomedullary Nail. J Orthop Trauma. 2015;29(9):e299-304. PubMed | CrossRef
14. Caruso G, Corradi N, Caldaria A, Bottin D, Lo Re D, Lorusso V, et al. New tip-apex distance and calcar-referenced tip-apex distance cut-offs may be the best predictors for cut-out risk after intramedullary fixation of proximal femur fractures. Sci Rep. 2022;12(1):1-0. PubMed | CrossRef

Citation: Sifi N, Benjelloun A, Timofiev E, Van Nieuwenhuyse N. Are The Lateral Wall Reduction And Ideal Tip-Apex Distance Important In Reverse Oblique And Transverse Intertrochanteric Femoral Fractures (31-A3) Treated With Gamma Nail?. J Orth Clin Res. 2022;1(1):1-12.
DOI: https://doi.org/10.37191/Mapsci-JOCR-1(1)-004