ORIGINAL ARTICLE

A simple minimally invasive technique providing anterior and medial reduction in intertrochanteric femur fractures: A case–control study

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ABSTRACT

BACKGROUND: The aim of the study was to compare the clinical and radiological results of the Verbrugge minimally invasive technique used in AO/OTA 31–A2.2/A2.3 intertrochanteric fracture types with those of the closed reduction technique performed on a traction table.

METHODS: A retrospective evaluation was made of 671 patients treated in our clinic for intertrochanteric fracture between 2017 and 2020. The patients included in the study were those aged >70 years, applied with intramedullary nailing for an AO/OTA 31–A2.2/A2.3 fracture type, with >1 year of follow-up. Patients were excluded if they did not meet these criteria, if they had a pathological fracture, an open fracture, or a history of hip surgery. A total of 177 patients were accepted for analysis in the study. The patients were separated into two groups as those where reduction was provided with the Verbrugge minimal invasive technique Verbrugge reduction group (VRG) and those with closed reduction applied on a traction table Conventional reduction group (CRG). The reduction quality was evaluated radiologically with the modified Chang method and the varus reduction rates were compared. The clinical results of the groups were compared in respect of time to full weight-bearing mobilization, complication rates, and Harris Hip Scores (HHS).

RESULTS: Varus malreduction was seen less often in the VRG compared to the CRG, the reduction quality was more successful, the patients could be mobilized earlier and the HHSs were better. No significant difference was determined in terms of operating time and complications.

CONCLUSION: The Verbrugge method can be used in all AO/OTA 31–A2.2/A2.3 intertrochanteric fractures where closed reduction applied on a traction table is not sufficient. This method can be considered to be an effective technique that increases the quality of the fracture reduction, provides protection throughout the operation, and has similar complication rates to those of the conventional reduction method.

Keywords: Intertrochanteric fractures; minimally invasive surgery; reduction quality.

INTRODUCTION

Intertrochanteric femur fractures are often seen in the elderly population and several studies have shown that intramedullary nailing is the gold standard method in the treatment of these fractures.[1–4] However, complications occur at rates of up to 20% after intramedullar nailing.[5] Successful reduction is known to be important for the prevention of complications and obtaining satisfactory clinical results.[6–9] Although sufficient reduction is obtained with closed manipulation and traction, in some conditions, there is a need for additional reduction techniques.[10]

In the treatment of intertrochanteric femur fractures, the ideal treatment method for AO/OTA 31–A2.2/A2.3 fractures is still a matter of debate because these types of fractures are described as unstable fractures.[11,12] To obtain successful union, it is important that sufficient cortical contact is provid-

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ed between the head-neck fragment and the femoral shaft.[13] The basic criteria for stability are accepted by most surgeons as the provision of medial calcar support.[12] However, providing anterior cortical continuity is also an important criteria affecting clinical outcomes, but is usually given less importance.[9] Consequently, an acceptable reduction and adequate treatment modality for AO/OTA 31–A2.2/A2.3 fractures has not yet been clearly explained.[11,14]

When the bone healing mechanisms are considered, although closed reduction is the most appropriate method which can be selected so as not to disrupt the biology of the fracture line, the nature of irreducible fractures makes repeated maneuvers ineffective.[10] Although the selection of the use of support (crutches) that will be used is made by several surgeons during the operation, the efficacy of this method has not been shown in unstable fractures in the sagittal plane (Koval KJ). There are some reduction techniques in literature that can be used in these conditions. Chun et al. (2011) reported that reduction can be obtained in fractures with anterior and medial displacement with the use of a bone clamp and cerclage wire. However, it was reported that this method could cause rehabilitation and wound problems. In that study, reduction was obtained by pushing the proximal fracture fragment from anterior to posterior and from medial to lateral percutaneously with 4.2 mm Steinmann pins with the help of an assistant. At this stage, this position is protected with a second pin advanced to the femoral head. The disadvantages of this method have been reported to be wound site maceration, lateral femoral cutaneous nerve damage during the anterior cut, vascular damage, and prolonged operating time (Chun YS). Tian et al. reported a study in which reduction was obtained and K-wire was similarly used for subsequent protection (Tian K). In another method described in the literature, it has been reported that for reduction of a fragment with posterior displacement, placement of a Bennett retractor in the posterior by advancing it from the incision and making a maneuver in an upwards direction could be effective. In some difficult reduction cases, a pin to be fixed to the acetabulum by passing the femoral head allows independent movement of the distal fragment by stabilizing the proximal fragment (Nieves). Afsari et al. reported 98% successful union in treatment with intramedullar nailing and minimally invasive reduction with the aid of a clamp applied in high subtrochanteric fractures where closed reduction was not possible. The study showed that excellent reduction rates were obtained with no increase determined in complication rates, which was associated with the minimally invasive application of the technique without stripping soft tissue. This application became more widely used in the subsequent period, and the use of the minimally invasive clamp reduction technique in fractures problematic in terms of reduction became widespread (Mingo, Kilinc, Afsari).

In our clinic in recent years, when closed reduction cannot be obtained on the traction table in cases with AO/OTA 31–A2.2/A2.3 intertrochanteric femur fracture, the minimally invasive reduction method, known as the Verbrugge method, has usually been used. In this technique, the incision made proximal of the trochanter major is extended 2 cm proximally. With the aid of Verbrugge bone forceps, fracture line reduction is obtained and the operation is performed with intramedullar nailing protecting the fixation throughout the operation.

The aim of this study was to determine whether or not there was any difference in the clinical and radiological results of cases where the Verbrugge minimally invasive technique was used and cases applied with the closed reduction technique on a traction table, operated on in previous years.

MATERIALS AND METHODS

Study Method and Patient Selection

Approval for the study was granted by the Clinical Research Ethics Committee (registry no: 00139584820). From the hospital archives, a retrospective examination was made of 671 patients who presented at our hospital because of intertrochanteric femur fracture between 2017 and 2020.

The study included patients aged ≥70 years with fracture type AO/OTA 31–A2.2/A2.3 applied with short proximal femur nail (TST-PROFIN- Proximal Femur Nail) and using a traction table. Patients were excluded from the study if they were aged <70 years, had a follow-up period shorter than 1 year, a pathological fracture, open fracture, neurovascular damage, or did not attend follow-up examinations. A total of 494 cases were excluded from the study, leaving a total of 177 cases for inclusion in the study. The patients were separated into two groups as Group 1, the Verbrugge reduction group (VRG) (n=55) comprising patients with reduction obtained with the Verbrugge minimally invasive method, and Group 2, the conventional reduction group (CRG) (n=122) with reduction obtained using a traction table.

Surgical Technique

All the cases with trochanteric fracture were operated on in our clinic under spinal anesthesia by the same surgeon. After anesthesia, all the cases were placed on the traction table without making any reduction maneuver. On the traction table, it was attempted to provide the reduction maneuvers with internal rotation, adduction, and axial traction. In the VRG, first nails were placed with an incision made proximal of the trochanter major (standard intramedullar nails, 170–220 mm in length and 9–11 mm in diameter). Before placing the spongious grooved self-tapping cannulated screws applied to the proximal, the incision made was extended 2 cm proximally. Following blunt dissection of the vastus lateralis, the fracture line was determined with palpation. Reduction of the fracture line was obtained with the use of Verbrugge bone forceps (Fig. 1). Then, continuity of the medial and anteri-

or cortex was confirmed with fluoroscopy. By locking the Verbrugge clamp, this was protected until the end of the operation. Two proximal and one distal locking screws were applied and the operation was completed (Fig. 2).

In the CRG, after obtaining acceptable reduction on the traction table, nails were placed without the aid of any instrument contributing to the reduction (standard intramedullar nails, 170–220 mm in length and 9–11 mm in diameter). Two proximal and one distal locking screws were applied and the operation was completed.

Post-operative Follow-up

For all the cases, on post-operative day 1, the hemogram was examined, direct radiographs were taken, and quadriceps and ankle exercises were started. On day 2, the dressing was changed and mobilization was achieved with non-weight-bearing on the operated extremity. Patients were called for follow-up examinations after hospital discharge at 1, 2, 3, and 12 months postoperatively. Direct radiographs were taken at each examination. When bone union was seen, mobilization with full weight-bearing was permitted.

Clinical and Radiological Evaluations

The groups were compared in respect of the time from fracture to surgery and the operating time. The clinical outcomes were compared in respect of the time to full weight-bearing mobilization, the Harris Hip Score (HHS), and complication rates.

On the radiograph taken at 1-month postoperatively, the femoral head-neck angle of the fractured extremity was compared with the contralateral side. Determination of >5° varus in the fractured hip compared to the unaffected side was evaluated as varus reduction. The reduction quality on the radiograph taken at 1-month postoperatively was evaluated with the modified Chang et al.[9] classification.

Anterior-Posterior Radiograph (Coronal Plane)

Continuity of the medial cortex was evaluated separated into three parts as positive medial cortex support (PMCS), neutral position (NP), and negative medial cortex support (NMCS). PMCS and NP positive and NMCS negative were evaluated as anterior-posterior reduction.

Lateral Radiograph (Sagittal Plane)

The amount of anterior-posterior displacement was evaluated. Displacement of <2 mm in the fracture line, to anterior or posterior, or a ratio of displacement less than half the thickness of the cortex were accepted as YES, sufficient cortical support was provided, and displacement of >2 mm was accepted as NO, sufficient cortical support was not provided. As a result of the measurements, three reduction outcomes were defined as successful, fair, and poor reduction (Table 1).

Statistical Analysis

Data obtained in the study were analyzed statistically using IBM SPSS vn. 22.0 software. In the comparisons of categorical variables between the groups, the Pearson Chi-square and Fisher's exact tests were used. Continuous variables were compared using the Independent Samples t-test if data showed normal distribution and the Mann–Whitney U test if data did not show normal distribution. A value of $p<0.05$ was accepted as statistically significant.

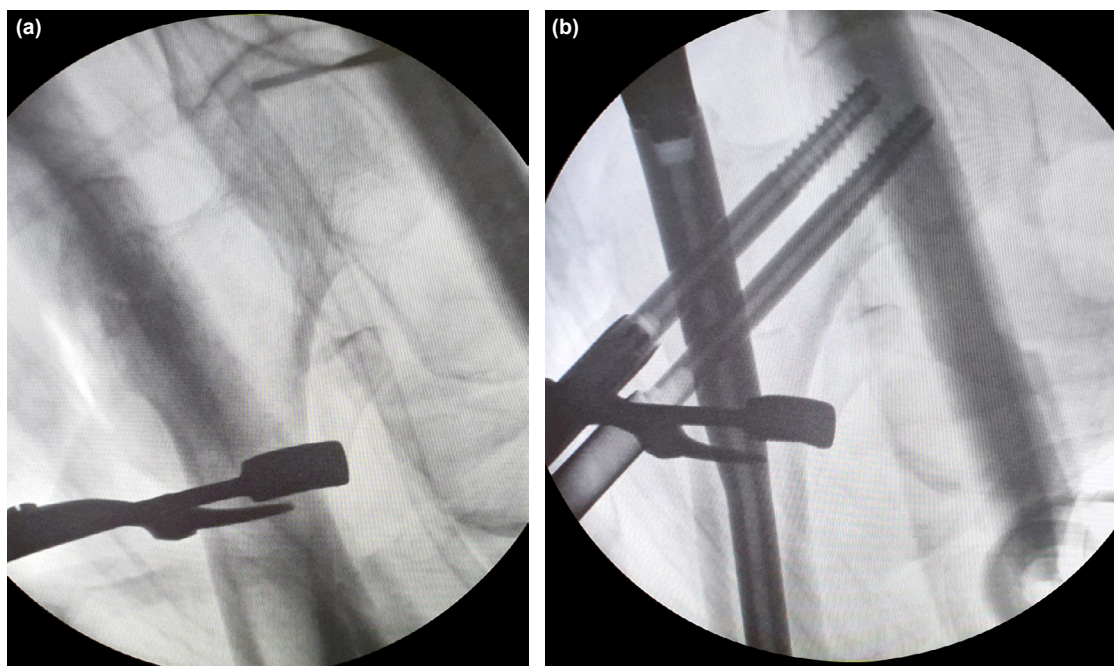

Figure 1. (a) Reduction with verbrugge clamp anteroposterior fluoroscopic view. **(b)** After the operation is completed; anterior-posterior fluoroscopy view.

RESULTS

The whole sample comprised 120 (67.8%) females and 57 (32.8%) males. Cases in the VRG comprised 38 (69.1%) females and 17 (30.9%) males with a mean age of 82.3±6.6 years and the CRG included 82 (67.2%) females and 40 (32.8%) males with a mean age of 82.0±6.1 years (p=0.699). The age and gender distribution was determined to be homogenous in the groups. No difference was determined between the groups in respect of the time to surgery and the operating time. The time from fracture to surgery was 3.2±0.9 days in the VRG and 2.9±0.8 days in the CRG (p=0.086). Operating time was determined as mean 100.75±12.44 min in the VRG and 100.3±15.0 min in the CRG (Table 2 and 3).

Table 1. Categorical characteristics distribution of the cases according to the groups

	Verbrugge group		Control group		p
	n	%	n	%	
Gender					
Female	38	69.1	82	67.2	0.941
Male	17	30.9	40	32.8	
Varus reduction					
Varus reduction exists	–	–	16	13.1	0.003
No varus reduction	55	100	106	86.9	
Reduction quality					
Successful	42	76.4	58	47.5	<0.001
Moderate	13	23.6	40	32.8	
Poor	0	0	24	19.7	
Complicated					
Yes	4	7.3	7	5.7	0.741
No	51	92.7	115	94.3	

Table 2. Modified evaluation of reduction quality described by Chang et al.

AP X-Ray	Lateral X-Ray	Reduction
PMCS or NP	Yes	Successful
PMCS or NP	No	Moderate
NMCS	Yes	Moderate
NMCS	No	Poor

AP: Anteroposterior; PMCS: Positive medial cortex support; NP: Neutral position; NMCS: Negative medial cortex support.

Varus reduction was determined in no cases of the VRG and in 16 (13.1%) of the CRG (p=0.003). In the comparison of the head-neck angle difference between the operated hip and the non-operated hip, the angle difference was determined to be mean 2.9±1.5400B0 in the VRG and −0.19±2.97° in the CRG (p<0.001). In the evaluations of reduction quality, successful reduction was obtained in 42 (76.4%) cases and fair reduction in 13 (23.6%) cases in the VRG, with no cases of poor reduction. In the CRG, 58 (47.5%) cases were evaluated as successful reduction, 40 (32.8%) as fair, and 24 (19.7%) as poor reduction (p<0.001). The time to mobilization with full weight-bearing was 5.09±0.93 weeks in the VRG and 6.14±1.64 weeks in the CRG (p<0.001) (Table 2 and 3).

No statistically significant difference was determined between the groups in respect of complication rates. Complications were seen in 4 (7.3%) cases in the VRG (three with wound site infection and one with cut-out) and in 7 (5.7%) cases in the CRG (three with wound site infection and four with cut-out) (p=0.741). Of the three cases in the VRG with wound site infection, two were treated with empirical antibiotherapy. In the other case, surgical debridement was performed and a sample was taken and the infection was subsequently brought under control with antibiotherapy appropriate to the culture. In the three CRG patients with infection, treatment was provided with empirical antibiotherapy. The patients in both groups with cut-out were applied with partial hip pros-

Table 3. Clinical and radiological evaluation

	Verbrugge Group (n=55)		Control Group (n=122)		p
	Mean±SD	Median (Min.–Max.)	Mean±SD	Median (Min.–Max.)	
Age	82.31.±6.63	83 (70–95)	82.03.±6.12	81 (70–93)	0.699
Time-to-surgery (days)	3.22.±0.96	3 (2–5)	2.91.±0.85	3 (1–5)	0.086
Operation duration (minutes)	100.75.±12.44	101 (72–124)	100.38.±15.02	99.5 (72–130)	0.865
Head-neck angle (degrees)	133.88.±2.75	133.4 (128.4–139.8)	131.42.±3.7	131.5 (122.5–139.3)	<0.001
Head-neck angle contrlateral (degrees)	129.97.±2.97	129.5 (122.3–135.3)	131.57.±2.32	131.65 (126.2–139.6)	<0.001
Angle difference (%)	2.91.±1.54	2.57 (0.52–10.4)	–0.19.±2.97	0.57 (–7.67–5.34)	<0.001
Full load mobilization time (week)	5.09.±0.93	5 (4–7)	6.14.±1.64	6 (3–9)	<0.001
Harris Hip Score	79.33±8.83	80 (62–93)	73.03±13.34	74.50 (44–96)	0.005

SD: Standard deviation; Min: Minimum; Max: Maximum.

thesis. The HHS was determined to be mean 79.3±8.8 in the VRG and 73.0±13.3 in the CRG (p=0.005) (Tables 2 and 3).

DISCUSSION

In this study, the clinical and radiological results were evaluated to compare the efficacy of the Verbrugge technique used in the past 2 years in our clinic for the reduction of AO/OTA 31–A2.2/A2.3 intertrochanteric femur fractures with the closed reduction method performed using a traction table. Compared to the closed reduction traction table group, in the patients with reduction obtained with the Verbrugge method during the operation, varus reduction was seen less (p=0.003), more successful reduction quality was obtained (p<0.001), patients could be mobilized earlier (p<0.001) and the HHS was higher (p=0.005). No statistically significant difference was determined between the groups in respect of operating time and complication rates.

The provision of anatomic reduction is the most important factor affecting the outcomes of intertrochanteric femur fractures.[15] However, as approximately 75% of these fractures are unstable, it is extremely difficult to reach the ideal reduction target.[16] Techniques have been described in the literature that can be used in percutaneous or minimally invasive reduction of femur intertrochanteric fractures. In a study including unstable intertrochanteric femur fractures, Carr et al.[17] reported that success was achieved in the continuity of the anterior and medial cortex in reduction made with the aid of a bone hook in addition to traction table use. Kim et al.[18] reported that not having to make another incision was an advantage of this technique in cases where reduction was made using a bone hook. However, it was also stated in the same study that varus reduction rates could be increased associated with the use of this technique. In the literature, there are reduction methods described when using this technique using instruments other than a bone hook, such as K-wire and a Hohman retractor.[19–22] Although reduction quality has been improved and positive clinical results have been obtained with the reported techniques, all of these techniques are dependent on an assistant. This may be a drawback on the point of providing permanent and reliable reduction during the operation. The advantage of the Verbrugge reduction method used in this study compared to other minimally invasive and percutaneous techniques is that it reduces dependence on an assistant and provides reliable and permanent stability throughout the operation. In the present study, cases treated with the minimally invasive Verbrugge reduction technique, varus reduction was not determined in any case on the 1-month post-operative follow-up radiographs.

In a study that evaluated post-operative fracture reduction, Du et al.[23] examined 68 cases with AO/OTA 31–A2.2/A2.3 intertrochanteric fractures. Intramedullar nails were applied to all the cases and postoperatively, the head-neck fragment rotation was examined with computed tomography (CT). The results obtained showed that although only 5.9% of the cases were evaluated as poor reduction according to the Chang criteria, there was determined to be rotation in 84% of all the cases. Li et al.[24] showed that stable reduction in the medial and anteromedial cortex provided successful clinical results by preventing rotation. It was reported that stable reduction obtained at the time of the operation provided permanent alignment by preventing displacement of the fragments and this provided successful reduction. The minimally invasive reduction method used in the present study protected the reduction obtained in the anterior and medial cortex throughout the operation. It was determined that the use of the Verbrugge clamp prevented reduction loss and rotation that may occur while performing the reaming procedure for the proximal screws or when placing proximal screws. However, there was no rotation measurement with CT of the patients applied with the Verbrugge technique, and this can be considered a limitation of the study.

Some complications can develop together with the methods used when making additional interventions in the reduction of intertrochanteric fractures. In a study that included reduction using the percutaneous double pin method and the provision of the continuity of the reduction, Chun et al. reported that there could be complications of wound site maceration, lateral femoral cutaneous nerve damage during the anterior cut, vascular damage, and prolonged operating time (Chun et al.). In another study, Kim et al.[18] reported the risk of neurovascular injury during reduction performed with the bone hook technique. There are studies in the literature recommending open reduction in unstable AO/OTA 31–A2,3 fractures when medial and anteromedial cortical reduction cannot be obtained. However, it has been reported in those studies that operating time and blood loss are increased in open reduction and therefore, there is a high risk of local and systemic infection.[25] In the present study, cortical continuity was obtained with the minimally invasive method applied and open reduction techniques were not required in any case. In addition, in the patients applied with intramedullary nailing using the Verbrugge minimally invasive reduction technique, no significant increase was determined in complications compared to the patients applied with intramedullar nailing after closed reduction. The reason for this was considered to be that reduction was obtained without a separate incision by extending the incision previously made by 2 cm proximally for the application of the proximal screws.

There were some limitations to this study, primarily that it was retrospective in design and a relatively small patient group was included in the study. In addition, the inadequate measurement of rotation with fluoroscopy imaging in patients applied with the Verbrugge technique indicated a need for a more advanced imaging technique.

Conclusion

The Verbrugge minimally invasive reduction method is an effective method that can be used in AO/OTA 31–A2.2/A2.3 intertrochanteric femur fractures when closed reduction cannot be achieved. The reasons for selection are evaluated as protection throughout the operation of the reduction obtained that the reduction is obtained independently of an assistant, and it does not cause an increase in complication rates as it is a minimally invasive intervention.

Ethics Committee Approval: This study was approved by the Ümraniye Training and Research Hospital Clinical Research Ethics Committee (Date: 29.04.2021, Decision No: 00139584820).

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Conflict of Interest: None declared.

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REFERENCES

1. Curtis MJ, Jinnah RH, Wilson V, Cunningham BW. Proximal femoral fractures: A biomechanical study to compare intramedullary and extramedullary fixation. Injury 1994;25:99–104. [CrossRef]
2. Sambandam SN, Chandrasekharan J, Mounasamy V, Mauffrey C. Intertrochanteric fractures: A review of fixation methods. Eur J Orthop Surg Traumatol 2016;26:339–53. [CrossRef]
3. Saudan M, Lübbeke A, Sadowski C, Riand N, Stern R, Hoffmeyer P. Pertrochanteric fractures: Is there an advantage to an intramedullary nail? A randomized, prospective study of 206 patients comparing the dynamic hip screw and proximal femoral nail. J Orthop Trauma 2002;16:386–93.
4. Schipper IB, Marti RK, van der Werken C. Unstable trochanteric femoral fractures: Extramedullary or intramedullary fixation. Review of literature. Injury 2004;35:142–51. [CrossRef]
5. Anglen JO, Weinstein JN, American Board of Orthopaedic Surgery Research Committee. Nail or plate fixation of intertrochanteric hip fractures: Changing pattern of practice. A review of the American board of orthopaedic surgery database. J Bone Joint Surg Am 2008;90:700–7.
6. Kaufer H. Mechanics of the treatment of hip injuries. Clin Orthop Relat Res 1980;146:53–61. [CrossRef]
7. Bojan AJ, Beimel C, Taglang G, Collin D, Ekholm C, Jönsson A. Critical factors in cut-out complication after gamma nail treatment of proximal femoral fractures. BMC Musculoskelet Disord 2013;14:1. [CrossRef]
8. Kozono N, Ikemura S, Yamashita A, Harada T, Watanabe T, Shirasawa K. Direct reduction may need to be considered to avoid postoperative subtype P in patients with an unstable trochanteric fracture: A retrospective study using a multivariate analysis. Arch Orthop Trauma Surg 2014;134:1649–54. [CrossRef]
9. Chang SM, Zhang YQ, Ma Z, Li Q, Dargel J, Eysel P. Fracture reduction with positive medial cortical support: A key element in stability reconstruction for the unstable pertrochanteric hip fractures. Arch Orthop Trauma Surg 2015;135:811–8. [CrossRef]
10. Moehring HD, Nowinski GP, Chapman MW, Voigtlander JP. Irreducible intertrochanteric fractures of the femur. Clin Orthop Relat Res 1997;339:197–9. [CrossRef]
11. Parker MJ, Handoll HH. Gamma and other cephalocondylic intramedullary nails versus extramedullary implants for extracapsular hip fractures in adults. Cochrane Database Syst Rev 2008;3:CD000093. [CrossRef]
12. Knobe M, Gradl G, Ladenburger A, Tarkin IS, Pape HC. Unstable intertrochanteric femur fractures: Is there a consensus on definition and treatment in Germany? Clin Orthop Relat Res 2013;471:2831–40.
13. Baumgaertner MR, Chrostowki JH, Levy RN. Intertrochanteric hip fractures. In: Browner BD, Jupiter JB, Levine AM, Trafton PG, editors. Skeletal Trauma. Philadelphia, PA: WB Saunders; 1998. p. 1852–76.
14. Pervez H, Parker MJ, Pryor GA, Lutchman L, Chirodian N. Classification of trochanteric fracture of the proximal femur: A study of the reliability of current systems. Injury 2002;33:713–5. [CrossRef]
15. Desjardins AL, Roy A, Paiement G, Newman N, Pedlow F, Desloges D, et al. Unstable intertrochanteric fracture of the femur. A prospective randomised study comparing anatomical reduction and medial displacement osteotomy. J Bone Joint Surg Br 1993;75:445–7. [CrossRef]
16. Apel DM, Patwardhan A, Pinzur MS, Dobozi WR. Axial loading studies of unstable intertrochanteric fractures of the femur. Clin Orthop Relat Res 1989;246:156–64. [CrossRef]
17. Carr JB. The anterior and medial reduction of intertrochanteric fractures: A simple method to obtain a stable reduction. J Orthop Trauma 2007;21:485–9. [CrossRef]
18. Kim Y, Dheep K, Lee J, Yoon YC, Shon WY, Oh CW, et al. Hook leverage technique for reduction of intertrochanteric fracture. Injury 2014;45:1006–10. [CrossRef]
19. Tian K, Liu C, Yan J, Fan K, Ma W, Chen K. Feasibility study of Kirschner wire-fixation-cortical bone technique in treatment of intertrochanteric fracture. Zhongguo Xiu Fu Chong Jian Wai Ke Za Zhi 2019;33:1239–44.
20. Chun YS, Oh H, Cho YJ, Rhyu KH. Technique and early results of percutaneous reduction of sagittally unstable intertrochateric fractures. Clin Orthop Surg 2011;3:217–24. [CrossRef]
21. Seong YJ, Jang JH, Jeon SB, Moon NH. Characteristics and surgical outcomes of Intertrochanteric or subtrochanteric fractures associated with ipsilateral femoral shaft fractures treated with closed intramedullary nailing: A review of 31 consecutive cases over four years at a single Institution. Hip Pelvis 2019;31:190–9. [CrossRef]
22. Sharma G, Kumar GN, Yadav S, Lakhotia D, Singh R, Gamanagatti S, et al. Pertrochanteric fractures (AO/OTA 31-A1 and A2) not amenable to closed reduction: Causes of irreducibility. Injury 2014;45:1950–7. [CrossRef]
23. Du S, Xiong W, Zhang S, Hu S, Zhang L, Chen S, et al. The measurement and clinical significance of the rotation angles of head-neck fragments after cephalomedullary nail fixation in intertrochanteric fractures. Zhongguo Xiu Fu Chong Jian Wai Ke Za Zhi 2019;33:1228–33.
24. Li J, Zhang L, Zhang H, Yin P, Lei M, Wang G, et al. Effect of reduction quality on post-operative outcomes in 31-A2 intertrochanteric fractures following intramedullary fixation: A retrospective study based on computerised tomography findings. Int Orthop 2019;43:1951–9. [CrossRef]
25. Díaz VJ, Cañizares AC, Martín IA, Peinado MA, Doussoux PC. Predictive variables of open reduction in intertrochanteric fracture nailing: A report of 210 cases. Injury 2016;47:S51–5. [CrossRef]

ORİJİNAL ÇALIŞMA - *ÖZ*

İntertrokanterik femur kırıklarında anterior ve medial redüksiyonu sağlayan minimal invaziv basit bir teknik: Bir olgu kontrol çalışması

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AMAÇ: İntertrokanterik kırıkların AO/OTA 31-A2.2/A2.3 kırık tiplerinde kullanılan Verbrugge minimal invaziv tekniğinin klinik ve radyolojik sonuçlarını, traksiyon masasında yapılan kapalı redüksiyon tekniği ile kıyaslamaktır.

GEREÇ VE YÖNTEM: Çalışma geriye dönük olarak dizayn edildi. 2017–2020 yılları arasında kliniğimize intertrokanterik kırık nedeniyle başvuran 671 hasta değerlendirildi. Bu hastalardan; 70 yaş üzeri olan, bir yıldan uzun takipleri mevcut olan, kırık tipi AO/OTA 31-A2.2/A2.3 olan ve tarafımızca intramedüller çivileme uygulananlar çalışmaya dahil edildi. Bu kriterleri sağlamayan, patolojik kırığı olan, açık kırığı olan, geçirilmiş kalça operasyonu hikayesi olan hastalar çalışma dışı bırakıldı. Toplam 177 olgunun bu çalışmaya uygun olduğu tespit edildi. Hastalar; operasyonda Verbrugge minimal invaziv tekniği ile redüksiyon sağlananlar (Verbrugge reduction group, VRG) ve traksiyon masası ile kapalı redüksiyon sağlananlar (convantionel reduction group, CRG) olarak iki gruba ayrıldı. Radyolojik olarak redüksiyon kalitesi modifiye Chang yöntemi ile değerlendirildi, varus redüksiyon oranları karşılaştırıldı. Klinik sonuçlarda ise tam yük ile mobilizasyon zamanı, komplikasyon oranları, Harris Kalça Skoru (HHS) karşılaştırıldı.

BULGULAR: Verbrugge minimal invaziv tekniği ile redüksiyon sağlanan olgularda, traksiyon masasında redüksiyon sağlanan gruba göre varus malredüksiyonunun daha az görüldüğü, daha başarılı redüksiyon kalitesi elde edildiği, hastaların daha erken dönemde mobilize edilebildiği ve HHS'nin daha yüksek olduğu tespit edildi. Ameliyat süresi ve komplikasyonlar arasında anlamlı fark tespit edilmedi.

TARTIŞMA: Verbrugge yönteminin, traksiyon masasi ile kapalı redüksiyonun yeterli görülmediği tüm AO/OTA 31-A2.2 /A2.3 intertrokanterik femur kırıklarında kullanılabilecek; kırık redüksiyonunun kalitesini arttıran ve ameliyat boyunca korunmasını sağlayan, komplikasyon oranları açısından konvansiyonel redüksiyon yöntemi ile benzer, efektif bir teknik olduğu düşünülmektedir.

Anahtar sözcükler: İntertrokanterik kırıklar; minimal invaziv cerrahi; redüksiyon kalitesi.

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