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DO TRACTION-INTERNAL ROTATION X-RAYS HAVE AN AFFECT ON THE TREATMENT OPTIONS OF PROXIMAL FEMUR FRACTURES AMONG ORTHOPEDIC SURGEONS WITH DIFFERENT LEVELS OF EXPERTISE?

PROKSİMAL FEMUR KIRIKLARINDA ÇEKİLEN TRAKSİYON-İÇ ROTASYON GRAFİSİ FARKLI TECRÜBEDEKİ ORTOPEDİ HEKİMLERİNİN TEDAVİ SEÇENEKLERİNİ ETKİLİYOR MU?

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ABSTRACT

Objective: The purpose of the current study was to investigate whether the traction-internal rotation X-ray used in proximal femur fractures actually alters the implant choice among 12 different levels of expertise orthopaedic surgeons.

Material and Methods: The radiographs of 50 patients who were treated due to proximal femur fracture in our clinic were identified retrospectively. Twelve orthopaedic surgeons evaluated the patient X-rays in two different rounds, two weeks apart. Each observer was asked to independently examine the anteroposterior radiographs of both hips in the first round and the traction-internal rotation radiographs in the second round. Inter-observer agreement was determined using the Fleiss' Kappa statistic, while intra-observer agreement was calculated using the Kappa statistic.

Results: A total of 50 patients with proximal femur fractures were included in our study. 26 of the patients were female (52%) and 24 (48%) were male. The average age of the participants was 70 (50±94). The implant options were as follows: total hip arthroplasty, hemiarthroplasty, proximal femur nail, long femur nail, 95° AO blade plate, anatomical plate, cannulated screw and dynamic hip screw. The intraobserver agreement was found to be moderate to substantial (κ=0.44-0.68) in consultant trauma surgeons, moderate in senior orthopaedic surgeons (κ=0.47-0.56) and fair to moderate (κ=0.24-0.59) in orthopaedic residents. The

ÖZET

Amaç: Bu çalışmanın amacı, proksimal femur kırıklarında kullanılan traksiyon-iç rotasyon röntgeninin, 12 farklı uzmanlık seviyesindeki ortopedik cerrahlar arasında implant seçimini gerçekten değiştirip değiştirmediğini araştırmaktır.

Gereç ve Yöntem: Kliniğimizde proksimal femur kırığı nedeniyle tedavi edilen 50 hastanın radyografileri retrospektif olarak belirlendi. Hasta röntgenleri 12 ortopedik cerrah tarafından iki hafta arayla iki farklı turda değerlendirildi. İlk turda her gözlemciden her iki kalçanın ön-arka radyografilerini, ikinci turda ise traksiyon-iç rotasyon radyografilerini bağımsız olarak incelemeleri istendi. Gözlemciler arası uyum için Fleiss Kappa istatistiği, gözlemciler içi uyum için Cohen Kappa kat sayısı kullanıldı.

Bulgular: Çalışmamıza proksimal femur kırığı olan toplam 50 hasta dahil edildi. Hastaların 26'sı (%52) kadın, 24'ü (%48) erkekti. Katılımcıların yaş ortalaması 70 (50±94) idi. İmplant seçenekleri total kalça artroplastisi, hemiartroplasti, proksimal femur çivisi, uzun femur çivisi, 95° AO blade plak, anatomik plak, kanüllü vida ve dinamik kalça vidası olarak belirlendi. Gözlemciler içi uyum danışman travma cerrahlarında orta ila önemli (κ=0,44-0,68), kıdemli ortopedi cerrahlarında orta (κ=0,47-0,56) ve ortopedi asistanlarında ortanın altı ve orta (κ=0,24-0,59) olarak saptandı. Gözlemciler arasında uyum ise danışman travma cerrahları arasında orta ila önemli düzeyde (κ=0,56-0,62), kıdemli ortopedi cerrahlar

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inter-observer agreement was moderate to substantial between consultant trauma surgeons (κ=0.56-0.62), moderate agreement between senior orthopaedic surgeons and fair agreement between orthopaedic residents respectively (κ=0.45, κ=0.30).

Conclusion: Traction radiography is crucial in the proper classification of proximal femur fractures in accordance with the literature. This study shows that as professional experience increases, traction radiography increases the consistency in surgical implant selection.

Keywords: Hip fracture, traction-internal rotation X-ray, proximal femur

arasında orta derecede ve ortopedi asistanları arasında ortanın altı düzeyde (κ=0,45, κ=0,30) idi.

Sonuç: Traksiyon radyografisi proksimal femur kırıklarının literatüre uygun olarak doğru sınıflandırılmasında önemlidir. Bu çalışma mesleki deneyim arttıkça traksiyon radyografisinin cerrahi implant seçiminde tutarlılığı arttırdığını göstermektedir.

Anahtar kelimeler: Kalça kırığı, traksiyon-iç rotasyon röntgeni, proksimal femur

INTRODUCTION

Hip fractures are one of the most common trauma referrals to orthopaedic emergency departments (1). With the development of technology, an increase in the incidence of hip fractures is observed because of the prolonged life expectancy in the human population (1, 2). These hip fractures can occur in two different segments of the population (1). While a minority of the cases occurred in the younger generation usually caused by high-energy trauma, the major remaining part happened in the elderly due to numerous factors along with age-associated reduced bone quality (3). With the early diagnosis and correct treatment algorithm, this burden on the health system can be significantly reduced.

Several methods exist in the classification of proximal femoral fractures based on plain radiographs, but none has been shown to be practical with satisfactory reproducibility and reliability in literature reviews (4, 5).

In a suspected hip fracture, evaluation begins with a standard pelvis AP (anteroposterior) X-ray. In some clinics, cross table lateral is added in addition to the pelvis Anteroposterior (AP) X-ray (1). In rare cases, CT and MRI are also used in some occult hip fractures (6). Recognising the pattern of the fracture on radiographs is essential to determine the surgical treatment. The affected limbs of patients with proximal femur fractures usually appear in a short and externally rotated posture. The position of the extremity, considering the natural anteversion of the femur, the fracture pattern can be difficult to understand. Therefore, traction-internal rotation projection corrects the femoral anteversion and aligns the fracture.

Our aim in this study was to investigate whether the traction-internal rotation X-ray used in proximal femur fractures actually alters the treatment plan among 12 different levels of expertise orthopaedic surgeons.

MATERIAL AND METHODS

Study design and setting

This single-centre retrospective study was performed in the Department of Orthopaedics and Traumatology with permission of İstanbul Faculty of Medicine Clinical Research Ethics Committee (Date: 26.01.2024, No: 2).

Patient selection

Patients with fractures of 31A1/2/3 and its subtypes according to the new AO/OTA classification between 2022 and 2023 were retrospectively analysed (7). Standard plain Pelvis AP, cross table lateral and AP traction- internal rotation radiograph of 50 randomly selected patients were chosen from our hospital database via the Picture Archive and Communication System (PACS) and formed into two electronic folders. Demographic data of these patients including age and gender were also recorded (Table 1).

Table 1: Demographics of the patients

	Mean ± SD	Min-Max
Age, years	74.7±10	50-94
Gender, F/M	26/24 (52%-48%)	
Side (R/L)	33/17 (66%-34%)	

F: Female, M:Male, R: Right, L: Left

Inclusion criteria:

- Patients older than 18 years old
- Patients with fractures of 31A1/2/3 and its subtypes

Exclusion criteria:

- Patients younger than 18 years old
- Patients with concomitant proximal and diaphyseal or distal femur fractures
- Patients with femoral head fracture

The techniques of the images are given below.

AP pelvis (Figure 1a): Patient in supine position with the beam perpendicular to the pelvis and feet positioned in 15°-20° of internal rotation.

Cross table lateral (Figure 1b): Patient in the supine position with the radiation beams parallel to the table, the unaffected hip is abducted and flexed to >80°. With the affected limb in 15o internal rota- tion, the X-ray tube is placed at the foot of the opposite extremity and the beam is parallel to the table and 45° to the extremity.



Figure 1a: Anteroposterior (AP) X-ray of the hip.

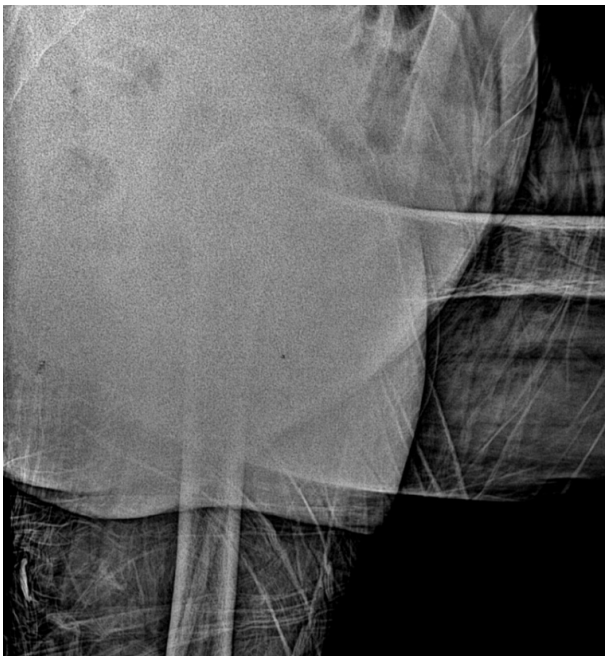


Figure 1b: Cross-table lateral X-ray of the hip.

Traction-internal rotation radiograph (Figure 1c): Patient in supine position with the beam perpendicular to the pelvis, the first assistant holds the patient from the armpits and the other assistant applies traction to the affected limb from the ankle until the limb length is equal to the other.

The X-rays were prepared in the digital platform and sent to the participants by e-mail. The operation technique and implant choice were asked participants with a 2-week interval. The operation techniques were consisted of three different modalities including open reduction-internal fixation group such as Dynamic hip screw (DHS), Screw fixation, 95 or 130 AO Blade, Anatomical Proximal Femur plate, intramedullary nailing (Short or long Intramedullary Nailing), arthroplasty (Hemiarthroplasty or Total Hip Replacement) which formed the treatment options.

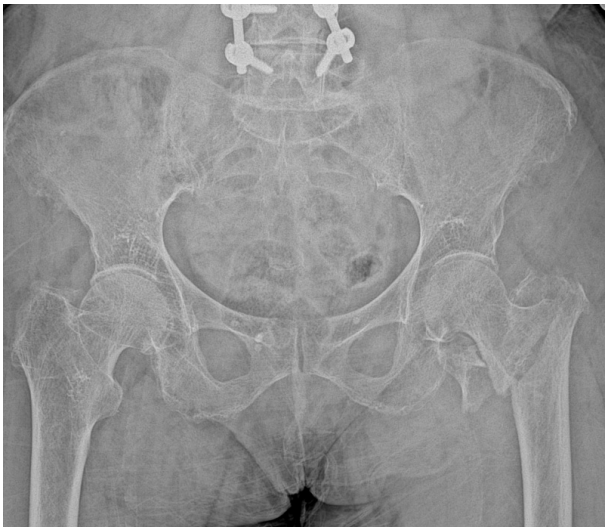


Figure 1c: Traction- internal rotation X-ray of the hip.

Twelve observers were selected in accordance with their orthopaedic experience as following; five consultant trauma surgeons, three senior orthopaedic surgeons and four orthopaedic residents

In the first step, the fracture side was shown randomly to the twelve orthopaedic physicians via standard pelvis radiograph and asked their surgical options. In the second step, all radiographs were mixed in a randomised sequence and the traction-internal rotation X-rays were added next to the standard pelvis AP radiograph and showed the participants two weeks after the initial survey. In this step, we asked about their surgical options again. In this way, the surgical preferences of each observer were obtained twice, two weeks apart, regardless of their initial choice.

Statistical analysis

The statistical data were analysed using SPSS (Statistical Package for the Social Sciences) version 27.0 (IBM SPSS Corp., Armonk, NY, USA). The mean, minimum–maximum, standard deviation (SD), and percentage were used as descriptive statistics.The value of $p<0.05$ was considered statistically significant. Inter-observer agreement was determined with The Fleiss' Kappa statistic, while intra-observer agreement was calculated with the Kappa statistic (Cohen's Kappa coefficient) in two time points (one month interval) individually (Table 2) (8).

RESULTS

A total of 50 patients with proximal femur fractures were included in our study. 26 of the patients were female (52%) and 24 (48%) were male. The average age of the participants was 70 (50–94) (Table 1).

Table 2: Kappa statistic agreement scores

Value of κ	Agreement
<0	Poor agreement
0.00-0.20	Slight agreement
0.21-0.40	Fair agreement
0.41-0.60	Moderate agreement
0.61-0.80	Substantial agreement
0.81-1.00	Almost perfect agreement

The inter-observer analysis for the first and second observational points are shown in Table 3, respectively. The inter-observer agreement was moderate to substantial between the consultant trauma surgeons (κ=0.56-0.62) (Table 3). On the other hand, moderate agreement was found between senior orthopaedic surgeons and fair agreement was found in orthopaedic residents respectively (κ=0.45, κ=0.30). When all the observers were taken into consideration, the interobserver agreement was found to be fair.

Intra-observer analysis of all participants is given in Table 4. The intra-observer agreement of the consultant trauma surgeons was found to be moderate to substantial (κ=0.44-0.68) (Table 4).

The intra-observer agreement of orthopaedic surgeons was found to be moderate (κ=0.47-0.56) (Table 4).

The intra-observer agreement of orthopaedic residents was found to be fair to moderate (κ=0.24-0.59) (Table 4).

Table 3: Inter-observer analyses for the comparison of the two observational points

Status	Fleiss' kappa (%95 CI)	Level of agreement
All observers		
First assessment	0.32 (0.31-0.34)	Fair
Second assessment	0.40 (0.37-0.41)	Fair
Consultant trauma surgeons (O-1, O-2, O-3, 0-4, and O-5)		
First assessment	0.56 (0.60-0.69)	Moderate
Second assessment	0.64 (0.6-0.68)	Substantial
Senior orthopaedic surgeons (O-6, O-7, and O-8)		
First assessment	0.52 (0.43-0.60)	Moderate
Second assessment	0.45 (0.37-0.54)	Moderate
Orthopaedic residents (O-9, O-10, O-11, and O-12)		
First assessment	0.32 (0.26-0.37)	Fair
Second assessment	0.30 (0.23-0.35)	Fair

DISCUSSION

The most important finding of our study is that intra- and inter-observer agreement is higher in experienced orthopaedic surgeons (consultants and seniors) after the use of traction radiography in the treatment choice of proximal femur fractures. Diagnosing and classifying proximal femur fractures has a significant impact on determining the optimal method of treatment and the overall prognosis of the patient (9).

Table 4: Intra-observer analyses for the comparison of the two observational points

	Observer	Cohen's K value (95% CI)	Level of agreement
Consultant trauma surgeons	O-1	0.68	Substantial
	O-2	0.53	Moderate
	O-3	0.64	Substantial
	O-4	0.59	Moderate
	O-5	0.44	Moderate
Senior orthopaedic surgeons	O-6	0.56	Moderate
	O-7	0.53	Moderate
	O-8	0.47	Moderate
Orthopaedic residents	O-9	0.24	Fair
	O-10	0.59	Moderate
	O-11	0.42	Moderate
	O-12	0.28	Fair

Dr. Witze identified the use of traction-internal rotation radiography in the diagnosis of hip fractures in 1974 (10). Although Dr. Witze originally identified it with its use of the diagnosis of subtle proximal femur fractures, it later began to be part of the standard radiographic series obtained for hip fracture at several departments of orthopaedics and traumatology (11).

A number of studies examining the necessity of traction X-ray were found in the literature review (12-14). A study by Koval et al. reported that routine traction radiography in proximal femur fractures is more accurate in fracture classification. Moreover, they also stated that this has a direct impact on accurate surgical planning and implant choice (12). Even though their study was conducted with 15 orthopaedic residents, in our study, fair agreement was found in the evaluation of implant selection with traction X-rays between resident physicians. A similar study was conducted by Khurana et al. in 2018 (13). X-rays were evaluated by 2 musculoskeletal radiologists. It was re-

ported in the study that traction radiography increased accuracy in proximal femur fracture classification even among radiologists. On the other hand, the universal classification of pertrochanteric fractures is the AO/OTA. Two recent studies were published about the reliability of the classification (15, 16). Both studies revealed that internal rotation traction X-rays did not improve the reliability of the new AO/OTA classification for pertrochanteric fractures as assessed by inter- and intra-observer agreement between different levels of expertised surgeons.

The unique aspect of our study was to examine the effects of traction X-rays on surgical implant choice among three groups of orthopaedic surgeons. Traction X-rays are important to distinguish whether the fracture is stable or unstable, especially in proximal femur fractures. Based on the literature, while DHS and intramedullary nails can be applied to stable fractures, intramedullary devices are more preferred for unstable fractures due to their biomechanical superiority (17, 18). A recent study similar to ours was conducted by Garcia-Serrano et al (14). In their study, 3 different groups of orthopaedic physicians (residents, seniors and trauma specialists) evaluated the necessity of traction radiography and found that traction X-rays can be used to modify the choice of the implant in pertrochanteric fractures.

Our study has some limitations. First, it is a retrospective study with a relatively small number of each type of fracture and not all the subgroups in the AO classification were included. This may have created a selection bias. Second, as it is known, lateral wall competency is a criterion for instability of the proximal femur fractures and is not taken into account when choosing an implant by the participants. Third, the interpretation was not based on computed tomography images, and the misdiagnosis of the classification may have affected the implant selection.

CONCLUSION

The accurate diagnosis of proximal femoral fractures is important in selecting the optimal surgical treatment. This study shows that traction radiography increases the agreement of implant selection of the proximal femur fractures, especially among experienced trauma surgeons. In this way, it becomes an important guide in the treatment algorithm.

Ethics Committee Approval: Ethics committee approval was received for this study from the İstanbul Faculty of Medicine Clinical Research Ethics Committee (Date: 26.01.2024, No: 2).

Informed Consent: Due to the retrospective design of the study, informed consent was not taken.

Peer Review: Externally peer-reviewed.

Author Contributions: Conception/Design of Study- Y.S., M.D.; Data Acquisition- T.F.Y., E.K.; Data Analysis/Interpretation – E.K., T.F.Y.; Drafting Manuscript- Y.S., E.K., M.D.; Critical Revision of Manuscript- E.K., Y.S., M.D.; Final Approval and Accountability- Y.S., M.D., C.Ş.; Technical or Material Support- M.D., Y.S.; Supervision- C.Ş., M.D., Y.S.

Conflict of Interest: The authors have no conflict of interest to declare.

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REFERENCES

1. Emmerson BR, Varacallo MA, Inman D. Hip Fracture Overview. In: StatPearls. Treasure Island (FL): StatPearls Publishing; 2023.
2. Johnell O, Kanis JA. An estimate of the worldwide prevalence and disability associated with osteoporotic fractures. Osteoporos Int 2006;17(12):1726-33. [CrossRef]
3. Deandrea S, Lucenteforte E, Bravi F, Foschi R, La Vecchia C, Negri E. Risk factors for falls in community-dwelling older people: a systematic review and meta-analysis. Epidemiology 2010;21(5):658-68. [CrossRef]
4. Blundell CM, Parker MJ, Pryor GA, Hopkinson-Woolley J, Bhonsle SS. Assessment of the AO classification of intracapsular fractures of the proximal femur. J Bone Joint Surg Br 1998;80(4):679-83. [CrossRef]
5. Andersen E, Jorgensen LG, Hededam LT. Evans' classification of trochanteric fractures: an assessment of the interobserver and intraobserver reliability. Injury 1990;21(6):377-8. [CrossRef]
6. Deleanu B, Prejbeanu R, Tsiridis E, Vermesan D, Crisan D, Haragus H, et al. Occult fractures of the proximal femur: imaging diagnosis and management of 82 cases in a regional trauma center. World J Emerg Surg 2015;10:55. [CrossRef]
7. Meinberg EG, Agel J, Roberts CS, Karam MD, Kellam JF. Fracture and dislocation classification compendium-2018. J Orthop Trauma 2018;32(Suppl 1):S1-170. [CrossRef]
8. Landis JR, Koch GG. The measurement of observer agreement for categorical data. Biometrics 1977;33(1):159-74. [CrossRef]
9. Ly T, Swiontkowski M. Intracapsular hip fractures. Skeletal trauma: basic science, management, and reconstruction Fifth Edit Philadelphia, PA: Saunders. 2014:1607-81.
10. Wiltse LL. Internal rotation for the diagnosis of impacted fracture of the hip. Clin Orthop Relat Res 1974;(103):20. [CrossRef]
11. Mitchell PM, Gavrilova SA, Dodd AC, Attum B, Obremskey WT, Sethi MK. The impact of resident involvement on outcomes in orthopedic trauma: An analysis of 20,090 cases. J Clin Orthop Trauma 2016;7(4):229-33. [CrossRef]
12. Koval KJ, Oh CK, Egol KA. Does a traction-internal rotation radiograph help to better evaluate fractures of the proximal femur? Bull NYU Hosp Jt Dis 2008;66(2):102-6.
13. Khurana B, Mandell JC, Rocha TC, Duran-Mendicuti MA, Jimale H, Rosner B, et al. Internal rotation traction radiograph improves proximal femoral fracture classification accuracy and agreement. AJR Am J Roentgenol 2018;211(2):409-15. [CrossRef]

14. Garcia-Serrano MC, Garcia-Guerrero LF, Gomez-Gelvez A, Pinzon-Rendon AA. Diagnostic imaging concordance study: Are traction radiographs necessary in a hip fracture? Injury 2021;52(6):1445-9. [CrossRef]
15. Chan G, Hughes K, Barakat A, Edres K, da Assuncao R, Page P, et al. Inter- and intra-observer reliability of the new AO/OTA classification of proximal femur fractures. Injury 2021;52(6):1434-7. [CrossRef]
16. Perez-Abdala JI, Huespe I, Vildoza S, Novillo M, Llano L, Carabelli G, et al. The internal rotation traction radiograph does not improve the reliability in the AO classification system for pertrochanteric fractures. An inter- and intra-observer reliability assessment. Injury 2023;54(Suppl 6):110779. [CrossRef]
17. Socci AR, Casemyr NE, Leslie MP, Baumgaertner MR. Implant options for the treatment of intertrochanteric fractures of the hip: rationale, evidence, and recommendations. Bone Joint J. 2017;99-B(1):128-33. [CrossRef]
18. Alessio-Mazzola M, Traverso G, Coccarello F, Sanguineti F, Formica M. Dynamic hip screw versus intramedullary nailing for the treatment of A1 intertrochanteric fractures: A retrospective, comparative study and cost analysis. Jt Dis Relat Surg 2022;33(2):314-22. [CrossRef]