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Clinical and functional analysis of closed reduction-plastering and volar locking plate methods in distal radius fractures in patients over 60 years of age

60 yaş üstü hastalardaki distal radius kırıklarında kapalı redüksiyon-alçılama ile volar kilitli plak yöntemlerinin klinik ve fonksiyonel analizi

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ABSTRACT

Aim: Many different methods have been described in the treatment of distal radius fractures (DRF) in the elderly population, and which one is the better method is a matter of debate among orthopedic surgeons. The aim of this study was to compare the results of closed reduction and plastering (CRP) and volar locking plate (VLP), which are used in the treatment of DRF in the elderly population.

Materials and Methods: Between January 2019 and December 2020, 36 patients with DRF aged > 60 years were evaluated retrospectively. There were 19 patients in the CRP group and 17 patients in the VLP group. Wrist flexion, extension, pronation, supination, ulnar deviation, and radial deviation degrees and grip strength were measured in the first year of their treatment. The patients were evaluated functionally by patient-rated wrist evaluation (PRWE), modified Green and O'Brien score (MGOS), and resting and stress visual analogue scale (VAS).

Results: In both groups, similar ROM values were obtained and no significant difference was observed. While the PRWE score was 17.5 ± 5.5 in the CRP group and 12.5 ± 4.8 in the VLP group, the MGOS score was 83.0 ± 7.4 in the CRP group and 86.8 ± 12.6 in the VLP group, and the scores were not significantly different ($p = 0.802$, $p = 0.315$). While there was almost no pain in both groups at rest, more pain was felt in the VKP group under stress. While grip strength was 20.9 ± 6.4 kg in the CRP group, it was 22.2 ± 6.8 kg in the VLP group, and there was no significant difference compared to the contralateral wrist.

Conclusion: There is no clinical and functional difference between CRP and VLP in the one-year period after DRF treatment in the patient population aged > 60 years. Treatment should be planned according to the functional capacity of the patient.

Keywords: Distal radius, wrist fracture, closed reduction, plastering, volar locking plate.

ÖZ

Amaç: *Yaşlı popülasyonda meydana gelen distal radius kırıklarının (DRK) tedavisinde pek çok farklı yöntem tanımlanmış olup hangisinin daha iyi bir yöntem olduğu ortopedik cerrahlar arasında tartışma konusudur. Bu çalışmanın amacı yaşlı popülasyondaki DRK tedavisinde tercih edilen kapalı redüksiyon-alçılama (KRA) ve açık redüksiyon-internal fiksasyon ile volar kilitli plak (VKP) tedavilerinin sonuçlarını karşılaştırmaktır.*

Gereç ve Yöntem: *Ocak 2019-Aralık 2020 tarihleri arasında > 60 yaş DRK bulunan 36 hasta retrospektif olarak değerlendirildi. KRA grubunda 19, VKP grubunda ise 17 hasta mevcuttu. Hastaların tedavilerinin birinci yılında el bileği eklem hareket açıklıkları ölçüldü. El dinamometresi yardımıyla el bileği kavrama gücüne bakıldı. Ayrıca hastalar patient-rated wrist evaluation (PRWE), modified Green ve O'brien score (MGOS), istirahat ve stres visual analogue scale (VAS) ile fonksiyonel olarak değerlendirildi.*

Bulgular: *Her iki grupta da takiplerinin birinci yılında el bilekte benzer eklem hareket açıklığı değerleri elde edilmiş olup anlamlı bir fark görülmedi.*

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PRWE skoru, KRA grubunda 17,5 ± 5,5, VKP grubunda 12,5 ± 4,8 iken MGOS skoru KRA grubunda 83,0 ± 7,4 VKP grubunda 86,8 ± 12,6 bulunmuş olup her iki skor arasındaki fark istatistiksel olarak anlamlı değildi (p=0,802, p=0,315). İstirahat anında her iki grupta da neredeyse hiç ağrı yok iken stres altında VKP grubunda daha çok ağrı hissedilmiştir. Kavrama gücü KRA grubunda 20,9 ± 6,4 kg iken VKP grubunda 22,2 ± 6,8 kg ölçülmüş olup sağlam el bileğine göre anlamlı fark bulunamadı.

Sonuç: *60 yaş üstü hasta popülasyonundaki DRK tedavi sonrası bir yıllık süreçte KRA ve VKP yöntemleri arasında klinik ve fonksiyonel sonuçlar açısından fark bulunmamaktadır. Hastanın fonksiyonel kapasitesine göre tedavi planlaması düşünülmelidir.*

Anahtar Sözcükler: *Distal radius, el bileği kırığı, kapalı redüksiyon, alçılama, volar kilitli plak.*

INTRODUCTION

Distal radius fractures (DRFs) are common upper extremity fractures, with an incidence of up to 18% in the elderly population (1). The most common age groups for DRFs to peak are 18-25 years and > 65 years and they show a bimodal distribution (1). While they usually occur after high-energy traumas in young people, low-energy traumas with the effect of osteoporosis cause DRFs in the elderly (1). Osteoporosis weakens the metaphyseal bone by causing a decrease in trabecular bone volume, and therefore more unstable fractures due to metaphyseal defects are seen in DRFs in the elderly (2, 3).

There are non-surgical and surgical treatment methods for the treatment of DRFs, including closed reduction-plastering (CRP), Kirschner-wire pinning, external fixation, and open reduction-internal fixation (ORIF) with a volar locking plate (VLP) (4-6). External fixation and Kirschner-wire pinning are not used much due to high infection rates (7, 8). In general, CRP gives satisfactory results in the treatment of stable fractures, while a VLP via ORIF is recommended for unstable intra-articular fractures and in cases in which reduction continuity with plastering cannot be achieved (9, 10).

In elderly population, the treatment of DRFs is highly controversial. Although there are studies comparing operative and non-operative treatments of DRFs in the elderly (> 60 years) in the current literature, the results are not conclusive (4, 7, 9). According to a meta-analysis, surgical and non-surgical treatments have their own advantages and disadvantages (10). Although the possibility of anatomical reconstruction and stable fixation is higher in surgical treatment, it carries risks due to various comorbidities in elderly patients. According to some authors, non-surgical treatment is at the forefront, since radiographic anatomic reduction and alignment are not correlated with better functional outcomes in elderly patients compared to in younger patients (11, 12).

The aim of the present study was to evaluate patients in the elderly population with DRFs treated with CRP and VLP via ORIF, clinically and functionally, and compare the results of both treatment methods.

MATERIALS and METHODS

First of all, approval was obtained from the ethics committee of our institution for this study (ID: E1-21-2020 Date: 22/09/2021). Between January 2019 and December 2020, 51 patients who presented to the emergency department of our hospital due to DRFs were evaluated retrospectively. The study's inclusion criteria were as follows: patients > 60 years and treated with CRP or VLP via ORIF for DRFs. The exclusion criteria were as follows: < 60 years old, open fracture, pathological fracture, fracture dislocations, ipsilateral limb injuries, previous wrist fracture history, patients who underwent re-intervention due to reduction loss in conservative follow-up, and patients with advanced dementia and without regular clinical follow-up. Finally, the study went ahead with 36 patients who met these criteria. The patients were divided into two groups as patients treated with CRP and VLP. There were 19 patients (8 male, 11 female, mean age: 68.8 ± 2.7 range: 61-74) in the CRP group and 17 patients (9 male, 8 female, mean age: 69.9 ± 1.9 range: 62-81) in the VLP group. There was a mean follow-up period of 23.5 ± 5.7 months for CRP and 24.2 ± 6.1 months for VLP.

Non-surgical treatment protocol

CRP was applied to the patients in this group under sedation in the emergency room. After reduction, distal radius alignment was checked and below-elbow plaster was applied. No repetitive manipulation was applied to the patients. Afterwards, immediate radiographs were taken in the emergency room and the

reduction was confirmed. The criteria for acceptable reduction were > 5 mm radial height, > 15° radial inclination, 0-15° volar tilt, < 2 mm ulnar variance, and < 2 mm articular step-off or gap (13). Reduction was determined by radiography every 2 weeks and the casts were kept in a neutral position for 6 weeks (Figure-1). Active digital range of motion (ROM) exercises were given immediately after removal of the cast. Physiotherapy was started after plastering.

Surgical treatment protocol

All patients were operated on in the supine position under axillary brachial plexus block by the same surgeon. The modified Henry volar approach was used for fracture fixation. An incision was made between the flexor carpi radialis muscle and the radial artery. The pronator quadratus muscle was lifted in an L shape and the fracture was exposed. Fracture fixation with VLP was completed following the articular reduction. No patient required additional bone grafting. Fracture reduction was confirmed by fluoroscopy. The pronator quadratus muscle was repaired and the incision was closed. For postoperative pain control, the wrist was immobilized with a below-elbow splint for approximately 2 weeks (Figure-2). Active digital ROM exercises were given immediately after surgery. Two weeks after surgery the sutures and the splint were removed and physiotherapy was started.

Functional assessment

Wrist examinations were performed in the first year of the patients' treatment and, with the help of goniometry, involved wrist flexion (0°-90°), extension (0°-90°), pronation (0°-90°), supination (0°-90°), ulnar deviation (0°-30°), and radial deviation (0°-20°) degrees were measured. The grip strength of both the involved and contralateral wrists was measured with the help of a hand dynamometer (JAMAR®) (Figure-3). In addition, patients were evaluated functionally by patient-rated wrist evaluation (PRWE) (range, 0–150, with 0 for being asymptomatic), modified Green and O'Brien score (MGOS) (range, 100–0, with 100 for the best result), and at rest and under stress visual analogue scale (VAS) (VAS 0 = no pain, VAS 10 = severe pain) (14, 15).

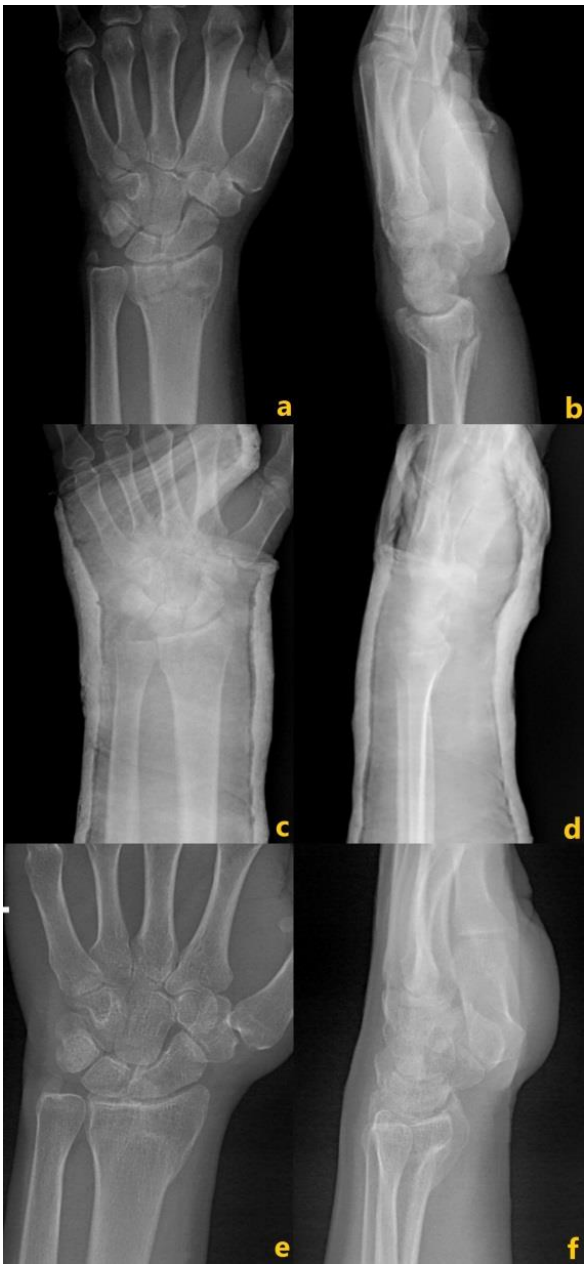

Figure-1. Anteroposterior (AP) **(a)** and lateral **(b)** radiographs of a 68-year-old female patient who presented to the emergency department after a simple fall showed a displaced distal radius fracture. In the AP **(c)** and lateral **(d)** radiographs of the patient taken after closed reduction and plastering treatment in the emergency room, it is seen that the fracture was reduced. In the AP **(e)** and lateral **(f)** radiographs taken 6 weeks after the plaster treatment was completed, it is seen that the fracture has healed in the anatomical alignment.

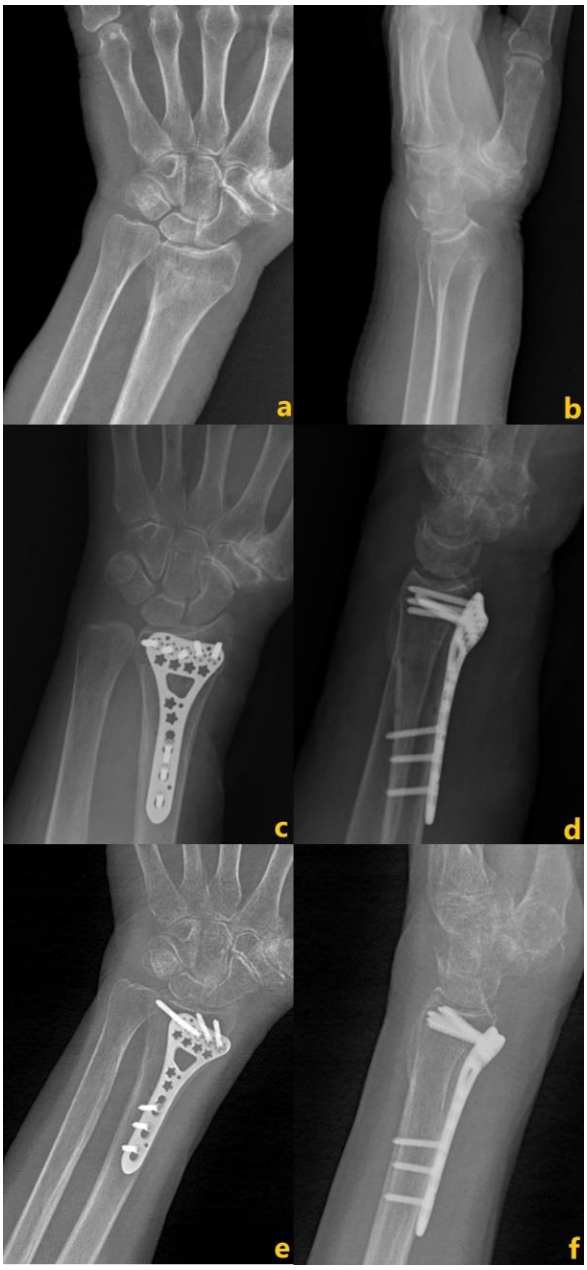

Figure 2. Anteroposterior (AP) **(a)** and lateral **(b)** radiographs of a 64-year-old male patient who presented to the emergency department after a simple fall showed a displaced distal radius fracture. In the immediate postoperative AP **(c)** and lateral **(d)** radiographs of the patient who underwent volar locking plate via open reduction and internal fixation, anatomical reduction was observed. In the AP **(e)** and lateral **(f)** radiographs of the patient taken 6 weeks after surgery, complete healing was achieved in the fracture line.

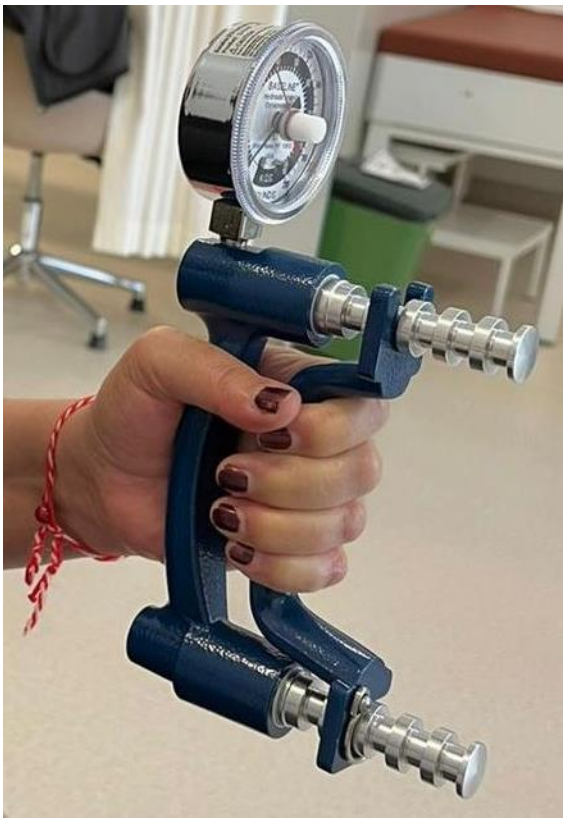

Figure-3. Appearance of the hand dynamometer used in the measurement and measurement of wrist grip strength.

Statistical Analyses

Statistical analyses were performed using SPSS (Version 25.0, SPSS Inc., Chicago, IL, USA). If continuous variables were normally distributed, they were described as the mean ± standard deviation ($p > 0.05$ in the Kolmogorov–Smirnov test or Shapiro–Wilk test ($n < 30$)), and if the continuous variables were not normally distributed, they were described as the median. The continuous variables were compared by the use of Student's t test or the Mann–Whitney U test depending on parametric or non-parametric values, respectively. The categorical variables between the groups were analyzed by using the chi square test or Fisher's exact test. The level for statistical significance was predetermined at $p < 0.05$.

RESULTS

The demographic information, ROM of the involved wrist, and functional scores of the patients in both treatment groups are shown in Table-1. The mean age, sex distribution, and involved extremity characteristics of the patients

were similar between the groups. Considering the ROM of the joint, although slightly better results were obtained in the CRP group in flexion, supination, pronation, and radial deviation movements and in the VLP group in extension and ulnar deviation movements, there was no significant difference between the two groups in any value. Although better scores were observed in the VLP group in terms of functional scores, the difference between the two groups was not statistically significant.

The VAS scores of the patients at rest and under stress are presented in Table-2. Almost all of the patients in both groups did not feel pain, especially at rest. At the time of stress, however, there was a more heterogeneous distribution, and there was no significant difference between the two groups in terms of all VAS values.

The grip strength measured by hand dynamometer of the involved and contralateral wrists of the patients in both groups is shown in Table-3. Although the involved wrist showed some loss in grip strength compared to the contralateral wrist in both treatment groups, there was no significant difference.

Table-1. Comparison of demographic characteristics, range of motion and functional status of patients in both treatment groups.

	CRP (Mean ± SD)	**VLP (Mean ± SD)**	**p**
Age (years)	68,8 ± 2,7	69,9 ± 1,9	0,684
Gender (n)			
Male	8	9	0,726
Female	11	8	
Involved Wrist (n)			
Right	9	9	1,000
Left	10	9	
Flexion (°)	66,2 ± 9,9	63,5 ± 12,5	0,639
Extension (°)	60,3 ± 6,8	65,0 ± 10,9	0,146
Supination (°)	86,0 ± 5,4	85,0 ± 4,7	0,415
Pronation (°)	88,2 ± 3,8	85,9 ± 4,4	0,129
Ulnar Deviation (°)	26,0 ± 6,1	28,8 ± 4,5	0,244
Radial Deviation (°)	15,8 ± 4,2	14,7 ± 4,1	0,471
PRWE	17,5 ± 5,5	12,5 ± 4,8	0,802
MGOS	83,0 ± 7,4	86,8 ± 12,6	0,315

CRP: Closed reduction and plastering, VLP: Volar locking plate, PRWE: Patient rated wrist evaluation, MGOS: Modified Green and O'Brien score, SD: Standard deviation

Table-2. Distribution of patients in both treatment groups according to VAS values at rest and stress.

	CRP		**VLP**		**p**
VAS at Rest	n	%	n	%	
0	18	94,7	17	100,0	1,000
1	1	5,3	0	0,0	
VAS Under Stress					
0	10	52,6	7	41,2	0,396
1	4	21,1	6	35,3	
2	3	15,8	4	23,5	
3	2	10,5	0	0,0	

CRP: Closed reduction and plastering, VLP: Volar locking plate, VAS: Visual analogue scale

Table-3. Comparison of involved and contralateral wrist grip strengths of patients in both treatment groups.

		Grip Strength (kg) (Mean ± SD)	p
CRP	İnvolved Wrist	20,9 ± 6,4	0,594
	Contralateral Wrist	22,4 ± 5,8	
VLP	İnvolved Wrist	22,2 ± 6,8	0,230
	Contralateral Wrist	24,9 ± 6,5	

CRP: Closed reduction and plastering, VLP: Volar locking plate, SD: Standard deviation

No neurovascular complication was observed in the patients during the treatment or follow-up periods. Two patients in the CRP group had skin wounds due to plaster compression, but this healed with dressing after the plaster was removed. In the VLP group, a superficial infection developed in the incision line in the early postoperative period in one patient, but the infection completely disappeared with antibiotic treatment.

DISCUSSION

Since the production and introduction of the VLP, the frequency of surgical treatment of DRFs has increased significantly (16). Studies, especially in young and active patients, have shown a significant correlation between anatomical reduction and functional outcomes (17,18). ORIF is recommended to restore articular congruity and radial alignment in young patients, to prevent posttraumatic wrist arthrosis, and to achieve good functional results (18,19). On the other hand, there are not many studies in the literature showing a clear relationship between anatomical restoration of the joint and functional outcomes in elderly patients. In the current study, non-surgical and surgical treatment methods in the elderly population were compared clinically and functionally.

In patients treated with CRP or VLP via ORIF, the main goal is to provide the joint with functional ROM by creating articular congruity. In a prospective randomized study conducted by Arora et al. in patients aged 65 and over, 36 patients treated with VLP via ORIF and 37 patients treated with cast immobilization were compared (6). No significant difference was reported between the two groups in terms of the degrees of supination, pronation, ulnar deviation, and radial deviation (6). Egol et al. compared the operative and non-operative treatment groups of patients over 65 years of age with displaced DRFs (7). According to a systematic review and meta-analysis comparing non-surgical and surgical treatment of DRFs in the elderly population, there was no significant difference in wrist extension, pronation, or supination between the two groups, whereas greater wrist flexion and radial and ulnar deviation were achieved in the non-surgical group (10). In the current study, extension, flexion, supination, pronation, ulnar deviation, and radial deviation parameters measured to evaluate the wrist joint ROM were compared and no significant difference was found between the CRP and VLP groups.

Functional scoring tests are generally used to evaluate outcomes in treated patients. Arora et al. followed up 130 patients over the age of 70 who were treated with VLP and CRP for approximately 55 months, and reported that there was no significant difference between the two groups in terms of PRWE or MGOS scores and that the level of pain was lower in the CRP group (5). In a randomized clinical trial comparing VLP and CRP in the treatment of DRFs in the elderly population, no significant difference was found between the two treatment groups in PRWE; Disabilities of the Arm, Shoulder and Hand questionnaire (DASH); or pain scores in the first year of follow-up (20). Hassellund et al. evaluated 100 patients aged > 65 years with displaced DRFs functionally with QuickDASH and PRWE in the first year after treatment and found no significant difference between the two groups (21). In another study conducted in 75 patients over 65 years of age, it was reported that there was no difference between the first-year DASH and MGOS scores of patients treated with VLP or CRP (22). Arora et al. found no statistically significant difference between post-treatment pain at rest and pain under stress values in DRFs treated with VLP and CRP (6). In our study, the patients in both treatment groups were evaluated

with PRWE, MGOS, and VAS scores at rest and under stress in the first year of their treatment. There was no significant difference between the two methods in terms of functionality. Again, there was almost no pain at rest in either group. When the pain values under stress were examined, the number of patients who had no pain was higher in the CRP group.

One of the parameters used in the functional evaluation after DRFs is the grip strength of the hand/wrist. The more grip strength is gained after the treatment, the more successful the treatment will be. In a randomized prospective study by Martinez-Mendez et al., 97 patients who underwent CRP and VLP were compared in the second year of treatment and although there was a loss of grip strength in both groups compared to the unaffected side, no significant difference was found between them (13). According to a systematic review and meta-analysis evaluating 8 studies, there was no difference in grip strength between the operative and non-operative treatment groups (10). Arora et al., supporting these views, did not report a significant difference in grip strength in DRFs treated with VLP and CRP (5). On the other hand, in another study, significantly better grip strength was obtained in the ORIF group 3 months after treatment, while there was no difference in grip strength between the ORIF and CRP groups at the 6- and 12-month check-ups (22). In the present study, although lower grip strength was observed on the involved side compared to the contralateral side in the patients in both treatment groups in the first year of treatment, no significant difference was found between the two groups, similar to the literature.

There are some limitations of the present study. First of all, it was a retrospective study. Second, the treatment method applied was usually the joint decision of the patient and the surgeon and was not randomized. Third, radiological parameters were not taken into account in patients; only fracture union was evaluated. Fourth, although all patients were over the age of 60, the functional capacity of each patient was different, which affected the treatment results. Finally, the number of patients was not very large and the follow-up period was not very long. More patients and longer follow-up are needed.

CONCLUSION

There is no clinical or functional difference between surgical and non-surgical treatments for DRFs in the patient population over 60 years of age within one year of treatment. Whichever method is used in the treatment, the important thing is to ensure anatomical alignment and joint harmony. Considering the risks of surgical procedures and the cost of surgical treatment in the elderly population, CRP should be prioritized.

Conflicts of interest: The authors declare that they have no conflict of interest.

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