



수장측 잠금 금속판을 이용하여 치료한 원위 요골 골절 환자에서 동시에 발생한 고관절 골절이 미치는 영향: 고령 환자들을 대상으로 한 짝짓기 분석

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Effect of Coincident Hip Fracture on Distal Radius Fracture in Patients Treated with a Volar Locking Plate: A Matched-Pair Analysis of Elderly Patients

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Received April 5, 2024

Revised May 27, 2024

Accepted May 27, 2024

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Financial support: None.

Conflict of interests: None.

Purpose: Although the incidence of simultaneous distal radius and hip fractures in older patients is minimal, patients with these coincident types of fractures exhibit unique features. This study analyzed the outcomes associated with operative treatment involving volar-locking plates in patients who sustained distal radius fractures and hip fractures and compared them with those in matched control patients who had undergone treatment for isolated distal radius fractures.

Materials and Methods: Between 2010 and 2015, 34 patients, who met the criteria for hip and distal radius fractures, were retrospectively reviewed. Thirty-four matched patients who underwent volar-locking plate fixation for isolated distal radius fractures during the same period were also reviewed. The clinical outcomes between the groups were compared using postoperative radiological parameters.

Results: The radiological assessment revealed a better radial length and inclination in the control group than in the study group at the final follow-up. In other words, patients with coincident hip fractures showed a higher tendency for loss of reduction. Despite the differences in radiological parameters, no significant differences in clinical outcomes were observed, except for grip strength.

Conclusion: Although volar-locking plating provides greater stabilization, a loss of reduction occurred in patients with coincident hip fractures.

Key Words: Radius, Hip, Colles' fracture, Hip fractures

Introduction

Although several studies have evaluated the epidemiology of isolated hip and wrist fractures associated with osteoporosis in older populations, information regarding patients who have experienced simultaneous hip and distal radius fractures remains limited.¹⁻⁴⁾ The incidence of simultaneous distal radius and hip fractures in older patients is minimal;

rosis in older populations, information regarding patients who have experienced simultaneous hip and distal radius fractures remains limited.¹⁻⁴⁾ The incidence of simultaneous distal radius and hip fractures in older patients is minimal;

however, patients with these types of coincident fractures exhibit unique features.²⁾ Uzoigwe et al.⁴⁾ found these combination fractures to be considerably more prevalent in females and reported that these patients required a greater length of hospitalization. Tow et al.³⁾ also reported that even though significant differences were not observed, patients with coincident hip and wrist fractures were more osteoporotic than those who had isolated hip fractures.

Few studies have investigated the effect of coincident distal radius fractures on the outcome of hip fractures. A recent meta-analysis reported that although coincident hip and distal radius fractures did not increase mortality, these combined fractures significantly increased the length of hospitalization compared to isolated hip fractures.⁴⁾ However, information regarding the effects of coincident hip fractures on the outcome of distal radius fractures still remains limited.

Therefore, this study aimed to compare the outcomes of operative treatment with volar-locking plates in patients who sustained distal radius fractures and hip fractures with that in matched control patients who sustained isolated distal radius fractures.

Materials and Methods

This study was approved by the Institutional Review

Board of Chung-Ang University Hospital (No. 1809-002-16202), and the written informed consent was waived due to the study's retrospective design. We retrospectively evaluated 758 patients who underwent volar-locking plate fixation for distal radius fractures at Chung-Ang University Hospital between January 2010 and December 2015. The following patients were excluded: 368 patients aged <65 years, 12 with ipsilateral upper-limb injuries, 14 with open fractures, 8 treated with additional dorsal plating or screws, and 18 with <6 months of follow-up. Among the remaining 338 patients, we identified patients who had undergone simultaneous hip-fracture surgery. Hip fractures were defined as fractures of either the intracapsular femoral neck or extracapsular peritrochanteric fractures. We also investigated patients who had undergone volar-lock plating for isolated distal radius fractures during the same period in order to compare radiologic and clinical outcomes in our study group with those in a matched control group of patients. Distal radius fractures were classified using the AO Foundation and Orthopaedic Trauma Association (AO/OTA) classification. A total of 34 patients who met the criteria of both hip and distal radius fractures were included in our study group, and 34 matching patients were selected from a population of 304 patients who underwent volar-lock plating for isolated distal radius fractures. To perform the retrospective matched-paired analysis, patients were

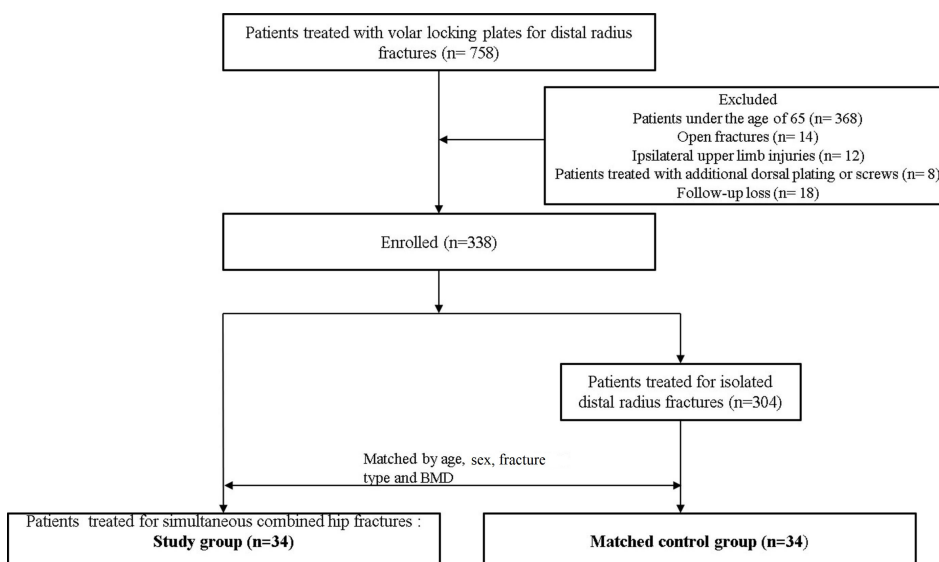


Fig. 1. Flow chart of study subjects. BMD: bone mineral density.

Results

matched for age (within 2 years), sex, fracture classification, and bone mineral density (BMD) (within 1 T-score) (Fig. 1).

All surgical procedures for hip fractures were performed by an experienced hip surgeon with ≥ 10 years' experience. Operations for distal radius fractures were performed by an experienced orthopedic hand surgeon using the standard trans-flexor carpi radialis approach, and all distal radius fractures were fixed using a volar-locking plate (Variable Angle LCP®; Depuy Synthes). All patients in the study and control groups were provided with a removable splint for 4 weeks following the operation and allowed early range of motion of their wrist and fingers. Routine follow-up visits were scheduled for 6 weeks as well as 3, 6, and 12 months. During visits, dual energy X-ray absorptiometry (DXA) was conducted at the femur neck to evaluate osteoporosis in all patients. Wrist radiography was obtained at each follow-up visit to evaluate the loss of reduction; radiological parameters, including radial inclination, radial length, and volar tilt, were measured immediately after the operation and at the final follow-up. All images were evaluated by two experienced hand surgeons. The reliability of measurements was assessed using intraclass correlation coefficients, which were interpreted as "poor" if values were <0.4 , "marginal" if values were ≥ 0.4 and <0.75 , and "good" if values were ≥ 0.75 . Follow-up examinations conducted at each follow-up included wrist range of motion, measured using a goniometer; grip strength, measured using a dynamometer; and functional outcome, measured using the Quick Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire. Pain was investigated using a 10-point visual analog scale (VAS), with 0 indicating no pain and 10 indicating severe pain.

The Student *t*-test was performed to analyze continuous variables, and the chi-squared or Fisher exact test was used for categorical variables. Cox's proportional hazards ratio was used to determine the effect of concomitant hip fracture in patients with wrist fracture while adjusting for age and sex. IBM SPSS Statistics (ver. 23.0; IBM Corp.) was used for all statistical analyses, and $p < 0.05$ was considered statistically significant.

Thirty-four patients who met the criteria of concurrent hip and distal radius fractures were treated at Chung-Ang University Hospital. The patients in our study group included 1 males and 33 females, with a mean age of 76.06 years (range, 65–85 years) and mean T-score of -3.56 (range, -5.6 to -2.5). The study group comprised 14 patients with femur-neck fractures and 20 with intertrochanteric fractures. The methods of hip-fracture fixation included hemiarthroplasty, nail fixation, dynamic screw fixation, and cannulated screw fixation. All patients underwent simultaneous surgery for combined fractures, and all distal radius fractures were ipsilateral to the hip fractures. The 34 matched pairs exhibited no significant differences in demographics, including AO/OTA classification (Table 1). The median duration of follow-up was 8 months (range, 6–36 months) in the study group and 10 months (range, 6–24 months) in the control group ($p=0.44$). According to the radiological assessment, no significant differences were observed between the groups in all radiological parameters immediately after the operation. At the final follow-up, however, radial length and inclination were better in the control group than in the study group (Table 2, Fig. 2). The intraclass correlation coefficient values were good for volar tilt (intra-observer, 0.89; inter-observer, 0.82), radial inclination (intra-observer, 0.92; interobserver, 0.89), and

Table 1. Comparative Characteristics between the Study Group and the Control Group

	Study group	Control group	p-value
Sample size	34	34	
Age (yr)	76.06 $\pm$ 5.03	76.56 $\pm$ 4.60	0.67
Sex ratio, male:female	1:33	1:33	>0.99
Mean BMI (kg/m ²)	24.8 $\pm$ 4.2	25.9 $\pm$ 3.9	0.78
Femoral neck T-score	-3.56 $\pm$ 0.92	-3.48 $\pm$ 0.85	0.69
Femoral neck BMD (g/cm ²)	0.63 $\pm$ 0.15	0.68 $\pm$ 0.13	0.15
AO/OTA classification			
A	14	14	>0.99
B	3	3	>0.99
C	17	17	>0.99

Values are presented as number only or mean $\pm$ standard deviation. BMI: body mass index, BMD: bone mineral density, AO/OTA: AO Foundation and Orthopaedic Trauma Association.

radial length (intra-observer, 0.85; interobserver, 0.82). The clinical and functional outcomes at the final follow-up are presented in Table 3. At the final follow-up, the wrist range of motion, including extension/flexion and supination/pronation, was not significantly different between the groups. Furthermore, no differences in pain scores and functional status were detected between the groups based on VAS and the Quick DASH scores, respectively. However, those with concomitant distal radius and hip fractures had significantly worse grip strength than those in the control group ($p<0.05$).

Discussion

The results of this study indicate that patients who had a combination of hip and radial fractures had a greater loss of radial length and inclination than those who exclusively had radial fractures. However, these results did not have any effect on functional outcome, except for the grip strength.

Distal radius fractures represent 18% of all fractures

in patients aged >65 years, with the incidence increasing markedly in females aged >65 years due to a greater risk of osteoporosis.⁵⁾ Previous studies have demonstrated that a history of distal radius fracture is associated with an increased risk of subsequent hip fracture and/or simultaneous occurrence of these fractures in older populations.¹⁻⁴⁾ Mulhall et al.¹⁾ conducted a retrospective analysis of patients with concomitant hip and upper-limb fractures and found distal radius fractures to be the most common upper-limb fractures associated with hip fracture. Shabat et al.²⁾ reported 46 patients with simultaneous distal radius and hip fractures. Consistent with our results, the findings of their research demonstrated that a combination of these fractures most often occurs in older age groups; interestingly, the fractures were always located on the ipsilateral side. The authors highlighted that patients with concurrent distal radius and hip fractures tended to stretch out their hands at the time of falling to the side of the fall for protection.²⁾ Based on these results, orthopedic specialists are advised to

Table 2. Comparative Radiological Results between the Study Group and the Control Group

	Study group	Control group	p-value
Immediately postoperation			
Volar tilt (°)	8.5±3.5	8.7±3.9	0.90
Radial length (mm)	11.7±2.0	11.3±2.8	0.48
Radial inclination (°)	21.8±2.6	22.0±3.9	0.85
Final follow-up			
Volar tilt (°)	7.2±3.2	8.4±3.7	0.17
Radial length (mm)	8.5±1.7	11.4±2.6	<0.001
Radial inclination (°)	16.6±3.7	21.8±3.1	<0.001

Values are presented as mean±standard deviation.

Table 3. Comparative Clinical Outcomes between the Study Group and the Control Group

	Study group	Control group	p-value
Range of motion (°)			
Extension	59.78±5.03	62.65±7.58	0.07
Flexion	61.18±8.82	63.35±7.36	0.27
Supination	82.65±2.50	84.29±5.49	0.32
Pronation	83.90±6.55	86.04±3.98	0.11
VAS	2.26±1.08	1.88±1.30	0.19
Grip strength (kg)	11.88±4.30	16.79±4.81	<0.001
Quick DASH	14.43±5.40	15.30±7.32	0.56

Values are presented as mean±standard deviation. VAS: visual analog scale, Quick DASH: Quick Disabilities of the Arm, Shoulder, and Hand.



Fig. 2. (A) Preoperative wrist radiographs of a 77-year-old patient with simultaneous hip and distal radius fractures. (B) Radiographs of the wrist immediately after surgery showing the proper placement of the plate and a satisfactory reduction of the distal radius fractures. (C) After three months, radiographs of the wrist show reduction loss of the distal radius fractures.

determine whether the ipsilateral wrist is injured in older patients with hip fractures, despite the incidence of simultaneous distal radius and hip fractures being minimal.

In our study, radial inclination and length in the study group were inferior to that in the control group. We surmise that the main factor contributing to the loss of reduction in study-group patients is the repetitive use of the wrist following surgery. Upper-limb function is important in patients with hip fractures to perform activities of daily living.⁶⁾ All patients in the study group underwent simultaneous surgery for hip and distal radius fractures. As previously described, patients with concurrent hip and wrist fractures exhibited longer hospital stays and incurred higher costs of stay than those with hip fractures alone.^{3,4)} However, early ambulatory recovery has had a significant impact on reducing postoperative complications, lengths and costs of hospital stays, and mortality rates in patients with hip fractures.⁷⁾ On this premise, all patients who undergo surgery for hip fractures are encouraged to maintain seated positions or walk with platform walkers after surgery as soon as possible to prevent postoperative complications. By pushing themselves up from a lying or seated position for mobilization, patients recovering from hip fractures potentially exert immense amounts of force on their wrists. Furthermore, greater amounts of stress might have been transmitted to the injured wrists of patients because all fractures occurred on patients' ipsilateral sides. Another factor leading to the loss of reduction may be osteoporosis, although there were no significant differences between the two groups in BMD at the femur neck following treatment. In our study, we used DXA BMD values at the femur neck in both groups, which have been reported to be closely related to a high incidence of osteoporotic fractures.^{8,9)} However, significant differences in BMD values according to densitometers and sites of measurement have been demonstrated.¹⁰⁻¹²⁾ Kanterewicz et al.¹³⁾ evaluated the association between Colles' fractures and osteoporosis in 58 postmenopausal females using an incident case-control study. The authors found that even though older patients (aged >65 years) had lower BMD values than control patients at all sites, including the hip, spine, and wrist, the differences were significant only in the

wrist.¹³⁾ Hung et al.¹²⁾ also reported a moderate-to-weak association between the material properties of the weight-bearing skeleton and those of non-weight-bearing bones. All of these reports indicate that the femur neck T-scores used in the current study may not entirely reflect BMD values of the distal radius. Thus, correlations would be superior if the same region of interest was measured in each patient.

Although the high incidence of distal radius fractures is a major health concern, the results of the relation between mortality and wrist fractures have been debated. Rozental et al.¹⁴⁾ reported that the survival rates after distal radius fractures were lower than those expected for individuals in standard populations. Another epidemiological study revealed that an increased standardized mortality ratio was found only in female patients aged >70 years after distal radius fractures but not in males or females aged <70 years.¹⁵⁾ However, hip fractures have been known to be the most common and serious injury in older patients, and they are associated with high morbidity and mortality rates.¹⁶⁾ Lee et al.¹⁷⁾ reported a one-year mortality rate after hip fracture of 12.2% and 5-year mortality rate of 32.3% in South Korea. Another study reported cumulative mortality rates after hip fracture of 11.4% at 6 months, 16.7% at 1 year, 25.2% at 2 years, 45.8% at 5 years, and 60% at 8 years in South Korea.¹⁸⁾ These previous studies concluded that patients with hip fractures exhibit higher mortality up to 5 years than the general population.

Notwithstanding, this study has certain limitations. We compared radiologic parameters between two groups of patients through strict matching of various preoperative factors that can independently affect radiologic outcomes. Satisfactory reduction and proper positioning of plating during surgery were necessary for successful outcomes, irrespective of concomitant hip fractures in the study group. We did not include these two important factors for matching analysis, and they might have influenced radiologic outcomes. However, all operations were performed by an experienced hand surgeon using one implant, and the two groups had similar radiologic outcomes immediately after surgery. Second, our fracture cohort comprised patients drawn from a relatively small single center, which might have limited the general-

ization of our results. Despite these methodologic limitations, we believe that our results offer preliminary evidence regarding reduction loss after volar plating in older patients with concomitant hip and wrist fractures compared with that in those with isolated fractures.

Conclusion

In conclusion, our study demonstrated that a combination of distal radius and hip fractures are considerably more prevalent in females and are always located on the ipsilateral side. In addition, while volar-locking plates provide greater stabilization for distal radius fractures, a loss of reduction occurred in patients who sustained concomitant hip and distal radius fractures.

요 약

목적: 고령 환자들에서 요골 골절과 고관절 골절이 동시에 일어나는 경우는 흔치 않으나, 동시에 발생하는 경우 독특한 특징을 보인다. 본 연구에서는 원위 요골 골절로 수장측 잠금 금속판을 이용하여 치료한 환자 중 고관절 골절이 동시에 일어난 환자와 요골 골절 단독으로 일어난 경우에서의 임상적 결과를 비교·분석하였다.

대상 및 방법: 2010년부터 2015년까지 원위 요골 골절과 고관절 골절이 동시에 발생한 34명의 환자들에 대한 후향적 분석을 시행하였다. 또한 동일 기간 동안 원위 요골 골절만 단독으로 발생한 34명에 대한 짝짓기 분석을 시행하여, 수술 후 방사선학적 지표, 임상적 결과를 비교하였다.

결과: 방사선학적 지표에 따르면, 최종 추시 결과상 요골 길이 및 요측 경사는 실험군보다 대조군에서 더 좋은 결과를 보였다. 즉, 고관절 골절이 동반되어 있는 환자에서 단독 원위 요골 골절에 비해 수술 부위 정복이 유지되지 않고 무너지는 경향을 보였다. 이러한 차이에도 불구하고, 임상적 결과에 있어서는 파악력을 제외하고는 유의미한 차이를 보이지 않았다.

결론: 수장측 잠금 금속판을 이용한 원위 요골 골절 치료에서 고관절 골절이 동반된 경우 단독 원위 요골 골절의 경우보다 수술 부위 정복 소실의 가능성이 높다.

색인 단어: 요골, 고관절, 콜레스 골절, 고관절 골절

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