Archives of Hand and Microsurgery

Arch Hand Microsurg 2019;24(1):32-39.
https://doi.org/10.12790/ahm.2019.24.1.32
pISSN 2586-3290 • eISSN 2586-3533

Original Article

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보존적 치료가 가능한 원위 요골 골절에서 척골돌기 골절 유무에 따른 결과

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Clinical Outcomes of Conservative Treatment for Distal Radius Fractures with or without Ulnar Styloid Fractures

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Purpose: Authors attempt to analyze the characteristics of combined ulnar styloid fracture (USF) and its influence on more than a year clinical outcome in patients who underwent conservative treatment for stable distal radius fracture (DRF).
Methods: The retrospective study is a case-control study between January 2011 and December 2016. Through the exclusion process, 175 patients were included (non-USF: 106 patients with 45.4 months mean follow-up, USF: 69 patients with 48.1 months mean follow-up). All patients were treated conservatively under acceptable distal radius alignment. The USF was divided into fracture locations. The visual analogue scale (VAS), Mayo wrist score, and Quick Disabilities of the Arm, Shoulder and Hand (DASH) outcome were assessed at the final follow-up at least more than 1 year.
Results: Between two groups depending on USF, there was none of radiologic outcome difference including union time, rdial height, radial tilting, and volar tilting. The mean VAS score at the final follow-up was 1.1 in both groups. The Mayo wrist score and DASH score for functional performance were 92.3 and 7.5, respectively, in patients with DRF alone, and 90.0 and 9.2, respectively, in those with combined USF, without statistical difference. The functional outcomes also did not present significant differences, depending on USF location and whether or not union.
Conclusion: USF does not have a serious effect on the clinical course of more than a year of conservative treatment of DRFs, and could be managed with conservative treatment regardless of fracture type and union.

Key Words: Distal radius fracture, Ulnar styloid fracture, Conservative treatment, Functional outcome

INTRODUCTION

Distal radius fracture (DRF) is one of the most common fractures that orthopedic surgeons encounter clinically, particularly in patients with osteoporosis[1,2]. Due to its pathologic mechanism, the incidence of ulnar styloid

Received October 3, 2018, Revised [1] November 23, 2018, [2] January 1, 2019, Accepted January 3, 2019

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fracture (USF) accounts for approximately ≥50%[1,3-5].

There has been a controversy regarding the separate management for USF simultaneously while surgically treating DRFs, and past comparative studies focused considerably more on surgically treated patients[6,7]. Studies are rare concerning the long-term outcome of patients with minimally displaced DRFs with USF treated conservatively[8]. When surgeons decide conservative management in DRF, USF does not influence on treatment mainstream[9]. Besides, a majority of hand surgeons does not think that it is important, they guess it only has a small impact afterward. Therefore, it is still unclear whether USF combined with USF accompanied with DRF affects the clinical outcome and whether surgical treatment is necessary for USF.

Authors attempt to statistically analyze the characteristics of combined USF and its influence on more than a year clinical outcome in patients who underwent conservative treatment for stable DRF.

The hypothesis of this study was whether DRF accompanies USFs would not be imperative in the consideration for deciding surgical intervention if clinicians decided to take conservative treatment on DRF.

MATERIALS AND METHODS

1. Subject

The present study is a retrospective case-control study conducted under the official approval of the Institutional Review Board (IRB No. CHAMC 2018-08-030). Between January 2011 and December 2016, we found 1,789 patients diagnosed with DRF who were treated in CHA Bundang Medical Center. We excluded patients with surgical management (n=608), age <20 years (n=319), age >65 years (n=401), conservative management despite unacceptable alignment (n=21), other combined multiple fractures (n=9), refracture (n=5) or occult fracture (n=12), and lost to follow-up (n=239). Finally, 175 patients treated conservatively were included.

The palmar tilt in any degree more than neutral was perceived as the acceptable range. Radial shortening of no more than 2 mm was treated conservatively. Cases in which radial inclination, measured from lunate facet to

Table 1. Descriptive statistics by USF

Variable	USF			p-value
	(–) (n=106)	(+) (n=69)	Total (n=175)	
Sex				0.218
Female	66 (62.3)	50 (72.5)	116 (66.3)	
Male	40 (37.7)	19 (27.5)	59 (33.7)	
Age (yr)	49.1±11.6	49.8±11.0	49.4±11.4	0.663
Follow-up period (mo)	45.4±19.2	48.1±20.4	46.5±19.7	0.387
Articular involvement				0.983
None	26 (24.5)	16 (23.2)	42 (24.0)	
Yes	80 (75.5)	53 (76.8)	133 (76.0)	
Reduction required				<0.001*
None	74 (69.8)	25 (36.2)	99 (56.6)	
Yes	32 (30.2)	44 (63.8)	76 (43.4)	
USF location				
None	106 (100.0)	0 (0.0)	106 (60.6)	
Distal to base	0 (0.0)	34 (49.3)	34 (19.4)	
Base	0 (0.0)	29 (42.0)	29 (16.6)	
Proximal to base	0 (0.0)	6 (8.7)	6 (3.4)	

Values are presented as number (%) or mean±standard deviation.
USF: ulnar styloid fracture.
*Significant statistical difference (p<0.05).

radial styloid, was more than 10° were also classified as conservatively treatable. Intraarticular step off was only allowed to be <2 mm for conservative treatment[10]. Fracture types depending on AO/OTA (Orthopaedic Trauma Association) classification were also identified from initial radiograms, X-ray, and computed tomography (CT) by two orthopedic surgeons.

In all patients, the follow-up period should be more than a year. The mean follow-up periods were 48.1±20.4 and 45.4±19.2 months in the patient group with and without USF, respectively.

Closed reduction was selectively performed to obtain an acceptable range of each inclusion criterion. Under acceptable alignment, short arm cast between 4 and 6 weeks, regardless of USF, was followed by range of motion exercise. Serial X-ray was performed during conservative management. In 63 patients (63/175, 36.0%), CT was initially performed to further identify USF. The USF was divided into three types, type I of distal to base fracture, type II of base fracture, and type III of proximally located fracture from styloid base (Table 1). More than 1 mm displacement of USF fragment was regarded as displacement group.

We assessed union time during follow-up period through plain radiographs. At the last follow-up, authors measured radial height, volar tilt, radial inclination, and arthritic changes. The visual analogue scale (VAS), Mayo wrist score, and Quick Disabilities of the Arm, Shoulder and Hand (DASH) outcome were assessed at the final follow-up of at least >1 year.

2. Statistical analysis

The Pearson chi-squared test or Fisher exact test for categorical variables, and the Student t-test or Kruskal–Wallis test for continuous variables were used. A p-value less than 0.05 was considered statistically significant. Statistical evaluation was conducted using software R (ver. 3.1.0, Comprehensive R Archive Network, GNU General Public License).

RESULTS

In patients with USF combined with DRF (44/69, 63.8%), closed reduction to achieve acceptable alignment was performed more than in patients with DRF alone (32/106, 30.2%). With regard to DRF, all patients achieved radiologic union with acceptable alignment between 4 and 15 weeks with conservative management.

1. Comparison depending on ulnar styloid fracture

DRF fracture union during follow-up period was detected in mean 7.34 weeks of only DRF and 7.66 weeks of DRF with USF groups. At the last follow-up, radial height, volar tilt, and radial inclination did not presented statistical differences between two groups (Table 2).

Table 2. Outcomes depending on ulnar styloid fracture

Variable	USF			p-value
	(–) (n=106)	(+) (n=69)	Total (n=175)	
Radiologic outcome				
Union time (wk)	7.34±1.84	7.66±1.84	7.46±1.85	0.228
Radial height (°)	11.5±2.1	11.1±2.7	11.4±2.4	0.255
Radial tilting (°)	22.0±4.3	21.7±4.6	21.8±4.4	0.266
Volar tilting (°)	10.5±7.2	8.7±10.6	9.8±8.7	0.213
Functional outcome				
VAS	1.1±1.7	1.1±1.8	1.1±1.8	0.853
Mayo wrist score	92.3±9.8	90.0±12.2	91.0±10.9	0.162
DASH score	7.5±12.3	9.2±12.7	8.2±12.5	0.398

Values are presented as mean±standard deviation.
USF: ulnar styloid fracture, VAS: visual analogue scale, DASH: Disability of the Arm, Shoulder and Hand.

Table 3. Outcomes depending on styloid process fracture location

Styloid process fracture location	Distal to base (n=34)	Base (n=29)	Proximal to base (n=6)	p-value
Sex				0.759
Female	25 (73.5)	20 (69.0)	5 (83.3)	
Male	9 (26.5)	9 (31.0)	1 (16.7)	
VAS	1.1±1.8	1.2±2.0	1.2±1.3	0.833
Mayo wrist score	90.6±10.8	89.3±14.2	90.2±11.6	0.780
DASH score	8.6±12.5	8.9±12.9	13.7±14.9	0.507
Initial displacement				0.125
None	10 (29.4)	14 (48.3)	4 (66.7)	
Yes	24 (70.6)	15 (51.7)	2 (33.3)	
Union				0.302
None	17 (50.0)	12 (41.4)	1 (16.7)	
Yes	17 (50.0)	17 (58.6)	5 (83.3)	

Values are presented as number (%) or mean±standard deviation.
VAS: visual analogue scale, DASH: Disability of the Arm, Shoulder and Hand.

There was no evidence of post-traumatic arthritis on last follow-up radiographs in all patients.

The mean VAS score at the final follow-up was 1.1±1.7 and 1.1±1.8 in the DRF only and DRF with USF groups, respectively. The Mayo wrist score and DASH score for functional performance were 92.3±9.8 and 7.5±12.3, respectively, in patients with DRF alone, and 90.0±12.2 and 9.2±12.7, respectively, in patients with combined USF, without statistical difference (Table 2).

2. Patients with ulnar styloid fracture

We divided the patients with USF depending on fracture location.

Of 69 patients, 41 patients initially presented with USF fragment >1 mm displacement (59.4%).

The functional outcomes, VAS, Mayo wrist score, and DASH score did not also present significant differences depending on USF location (Table 3).

Furthermore, authors compared outcomes depending on styloid process union. Of 69 patients, 39 patients (56.5%) achieved union during the follow-up period. Patients of union presented slightly better outcomes than non-union patients, without significant differences (Table 4).

Table 4. Outcomes depending on styloid process fracture fragment union

Styloid process union	Non-union (n=30)	Union (n=39)	p-value
Initial displacement			<0.001
None	2 (6.2)	26 (66.7)	
Yes	28 (93.8)	13 (33.3)	
VAS	1.3±1.9	1.0±1.7	0.452
Mayo wrist score	88.0±14.3	90.6±10.2	0.401
DASH score	8.7±11.1	9.5±14.0	0.786

Values are presented as number (%) or mean±standard deviation.
VAS: visual analogue scale, DASH: Disability of the Arm, Shoulder and Hand.

DISCUSSION

The main finding of the present study was that the conservative treatment on concomitant USF in patients with DRF, age between 20 and 65 years with minimal and acceptable degree of displacement, has shown favorable clinical results in consecutive clinical data collection via out-patient ward follow-up of more than a year. We excluded immature osseous structure of age younger than 20 years. Although DRF more commonly occurs in elderly patients with or without osteoporosis, we excluded those older than 65 years because elderly patients could be relatively satisfied with their overall condition regardless of radiographic outcomes[11].

To the best of our knowledge, only one comparative study was conducted regarding the effect of USF on outcomes after conservative treatment of the distal radius[8]. Turan et al.[8] reported mean Quick-DASH score of intact

USF (16.8), ulnar styloid non-union (19.5), and healed USF (19.4) without significant difference, which were slightly higher than our study. Although they only included 56 patients, they concluded that USF should not be the focus during initial treatment of DRF, which coincided with our reports.

In patients with USF, 63.8% required closed reduction to achieve acceptable alignment for DRF with significant difference. Compared with patients without fracture, combined USF can occur with higher energy with more change of displacement. However, once it is reduced until acceptable alignment, the result was similar in patients who did not undergo close reduction.

Furthermore, we did not find functional outcome differences based on USF location.

In previous researches, there were several implications of USF, including triangular fibrocartilage complex (TFCC) tear, chronic instability of distal radioulnar joint (DRUJ), extensor carpi ulnaris (ECU) tendon irritation, and ulnar nerve irritation[5,12-17]. Any legions can elicit wrist ulnar side pain and affect functional outcomes.

Ulnar styloid avulsion may result in DRUJ instability due to TFCC disruption, the principal stabilizer of the DRUJ[16,18]. Especially, some authors also mentioned potential DRUJ instability when displaced fracture involves the ulnar styloid base or fovea, because TFCC has insertion on it[5,6]. Moreover, pain could be chronic, which means subjective satisfaction would be poor. However, whether USF affects the function of wrist and trigger chronic instability of DRUJ is still debatable.

Richards et al.[19] evaluated the soft tissue injuries associated with DRFs by using arthroscopy. They found no correlation between USFs and TFCC injuries.

Kazemian et al.[20] used external fixation to treat DRF with USF, proving that USF does not influence DRUJ instability. Furthermore, Lindau et al.[21] reported that DRUJ problem after DRF has poor prognosis, but its instability was not correlated with the presence of USF. Finally, DRUJ problem might develop in DRF regardless of USF.

In previous studies, 17% to 54% of union rate was reported[1]. Despite high rate of nonunion, only a few cases were reported to be symptomatic in previous studies[22,23]. In our study, the USFs were united in 56.5% (39 of 69 patients), which was a relatively high union rate compared with previous reports[22]. Besides, nonunion did not present significant differences although with slight value differences.

Although there were only a few cases, some patients with non-united USF occasionally complain on nonunion site associated with ECU tendinitis due to irritation and impingement, which can be treated with simple excision of the fragment[15,16].

Nerve irritation or damage also can be imperative consideration after DRFs with or without USF. Clarke and Spencer[17] reported clinical and anatomical studies on patients with DRF with ulnar nerve palsy, resulting from dense scar tissue formation around nerve. The reasons of scar formation were fracture with open wound and dislocated radioulnar joint, which means high-energy injury[17]. However, no statistically relevant report suggested that USF was associated with the functional outcome. Moreover, based on meta-analysis, Wijffels et al.[1] claimed that the result of USF union or nonunion does not seem to influence the functional outcome, and the ulnar styloid should not be the focus during initial treatment.

Despite ongoing debates, most of the studies have documented that USF did not affect outcomes and that the presence, displacement, or level of USF did not have any effect on the outcome[6,8,12,24,25].

The present study has several limitations. First, our study contained only 175 cases of DRF with or without USF. With larger sample sizes, statistical differences might be generated. However, it is difficult to infer clinical implications because the two groups presented only a slight difference in functional results. Besides, USF can affect the patients with follow-up of less than 1 year and present significant difference in the short-term follow-up.

Nevertheless, the authors attempted to identify the influence of USF in conservatively treatable DRF, acceptable range from previous literature, with more than 1 year follow-up and relatively medium sample sizes.

CONCLUSION

USF does not have a serious effect on the clinical course of more than a year of conservative treatment of DRFs and could be managed with conservative treatment regardless of fracture type and degree of union.

CONFLICTS OF INTEREST

The authors have nothing to disclose.

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보존적 치료가 가능한 원위 요골 골절에서 척골돌기 골절 유무에 따른 결과

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목적: 저자들은 안정성 원위 요골 골절에 대하여 보존적 처치를 받은 환자들에서 척골 경상돌기 골절 동반이 1년 이상 추시관찰 이후에 미치는 임상적 결과와 그 성향에 대해서 분석을 시도하였다.

방법: 본 후향성 연구는 환자 대조군 연구로 2011년 1월부터 2016월 12월까지 배제 과정을 통해서 175명의 환자들이 연구에 포함되었다. 연구의 환자들은 수용 가능 범위 내의 원위 요골 정렬을 가진 골절로서 보존적 처치를 시행하였다. 최소 1년이 지난 후의 마지막 추시에서 시각 통증 척도(visual analogue scale, VAS), Mayo 손목 점수, 그리고 속성 Disabilities of the Arm, Shoulder and Hand (DASH) 결과값이 측정되었다.

결과: 척골 경상돌기 골절이 동반된 군과 동반되지 않은 군을 비교하였을 때, 최종 추시상에 방사선 결과에서 보이는 요골높이, 요골경사, 수장측 경사의 차이는 없었다. 마지막 추시에 측정된 평균 VAS 점수는 모두 1.1로 나타났다. 기능적인 능력을 평가하기 위한 Mayo 손목 점수와 DASH 결과값은 단순 원위 요골 골절에서 각각 92.3, 7.5점으로 측정되었으며, 척골 경상돌기 골절이 동반된 군에서는 각각 90.0과 9.2점으로 통계적으로 유의한 차이를 보이지 않았다. 척골 경상돌기 골절 위치와 유합 여부에 따른 기능적인 결과값, VAS, Mayo 손목 점수, 그리고 DASH 결과값들 역시 유의한 차이를 보이지 않았다.

결론: 척골 경상돌기 골절은 원위 요골 골절의 보존적 치료에서 임상 결과에 대하여 심각한 영향을 미치지 않으며, 손상 정도에 관계없이 보존적 처치만으로도 치료될 수 있다.

색인단어: 원위 요골 골절, 척골 경상골기 골절, 보존적 치료, 기능적 결과

접수일 2018년 10월 3일 **수정일** 1차: 2018년 11월 23일, 2차: 2019년 1월 1일 **게재확정일** 2019년 1월 3일

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