

Researching the effect of radial nerve injury in humerus shaft fractures

Radial nerve injury in humerus shaft fractures

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Abstract

Aim: Radial nerve injury (RNI) is a frequently encountered condition in distal humeral shaft fractures. However, few studies have researched the effect of RNI on fracture healing and extremity functions in patients. In this study, we examined the fracture union time and functional results of the extremity in patients with humerus shaft fracture and RNI.

Material and Methods: Thirty patients who underwent osteosynthesis with plaque due to 1/3 distal shaft fracture were included in our clinic between 2012 and 2019. We divided the patients with at least 12 follow-ups with and without RNI into two groups. We compared the union time of the fractures of these groups and their functional results after the fracture healing. We used the Disabilities of Arm, Shoulder and Hand (DASH) questionnaire for upper extremity function measurement.

Results: Nine (30%) out of 30 patients had RNI. Fractures of 28 patients (93.3%) were healed without the need for a second operation. Eight (88.8%) out of 9 patients with RNI demonstrated complete healing and 1 patient (11.2%) partial healing. No significant difference was found in patients with and without RNI in terms of fracture union time. DASH scores of patients with RNI were worse than patients without RNI.

Discussion: Although isolated RNI developed after humerus fracture does not negatively affect fracture healing rate and time, RNI developing after fracture negatively affects functional results of upper extremity.

Keywords

Humerus; Radial nerve; Fracture healing

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Introduction

Humerus shaft fractures constitute 1-3 % of all fractures [1, 2]. Radial nerve injury (RNI), on the other hand, is a condition encountered in 8% of humerus shaft fractures [2, 3]. Although 1/3 of distal humerus shaft fractures constitute 7.5% of all humerus fractures, the rate of radial nerve damage is quite high (22%) [3].

There are very few studies in the literature on the healing of the radial nerve-damaged humerus fractures. The negative effects of the extremity with prolonged immobilization on fracture healing due to nerve injury are known. In fact, if nerve injury affects the muscles around the fracture line, it is expected to negatively affect fracture healing. However, since the radial nerve does not innervate the muscles around the humerus, it is not expected to adversely affect fracture healing. According to our hypothesis, limitation of movement ability and joint ankylosis developed due to muscle dysfunction in the fracture distal reduces the blood flow of the extremity. Reduced blood flow also adversely affects fracture healing. To prove this hypothesis, among patients with distal humerus fractures, we compared those with and without radial nerve injury in terms of fracture healing and extremity functions.

Material and Methods

After receiving the approval of the ethics committee, totally 30 patients, 18 male and 12 female ranging in age from 21 to 54, who admitted to our clinic due to distal humerus shaft fracture between 2012 and 2019, were included in our study. Nine patients had RNI, 6 patients were diagnosed with RNI in the pre-operative period and 3 patients were diagnosed with RNI in the post-operative period. There was no significant difference between the ages of patients with and without RNI (Table 1).

All patients were intervened with a lateral incision through the distal humerus; radial nerve was explored in all patients, and the fracture line was reached after loosening. Fractures of all patients were fixed with a plaque-screw fixation system (Figure 1).

Patients were invited for control at one-month intervals after the operation. Dynamic wrist splints were delivered to patients with RNI. During the controls, XR radiographs of each patient were taken, and their physical examination and radiological evaluation results were recorded.

In the last examinations of the patients, motor examination of Extensor indicis, Brachioradialis muscles and wrist extensor group muscles were performed. The first finger dorsal and sensory examinations of the first web span of the hand were performed. The results were recorded. The nerve injury of the patients with all motor, sensory, and electromyography (EMG) controls returned to normal and was accepted to be healed over. The mean radial nerve healing time was 4.6 (3-12) months.

Functional evaluations of the upper extremity were done with the Disabilities of Arm, Shoulder and Hand (DASH) scoring.

Data were analyzed using SPSS version 20.0 (IBM Corp; Armonk, NY, USA). Independent samples t-test and the Mann-Whitney U tests were used for the comparisons of normally and non-normally distributed independent groups, respectively. The Fisher's exact test was used for categorical variables. A p-value <0.05 was accepted as statistically significant.

Results

The average age of 30 patients (12 females, 20 males) was 39 (21-54) years and nonunion was developed in 2 patients (one of the patients had RNI) during their average 51.7 (12-108) monthly follow-up. These patients were re-operated and union was achieved. Only one of the nine patients with RNI continued to have partial radial nerve injury (11.2%).

In patients with RNI, the average duration of fracture union was 4.6 (3-12) months, while in patients without RNI, the average duration of fracture union was 3.5 (2-9) months, and there was no statistically significant difference between the two groups. Patients with RNI had a higher DASH score (24.4) than patients without RNI (15.7) (Table 2). This high score shows us that the functional results of patients with RNI are worse.

Table 1. Background data of all patients

	Total	RNI (-)	RNI (+)	P
Patient	30	21	9	
Age	40,44	40,8	39,6	>0,05
Follow-up time	51,7	53,2	48,3	>0,05

RNI (-) : Patient without radial nerve injury, RNI (+): patient with radial nerve injury

Table 2. Comparison of the RNI (-) and RNI (+) patients

	RNI (-)	RNI (+)	P
Fusion time	3,5 month (2-6 month)	4,3 month (2-9 month)	>0,05
DASH score	15,7	22,4	<0,05

RNI(-) : Patient without radial nerve injury, RNI (+): patient with radial nerve injury, DASH: Disabilities of Arm, Shoulder and Hand

Discussion

In humerus fractures, RNI is common due to the mechanism of fracture formation and the sharpness of fracture ends. In addition, RNI is a common case during fracture surgery [2,3,4]. Since the radial nerve is located in the intermuscular area, it is easily affected by tension caused by loosening or pulling during surgery (Figure 2). Besides, abnormal movements cause nerve strain and nerve injury due to the patient's inability to control his/her arm after anesthesia [4-6]. For this reason, it is very important for the assistant health personnel to be attentive in the surgery of distal humerus fractures.

Since the spontaneous recovery rate of nerve injury after the radial nerve injury varies from 70% to 100%, nerve exploration after RNI is a controversial issue [3, 7-9] The operation of our patients in our study was performed not to control nerve injury, but with open reduction due to the need for surgery. Patients operated without open reduction were not included in our study. After an average follow-up of 51.7 months, only one of the nine patients continued to have partial radial nerve injury (11.2%). When examined the literature, we found a similar healing rate of radial nerve injury [2, 8].

We could not find in the literature any study examining the effect of RNI on fracture healing. In fact, due to the fact that the muscles around the humerus are not innervated by the radial nerve, we did not either think that radial nerve injury would directly affect fracture healing. Nevertheless, we thought



Figure 1. A. 26-year old male patient. Humerus 1/3 distal fracture, B. Postoperative AP radiograph, C. Fusion can be seen on postop 3rd month radiograph.



Figure 2. A humeral fracture and the close relationship with the radial nerve of the fracture fragments.

that fracture healing would also be negatively affected after muscle dysfunctions developed following RNI and muscle atrophies developed due to the inability to use the wrist and joint ankylosis.

Limitations

Since the most important deficiency of our study is retrospective nature and the number of patients was not very large, we could not evaluate the effect of factors such as cigarette history of the patients, mechanism of trauma, fracture type and extent of displacement, and degree of intraoperative radial nerve injury. We are of the opinion that the deficiencies in this issue will be eliminated with prospective studies including more patients.

Conclusions

We found in the results of our study that RNI did not negatively affect fracture healing. On the other hand, we also found that RNI had an adverse effect on upper extremity functions after the fracture healed.

Scientific Responsibility Statement

The authors declare that they are responsible for the article’s scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

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Conflict of interest

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