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Distal medial tibial locking plate for fixation of extraarticular distal humeral fractures; an alternative choice for fixation

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ABSTRACT

Objective: The aim of this study was to describe an alternative fixation method for distal humeral extra-articular fractures through posterior approach using distal tibia anatomic locking plate; and to evaluate the patient's functional outcome and union condition.
Methods: Eighteen patients (11 men and 7 women; average age of 37.0 ± 17.3 years (range: 18–73 years)) with a distal humeral extra-articular fracture who were treated with distal tibial medial locking plate were included into the study. The mean follow up time was 36.2 ± 16.7 (12–57) months. Functional results were evaluated with perception of pain, range of joint motion, grasp and pinch strengths.
Results: Union was achieved in 17 of 18 patients. Only one patient had non-union due to infection and underwent debridement. The mean time for union was 7.8 ± 5.9 months (2–20). Patient perception of pain was X = 1.88 ± 2.50 and X = 4.55 ± 2.68, respectively, at rest and activity. The active ranges of joint motion were adequate for functional use. General functional state of affected extremity (DASH-T) was perfect (X = 27.14 ± 25.66), the performance of elbow joint was good (X = 84.44 ± 11.57). There were no differences in the comparison of grasp and pinch grip of patients with uninvolved extremity ($p > 0.05$).
Conclusions: In distal humeral extra-articular fractures, use of distal medial tibia plate has advantages such as providing high rates for union, low rates for complication, and early return to work with early rehabilitation, therefore it may be considered a fixation choice that can be used for distal humeral extra-articular fractures.
Level of evidence: Level IV, therapeutic study.

Introduction

The humeral shaft fractures account for 3% of overall orthopedic injuries, resulting in social and functional losses.[1] The majority of humeral shaft fractures can be treated conservatively with high union rates and good functional results.[2] Surgical treatment is generally reserved for open fractures, floating elbow injuries, fractures associated with vascular injuries, unacceptable alignment and failure of conservative treatment.[3,4] Although there are many surgical options, fixation with plate-screw remains to be golden standard in surgical treatment of distal humeral shaft fractures.[5] Fixation of distal humerus fractures can be problematic due to the muscle forces acting on the fracture line and unique morphology of the distal humerus. Depending on the fracture pattern a short distal fracture segment allows limited opportunities for fixation; for this reason selection and application of the plate can be difficult.[6] In distal fractures, conventional 4.5 mm shaft plates allows placement of one or two screws in the distal fragment, often resulting in an insufficient fixation.[7–9] This study describes an alternative fixation method for distal humeral extra articular fractures through posterior approach using medial tibia anatomic locking plate; and evaluates the patient's functional outcome and union condition.

Material and method

The study is approved by the local ethical committee. An informed consent was obtained from all the patients. Patients

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treated for a distal humeral extraarticular fracture with distal medial tibial plate between 2011 and 2016, were included in this retrospective analysis. The inclusion criteria were; history of no previous restriction of elbow and shoulder joint, patients with distal humeral extra articular fractures in whom conservative treatment failed, patients of age of 18 years or over. Pathological fractures and patients without a regular follow-up were excluded from the study.

Injury mechanisms, additional injuries, any radical symptoms, and whether postoperative revision was required were noted.

The fracture unions were evaluated with anteroposterior and lateral radiography preoperatively, postoperatively and at sixth week, third month and sixth month. The osseous consolidation of patients was assumed when callus formation or cortical continuity was observed radiologically.

Surgical method

Modified triceps sparing approach was used, the triceps muscle was retracted medially to expose the radial nerve, proximal to its piercing of the intermuscular septum. After exploration of the nerve a 3.5 mm distal medial tibial plate was used to fix the fracture. Following fracture reduction, distal tibia medial anatomic plate of 3.5 mm (Synthes®) were used with minimum 6 screws distal and proximal to fracture (Table 2). The malleolar tip extension end of the plate was cut off and if required thin distal portion of the plate was bended for fitting the plate to the posterior cortex of Humerus (Fig. 1). No cast or brace was used postoperatively.

Rehabilitation program

Shoulder and elbow range of motion (ROM) were initiated postoperatively at second day after pain control. The patients had 15-20 repeated active distal and proximal Range of Joint Motion (RJM) exercises twice a day, and passive elbow RJM exercises. The patients with nerve injury underwent appropriate radial splint and electrical stimulation. The strengthening exercises were started after nerve recovery. A vertical Visual Analogue Scale of 10 cm was used to assess the pain experienced by patients.[10] A universal goniometer was used for Range of Joint Motion (RJM) assessment. Turkish version of DASH (DASH-T) was used for general assessment of upper extremity. Mayo elbow performance score was used for assessment of elbow joint. Grasp and pinch strength were compared with unaffected extremity.

Statistical analysis

Data was analyzed using the Statistical Packages for Social Sciences (SPSS, 16.0, version for Windows). Descriptive statistics (means, frequencies, standard deviation) were used to describe characteristics of humeral fractures.

Table 1
Demographic characteristics of patients.

Variables	Patients (n = 18)	
	Min-Max	X±SD
Age (year)	18–73	37.0 ± 17.3
Height (cm)	160–183	170.3 ± 6.8
Weight (kg)	53–97	77.5 ± 13.5
BMI (kg/m^2)	20.2–35.1	26.8 ± 5.4
Education (year)	0–16	8.8 ± 5.08
Follow-up period	12–57	36.2 ± 16.7
Time for union (month)	2–20	7.8 ± 5.9
Time to operation (day)	1–19	3.2 ± 4.5

Results

There were 18 patients included in the study, 11 men and 7 women with an average age of 37.0 ± 17.3 years (range: 18–73 years). The mean follow up time was 36.2 ± 16.7 (12–57) months. Other demographic characteristics of patients are provided in Table 1.

Of patients, seven had fractures due to low energy trauma and 11 had fractures due to high energy trauma. Only one patient had type 1 open fracture. 15 of patients were cases of acute fracture, and three were cases of revision. Of revised patients, one had intramedullary nail, and two had plate screws. Six of primary cases were operated for loss of closed reduction, five patients were operated for radial nerve injury after reduction or closed surgery. Two patients were operated for multi-trauma, and two patients were operated for segmented fractures. Two patients with AO A1 fractures were operated because of implant failure and two patients with radial nerve injury after reduction. Patients underwent surgery within an average of 3.2 days after the injury (range: 1–19 days). The fractures were classified according to AO-Müller classification. The mean distances of the fracture line to the epicondylar axis and olecranon fossa were measured as 51.43 ± 10.4 mm and 34.3 ± 8.72 mm respectively (Table 2).

Union was achieved in 17 of 18 patients. Only one patient had non-union due to infection and underwent debridement and the implant was (medial lateral plate) replaced. The mean time for union was 7,8 ± 5.9 months (2–20) (Table 1). The continuity of the nerve was impaired in only one of the five patients with radial nerve injury. It was repaired with sural nerve graft. The nerve functions improved in all of the patients (Fig. 2).

Patient perception of pain was X = 1.88 ± 2.50 and X = 4.55 ± 2.68, respectively, at rest and activity. The active ranges of joint motion were adequate for functional use. General functional state of affected extremity (DASH-T) was perfect (X = 27.14 ± 25.66), the performance of elbow joint was good (X = 84.44 ± 11.57) (Table 3).

There were no differences in comparison of grasp and pinch grip of patients with uninvolved extremity (Table 4).

Discussion

This study evaluated 18 patients with extra articular distal humeral diaphysial fractures clinically and radiologically, treated with tibia distal medial anatomic plate. This technique has been demonstrated to be an alternative fixation method to distal humerus extra articular fractures because it requires less soft tissue dissection, short operative time, and allows for stabile fixation with good functional results.

According to the forces acting to the fracture line surgical treatment is recommended for distal humeral fractures to achieve stable fixation and to give early elbow motion which is important for good functional outcomes.[11,12] Among the surgical treatment options, plate screw fixation is accepted as the gold standart.[13]

Due to anatomical structure specific to distal humerus, dual plate provides better biomechanical resistance compared to conventional shaft plates. The dual plate technique is disadvantageous as it requires exploration of both of the colons, and medial and lateral colon requires larger circumferential dissection of soft tissue.[14] Dual plating is widely encountered with postoperative complications such as pain and irritation of the ulnar nerve.[15] The incidence of ulnar neuritis has been reported up to 16% due to the exploration of the medial column and the adjacent placement of the implant near the cubital tunnel.[16,17] Such dissection of tissue is unavoidable for intraarticular fractures, but seems to be unacceptable for extra articular shaft fractures. The studies have

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