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Surgical treatment of displaced midshaft clavicular fractures with precontoured plates

Maximiliano Ranalletta, MD, Luciano A. Rossi, MD*, Santiago L. Bongiovanni, MD, Ignacio Tanoira, MD, Nicolas S. Piuzzi, MD, Gaston Maignon, MD

Department of Orthopedics and Traumatology, Prof. Dr. Carlos E. Ottolenghi, Italian Hospital of Buenos Aires, Buenos Aires, Argentina

Background: Plate fixation of displaced midshaft clavicular fractures has been shown to decrease nonunion, symptomatic malunion, and residual shoulder disability compared with nonoperative treatment. However hardware-related complications are a problem. The new features of the precontoured locking plates may reduce the need for hardware removal, thus maintaining the advantages of plate fixation. This study evaluated the clinical outcomes of patients with displaced midshaft clavicular fractures treated with precontoured locking plates.

Materials and methods: From November 2008 to December 2012, we surgically treated 72 patients with displaced midshaft clavicular fractures. We retrospectively evaluated 68 patients who underwent 68 interventions. Postoperative functional outcomes were assessed with the Constant score, the 11-item version of the Disabilities of Arm, Shoulder and Hand (QuickDASH) questionnaire, and radiographs. Pain was subjectively assessed with a visual analog scale. Complications were recorded. Patients were asked if they were able to return to their previous employment level.

Results: The mean follow-up period was 23.6 ± 10.7 months. The average values of the Constant, QuickDASH, and visual analog scale scores were 97.8, 1.8, and 0.4 points, respectively. At the last follow-up, 98.5% were able to return to their regular work. Of 15 complications (22.1%) that occurred, only 3 were considered as major: 1 subclavian vein extrinsic compression, 1 nonunion, and 1 hardware loosening. Hardware removal was required in 9 patients (13.2%).

Conclusions: Satisfactory clinical results with a low rate of complications were achieved with precontoured locking plates for displaced midshaft clavicular fractures and a low rate of hardware removal compared with traditional plates.

Level of evidence: Level IV, Case Series, Treatment Study.

Keywords: Clavicular fracture; midshaft; precontoured; plates

Clavicular fractures are common injuries and account for approximately 2.6% to 5% of all fractures in adults. Middle-third fractures are the most common type, representing approximately 80% of all clavicular fractures, of which 48% are displaced and 19% are comminuted.[25,26]

This study was approved by the Ethics Committee of the Italian Hospital of Buenos Aires (IRB: 00003580, Study No.: 2320).

*Reprint requests: Luciano A. Rossi, MD, Rawson 280, Appt 8A, Buenos Aires 1183, Argentina.

E-mail address: luciano.rossi@hospitalitaliano.org.ar (L.A. Rossi).

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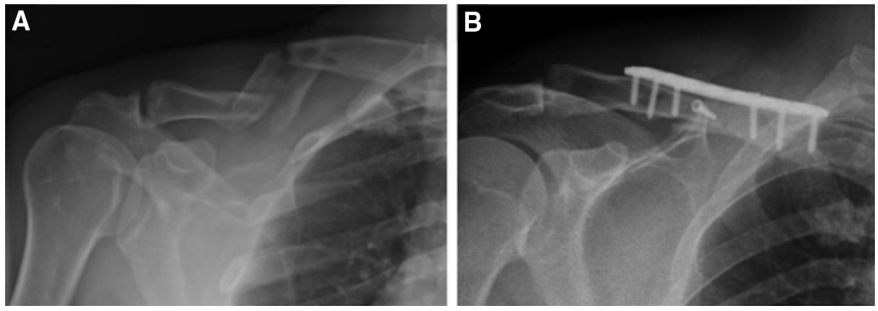

Figure 1 A 45° up-tilted clavicle radiograph shows (**A**) a Robinson type 2B2 fracture (displaced, comminuted, and segmental) and (**B**) bony union and that the precontoured plate fits the anatomic shape of the biological clavicle.

Traditionally, nonsurgical management has been favored as the initial treatment for most clavicular fractures because the initial studies did not separate displaced and comminuted fractures from the whole.[24,28] More recently, however, several studies showed suboptimal outcomes with nonoperative treatment in this subgroup of fractures.[2,3,6,12] Hill et al[14] reported a 15% incidence of nonunion and a 31% rate of unsatisfactory results in 52 patients with completely displaced midshaft clavicular fractures treated nonoperatively. Similar unfavorable outcomes with nonoperative treatment for displaced clavicular fractures were later updated by various studies.[20,21,24,25]

Several recent prospective, randomized clinical trials comparing nonoperative treatment with plate fixation showed that operative treatment improved functional outcomes and significantly decreased the incidence of long-term complications, such as nonunion and symptomatic malunion.[3,23,27,29] However, several problems associated with plate fixation have been reported, including hardware-related complications, such as irritation, protrusion, or loosening, and wound complications (infection, dehiscence).[17]

The development of precontoured clavicle plates and the introduction of angular stability have paved the way for a new perspective on surgical treatment for theses fractures. The aim of this study was to analyze the clinical outcomes and hardware-related complications of a group of patients with displaced midshaft clavicular fractures treated using precontoured locking plates.

Materials and methods

Seventy-two patients with 72 midshaft clavicular fractures (Fig. 1, *A*) were surgically treated at our unit with open reduction and precontoured angular stability plate fixation. Inclusion criteria were (*a*) patients aged between 16 and 70 years, (*b*) type 2B fractures according to Robinson's classification,[27] and (*c*) displacement (more than 2 cm). Exclusion criteria were (*a*) open fracture, (*b*) neurovascular injury, (*c*) a concomitant upper extremity injury, (*d*) pathologic fracture, (*e*) previous fracture in the same shoulder, and (*f*) lack of informed consent. The analysis consisted of 68 fractures in 68 patients because 4 patients were lost to follow-up.

Demographic and fracture characteristics were documented

Patients were seen postoperatively at 1 week, 2 weeks, and monthly until fracture consolidation, and then once a year. Radiologic evaluation was obtained in the immediate postoperative day and monthly until fracture consolidation. Fracture consolidation was defined as complete periosteal and endosteal bridging visible between the medial and lateral fragments in at least 2 different radiographic views and the absence of pain and instability in the fracture region.

Patients were evaluated at the last follow-up, by one of the authors (L.A.R.), using the Constant score and the 11-item version of the Disabilities of Arm, Shoulder and Hand (QuickDASH) score. Residual pain was evaluated using a visual analog scale (VAS), with 0 being ''no pain'' and 10 being ''maximum pain.'' All surgery-related complications and reoperations were documented. Patients were also asked if they had been able to practice sports again and if they had been able to perform them at the same level they had before the accident. Lastly, patients were asked if they were able to return to their previous work (Table I)

Patients received combined anesthesia (regional blockade and general anesthesia) and were placed in the beach chair position with an enhancement behind the ipsilateral scapula. An anterior-inferior approach centered in the fracture site was used. Once anatomic fracture reduction was performed, we proceeded with fixation. A precontoured locking plate (Acumed, Hillsboro, OR, USA) was placed on the superior side of the clavicle (Fig. 1, *B*). Interfragmentary screws were used for fragment fixation when a third fragment was present. In each plate fixation, we used a minimum of 3 screws on each side of the fracture.

The postoperative rehabilitation protocol consisted of an arm sling during the first 2 postoperative weeks. Pendulum motion was permitted during the first 3 weeks, followed by active abduction and flexion up to the horizontal plane from 3 to 6 weeks. Full shoulder active range of motion was allowed after 6 weeks, and return to full activities was permitted after 3 months.

Statistical methodology

Continuous variables are presented as means ± standard deviations and categoric variables as absolute and relative frequencies. The statistical analysis was performed using STATA 12 software (StataCorp LP, College Station, TX, USA). A P value of $<.05$ was considered statistically significant.