SCIENTIFIC ARTICLE

# Surgical Treatment of Displaced Midshaft Clavicle Fractures: Precontoured Plates Versus Noncontoured Plates

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**Purpose** To compare the outcomes and complications of open reduction and internal fixation using precontoured versus noncontoured plates for the treatment of midshaft clavicle fractures.

**Methods** Open reduction and internal fixation using was performed on 130 patients with a midshaft clavicle fracture. Precontoured plates were used in 69 cases (group A) and noncontoured plates in 61 cases (group B).

**Results** The average follow-up in both groups was approximately 21 months. There was a significant difference between the 2 groups in mean surgery duration and blood loss, although Disabilities of the Arm, Shoulder, and Hand and Constant-Murley Shoulder scores at final follow-up were similar. Plate removal was required in 44.9% (31 of 69) of the precontoured group and 65.6% (40 of 61) of the noncontoured group. The indication was prominence of the hardware in 27.5% (19 of 69) of the precontoured group and 54.1% (33 of 61) of the noncontoured. In both groups, body mass index was lower in patients requiring implant removal because of hardware prominence. A higher proportion of females in both groups required implant removal.

**Conclusions** Precontoured plates are associated with a lower rate of hardware removal. Body mass index and gender may be factors that influence the rate of hardware removal. *(J Hand Surg Am. 2016;41(9):e263–e266. Copyright © 2016 by the American Society for Surgery of the Hand. All rights reserved.)*

**Type of study/level of evidence** Therapeutic IV.

**Key words** Clavicle, midshaft, fracture, precontoured plate, noncontoured plate.

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Midshaft fractures account for 80%[1] of all clavicle fractures but the treatment for this condition remains controversial. In comparison with nonsurgical treatment, surgical management has been associated with better functional recovery, higher patient satisfaction and fewer complications, including symptomatic malunion and nonunion.[2–4] However, the choice of internal fixation implant varies despite an increasing focus on implant-related complications. Precontoured locking plates can theoretically fit the anatomical shape of the clavicle without needing to be contoured during surgery. This might decrease the duration of surgery and also reduce skin irritation and plate failure.[2,5,6] However, despite the

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**TABLE 1. General Conditions**

| | Group A | Group B |
|---|---|---|
| Gender | | |
| Male | 40 | 32 |
| Female | 29 | 29 |
| Sum | 69 | 61 |
| Age (y) | 38.0 ± 11.9 | 37.1 ± 11.2 |
| Cause | | |
| Traffic accident | 42 | 36 |
| Slip down | 20 | 18 |
| Fall down | 5 | 6 |
| Sports injury | 2 | 1 |
| Fracture type | | |
| A | 20 | 17 |
| B | 9 | 6 |
| C | 40 | 38 |
| Follow-up duration (mo) | 20.8 ± 3.1 | 20.7 ± 3.0 |
| BMI | 22.4 ± 3.3 | 22.1 ± 3.2 |

increased use of precontoured plates, soft tissue irritation requiring implant removal remains one of the most common complications related to internal fixation of clavicle fractures.

In this study, we compared the surgery duration, blood loss, functional recovery at final follow-up, and plate-related complications of a precontoured locking plate with those of a noncontoured plate for the treatment of clavicle midshaft fracture.

## MATERIALS AND METHODS

### General data

Institutional review board approval for the study was obtained. A retrospective study that reviewed all 145 cases of midshaft clavicle fracture between October 2012 and May 2014 was performed. The indications for surgery were significant displacement or shortening of the fracture by more than 2.0 cm or significant angular deformity with a risk of skin failure. According to the AO/OTA classification, each fracture was categorized as A, B, or C. After a discussion with the patient and his or her relatives, surgeons made the choice of plate, a decision made on the basis of a combination of fracture characteristics and the patient's financial resources. Five patients in the noncontoured group could not be contacted for follow-up, 10 cases were either younger than 18 years or older than 65 years and were excluded. Therefore, the study comprised 130 patients who sustained a midshaft clavicle fracture and underwent open reduction and internal fixation using a plate. Precontoured and noncontoured plates were used in 69 and 61 cases, respectively. The follow-up duration, age, body mass index (BMI), gender distribution, fracture type, and cause of the injuries in the 2 groups are listed in Table 1.

### Surgical technique and rehabilitation

The procedures were done with the patient under general anesthesia or a brachial plexus block and with the patients in the beach-chair position. An incision 10- to 12-cm in length was made above the clavicle and centered over the fracture site. Care was taken to protect the branches of the supraclavicular nerve in the subcutaneous tissue. Blood clots were removed from the fracture site and minimal periosteal stripping was carried out. Clamps were used to reduce the fracture fragments.

Type A fractures could be anatomically reduced. A K-wire was used for temporary fixation if the fracture was spiral or had a long oblique component, and then a plate was placed on the superior surface of the clavicle. Type B fractures could also be anatomically reduced, converted into a type A fracture by stabilizing the butterfly fragment with a lag screw and then applying the internal fixation plate. In type C fractures, the goal was not anatomical reduction but to correct shortening and rotation. Large fragments were stabilized with lag screws, and absorbable sutures were used to bundle together smaller fragments that were not amenable to internal fixation.

In the group treated with noncontoured implants, 3.5-mm dynamic compression plates were used in 29 cases, 3.5-mm locking compression plates in 20 cases, and 3.5-mm reconstruction plates in 12 cases. In the group treated with precontoured implants, 3.5-mm plates were used in all cases. All plates were placed superiorly. At least 3 bicortical screws were used on either side of the fracture in order to achieve maximum fixation strength. Bone grafts were not used in any of the patients.

In the postoperative period, the extremity was immobilized in a sling for 3 weeks, during which time active range of motion exercises for the elbow and shoulder pendulum movement exercises were encouraged. Three weeks after surgery, passive mobilization of the shoulder was increased while gradually transitioning to active exercises. Strength training was started after radiological and clinical healing had been achieved.

All patients were asked to follow-up monthly after surgery until fracture union, and then every 3 to 6 months after radiographic union. The duration of