



Angular stable fixation of displaced distal-third clavicle fractures with superior precontoured locking plates



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Hypothesis: We reviewed the outcome of angular stable plates in addressing displaced lateral-third clavicle fractures. We investigated union, shoulder function, request for implant removal, and return to sport. Our hypothesis was that these implants provide predictable union and return to sports without the negative consequence of leaving plates in situ, reducing the requirement for a second surgery.

Methods: We undertook a retrospective review of a consecutive series of patients who underwent this surgery between 2007 and 2010. Nineteen patients with a mean follow-up of 25 months were included. Postoperative follow-up was performed at 2 weeks and monthly thereafter until union was assessed as achieved clinically and radiographically. Two telephone interviews at a mean of 7 months and 25 months postoperatively assessed shoulder function by Oxford Shoulder Score, presence of any plate or scar discomfort, need for implant removal, and return to sport.

Results: Nineteen patients achieved union by 4 months (median, 12 weeks; range, 6-16 weeks). The mean Oxford Shoulder Score was 46 (range, 41-48) at a mean of 7 months (range, 3-18 months) and 47 (range, 44-48) at 25 months (range, 18-48 months). Initially, 2 patients requested implant removal; later, however, both declined surgery. No plates have been removed. Four patients complained of mild plate discomfort but did not wish removal. All patients had returned to sporting activities.

Conclusion: Angular stable plate fixation of Neer group II, type II clavicle fractures resulted in a 100% union rate with excellent return of function with no mandatory need for removal.

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

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Keywords: Lateral clavicle; unstable; fracture; nonunion; locked plate; angular stable fixation; hook plate

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Distal-third clavicle fractures account for approximately 12% to 15% of all clavicle fractures.⁴ These typically result from a direct blow to the shoulder. This type of injury is commonplace in sports associated with falling, such as cycling, skiing, and contact sports. Patients involved in these activities are typically young and employed and desire an early return to work and training routines.

Neer classified clavicle fractures into three parts.¹⁶ Group II fractures occur in the distal third of the clavicle. These fractures are further divided into type II when there is no residual ligamentous attachments to the medial fragment. These group II, type II injuries are further subdivided into 2 classes: those in which both the conoid and trapezoid ligaments are attached to the distal fragment, and those in which the conoid ligament is ruptured. Type II injury patterns are inherently unstable.

Because of the instability created by the unhindered downward pull of the shoulder girdle on the distal fragment and the unimpeded superior pull on the medial fragment by the trapezius muscle, these fractures have a 20% to 44% risk of nonunion.^{6,14,16} Nowak et al¹⁸ have shown the high incidence of symptomatic nonunion when nonoperative management fails. This contradicts other authors who believe that nonunions are often asymptomatic.^{17,20}

Prolonged immobilization is associated with persistent shoulder dysfunction,¹⁴ whereas acute stable surgical fixation facilitates early mobilization.¹⁴ Significant pain relief due to this stability has been shown to be provided within 12 hours of clavicle fixation.¹

Various surgical techniques have been described, including K-wires, threaded pin fixation, tension band wiring, and hook plate fixation. Each fixation technique has its own associated complications, which include wire migration, acromioclavicular joint arthrosis, subacromial impingement/erosion, and peri-implant fracture.^{3,8,15,19} Some of these fixation devices require a second surgery for implant removal after union has been achieved. Several authors believe that it is better to manage these cases nonoperatively to avoid the risks of these complications.^{5,10,12,17,20,21}

Precontoured low-profile distal-third locking plates have made angular stable fixation possible. A major advantage over fixation techniques is that neither the acromioclavicular joint nor the subacromial space is violated, thus providing no indication for implant removal.¹¹

The purpose of this study was to determine postoperative shoulder function, union rates, and the need for implant removal.

Materials and methods

Nineteen consecutive patients who were operated on from 2007 until 2010 were included. Seven surgeons (6 authors and 1 trainee) from the same academic department performed the surgeries. All had displaced group II, type II clavicle fractures (Fig. 1).

Surgical fixation with superior distal-third precontoured locking plates was employed in all patients irrespective of degree of comminution of the distal extent. These were Acumed (Hillsboro, OR, USA) or Synthes (Solothurn, Switzerland) plates. In our earlier cases, we used Acumed plates; later, Synthes plates were favored because they are made from stainless steel and have more lateral screw positions. Surgical technique has been described adequately by Lee et al¹³ with the beach chair position. Our only modification of this technique is the use of a cerclage suture to

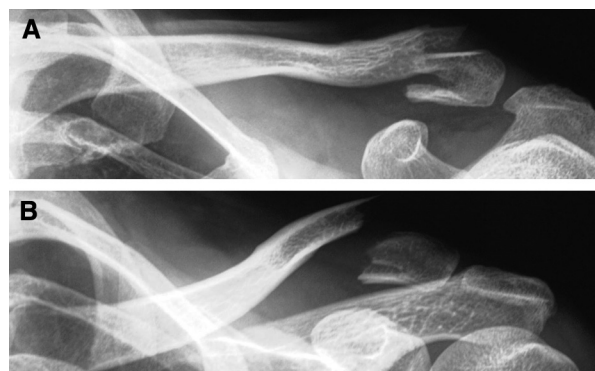


Figure 1 The 30° upshot (A) and anteroposterior (B) radiographs of a group II, type II displaced clavicle.

hold the distal comminuted fragments together and the use of a marker needle (Fig. 2) placed in the acromioclavicular joint and confirmed with a single fluoroscopic anteroposterior view to prevent inadvertent screw penetration during screw insertion, our principle being that placing the needle in the joint gives one a visual clue as to the lateral extent of plate positioning, thereby saving time and exposure to radiation by avoiding constant checking with fluoroscopy. Intraoperative fluoroscopy was used to confirm appropriate screw placement, aiming to achieve bicortical fixation and fracture reduction. The image intensifier is positioned obliquely from the opposite side of the patient so that it may be rotated to give anteroposterior as well as 30° upshot views (Fig. 3).

A shoulder immobilizer was used after surgery for the first 2 to 4 weeks (depending on the surgeon's impression of strength of fixation).

A retrospective review of radiographs and clinical notes was performed to assess time to radiographic union and to note any early complications (Fig. 4).

A telephone questionnaire was performed at a mean of 7 months postoperatively (range, 3-18 months). This included an Oxford Shoulder Score (OSS) and further questions including presence of plate and skin discomfort, any desire for hardware removal, and whether there had been return to the preinjury level of sport participation (Table I). The same telephone interview was repeated at a mean of 25 months postoperatively (range, 18-48 months).

Results

The cohort consisted of 19 patients; 17 patients were men. Average age was 44 years (range, 29-55 years). All 19 patients were followed up until union. All patients had radiographic union within 16 weeks (median, 12 weeks; range, 6-16 weeks) after surgery. There were no early complications. One screw was noted to penetrate the acromioclavicular joint but was asymptomatic (Fig. 5).

At initial telephone interview at a mean of 7 months postoperatively (range, 3-18 months), 15 respondents were included; 4 patients were unobtainable. The OSS (mean, 46; range, 41-48) revealed satisfactory shoulder function. Two patients (13%) experienced plate discomfort and

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