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Surgical management of uncomplicated midshaft clavicle fractures: a comparison between titanium elastic nails and small reconstruction plates

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Background: This study compared titanium elastic nail (TEN) fixation with plate fixation in patients with uncomplicated midshaft clavicle fractures.

Methods: The records of 57 patients with midshaft clavicular fractures that were operated on within 2 weeks after injury at Kaohsiung Veterans General Hospital, Kaohsiung City, Taiwan, were retrospectively analyzed. Each patient received either TENs (n = 25) or fixation with a 3.5-mm reconstruction plate (n = 32) depending on the preference of the operating surgeon. Operative parameters, postoperative pain and function scores, complications, and fracture union time were determined.

Results: There was no difference in the fracture pattern distribution between the 2 groups, and all operations were performed without complications. Operation time, wound size, blood loss, length of hospitalization, and subjective time to pain relief were less for the TEN group than for the 3.5-mm reconstruction plate fixation group ($P < .001$ for all). Patients in the TEN group showed a greater range of shoulder motion and higher Constant scores than those in the plate fixation group up to 18 weeks after surgery ($P < .001$ for all). Fewer patients in the TEN group, 4 (16%), requested removal of the implant, as compared with 12 (37.5%) in the plate group.

Conclusion: Fixation of uncomplicated midshaft clavicle fractures with TENs provides adequate fixation and faster relief of pain and return to normal function of the affected shoulder than fixation with 3.5-mm reconstruction plates.

Level of evidence: Level III, Retrospective Case-Control Design, Treatment Study.

Keywords: Titanium elastic nails; small reconstruction plates; clavicle fracture

Review board approval for this study was attained from the Institutional Review Board of Kaohsiung Veterans General Hospital, Kaohsiung, Taiwan.

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In adults, clavicular fractures account for 2.6% to 5% of all fractures and for 44% of all shoulder girdle injuries, with middle-third fractures accounting for 69% to 72%.[7,8,22] Although fracture union usually occurs regardless of the treatment selected,[1,3] controversy exists regarding optimal management. Nonoperative management, the most common approach to nondisplaced clavicular fractures in adults, consists of immobilization in a sling or figure-of-8 dressing followed by range-of-motion (ROM) exercises. Operative repair results in improved outcomes and lower rates of nonunion compared with nonoperative management and is recommended for patients with multiple risk factors for nonunion, especially significant displacement or clavicle shortening. Options for operative repair are open or closed reduction with plate fixation or intramedullary fixation. Intramedullary fixation involves smaller incisions, restores anatomy adequately, avoids potential complications from plate pressure, and is associated with less need for additional surgery. Because of the possibility of migration or back out of intramedullary fixation devices, plate fixation continues to be the option preferred by many surgeons.

The titanium elastic nail (TEN) system (Synthes, Paoli, PA, USA) is designed for fixation of fractures associated with a narrow medullary canal and/or when flexibility of the implant is vital. The elastic nail is easily contoured, inserted, and removed. When compared with nonoperative management, intramedullary fixation of midshaft clavicle fractures with TENs has been found to be associated with lower rates of nonunion and delayed union, a faster return to daily activities, and greater overall patient satisfaction.[20] Although fixation of midshaft clavicle fractures with TENs is repeatedly proposed to represent a valuable alternative to plate fixation, no comparative studies of these procedures have been performed. This study was therefore undertaken to compare these methods of fixation with respect to operative time, fracture union, pain relief, and functional parameters for patients with uncomplicated midshaft clavicular fractures.

Methods

We conducted a retrospective, case-controlled study on patients with clavicular fractures that were surgically treated at our hospital from January to December 2007. Open fractures, complex comminuted fractures (type 2B2), nonunion after 6 months of conservative therapy, and cases in which treatment was delayed for more than 3 weeks after injury were excluded because such cases are considered a strong indication for plate fixation. In addition, cases with neurovascular injury or multiple traumas were excluded. Indications for surgery included a fracture gap total displacement greater than 1 cm and intractable pain as subjectively described by the patient. Incomplete displacement was not an indication for surgery.

The patients were divided into 2 groups based on fixation method: open reduction with 3.5-mm reconstruction plates (small reconstruction plate [SRP] fixation group) and open or closed reduction with TENs (TEN fixation group). The choice of fixation method depended on the preference of the surgeon. All of the patients in the TEN group were operated on by the first author (Y.-W.T.), who has more than 12 years of orthopedic experience. Patients in the SRP group were operated on by 1 of 3 other surgeons whose experience performing orthopedic surgery ranged from 6 to 15 years. During the study period, patients were assigned to surgeons based on the on-call duty schedule.

Fracture patterns included transverse (type 2A2) (Fig. 1), oblique (type 2B) (Fig. 2), and wedge comminuted (type 2B1) types,[18] each of which is considered an indication for open or closed reduction with TENs or use of 3.5-mm reconstruction plates, depending on the viewpoint of the surgeon.

All TEN patients were advised to use an arm sling for relief of pain and protection of the wound for 1 week postoperatively. Subsequently, active ROM of the shoulder was encouraged once pain was tolerable. Patients in the SRP group wore an arm sling for 3 to 6 weeks postoperatively, depending on bone quality. Active motion of the shoulder joint was allowed after the patient was pain free or partial bone union had occurred.

Patients were followed up at 6-week intervals for the first 6 months postoperatively and, thereafter, every 3 months until 1 year postoperatively. Measurements of active abduction ability were initiated at the first visit after discharge (10-14 days postoperatively) and then performed at each follow-up visit. Shoulder function also was evaluated by ROM, by the scoring system of Constant and Murley,[4,11] and by the time of return to normal daily activities, defined as when arm sling use was no longer necessary. Assessment of fracture union was determined by plain radiography immediately after surgery and every 6 weeks through the 24th postoperative week. Clavicular length in the TEN group was measured between 4 and 5 months postoperatively, after bone union had occurred. Plain radiographs were also taken at 1 year postoperatively and before and after removal of the internal fixator. Measurements and the review of radiographs were performed by the surgeons who performed the surgery. Data regarding the operative time, wound size, blood loss, length of hospital stay, subjective pain relief time (determined based on the patient's subjective feelings of pain and no longer requiring analgesics), arm sling protection time, complications, and need for additional surgery for the 2 groups were recorded. Complications were defined as screw loosening, occurrence of skin tenting, development of a superficial infection, and bone nonunion.

Surgical technique for intramedullary fixation using TENs

For TEN fixation, each patient was placed on a radiolucent operating table in the supine position, and a roll of towels was placed beneath the scapulae to fully extend the clavicle. After clavicle extension, fluoroscopy was used to check for overlap of the fracture site. A 1- to 2-cm skin incision was made just above the sternal end of the clavicle. Approximately 2 cm distal to the sternoclavicular joint, an entry hole was created in the anteroinferior cortex of the sternal end of the clavicle with a 2.5-mm drill and was then widened by use of an awl. The TEN, measuring 2.0 to 3.5 mm, was contoured by hand into the shape of a bow with the tip of the nail pointing to the concave side of the bow (Fig. 3, *A*). The TEN was then fixed in a universal chuck with a T-handle. By use of oscillating hand movements, the unreamed TEN was advanced until it reached the fracture site.