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Case Report

Osteosynthesis using scorpion plate for nonunion of distal clavicle fracture with small distal bone fragment: A case report

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ABSTRACT

Distal clavicle nonunion is a relatively common complication of unstable, displaced distal clavicle fractures; however, its standard surgical procedure has not been fully established. We describe a case of symptomatic nonunion of a distal clavicle fracture with a very small distal bone fragment that was treated with a scorpion plate. A 63-year-old man presented with left shoulder pain after a bicycle fall 5 months earlier. Plain radiographs and computed tomography revealed atrophic nonunion of the distal clavicle with a small distal bone fragment measuring 12 mm in length. Shoulder pain interfered with his work and daily life; therefore, we scheduled surgery. After releasing the nonunion site, cancellous bone was grafted from the iliac crest. We placed a scorpion plate with two grasping arms that fixed the distal clavicular fragment without straddling the acromioclavicular joint. One year postoperatively, his pain subsided, and bone union was confirmed. Our case presents a surgical procedure for treating the nonunion of distal clavicle fractures using a scorpion plate and an autologous bone graft. This procedure is especially beneficial for cases with small distal bone fragments, because the grasping arms of the scorpion plate allow secure fixation of the distal bone fragment and bone graft without further fragmentation.

Introduction

Distal clavicle nonunion is a relatively common complication of unstable, displaced distal clavicle fracture [1], which can be symptomatic and sometimes require surgery [2]. Owing to limited information about the surgical management of distal clavicle nonunion, a standard treatment strategy has not been fully established. Additionally, surgery in patients with small distal fragments remains challenging because secure fixation of the distal clavicle is difficult [3].

The scorpion plate is an anatomical, nonlocking plate with two grasping arms. The main feature is that, in addition to screws, the plate arms grasp the distal fragment anteriorly and posteriorly without straddling the acromioclavicular joint [4]. The flexibility and torsional stiffness of the scorpion plate are equivalent to those of hook plates [5]. However, no reports have yet clarified scorpion plate fixation for distal clavicle nonunion.

Herein, we report the case of symptomatic distal clavicle nonunion with a small distal fragment, treated with a scorpion plate and autologous bone graft.

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Statement of informed consent

A statement by the ethics committee was not required for this anonymized case report, in accordance with the legislation of Japan. Written informed consent was obtained from the patient for the publication of this case report and any accompanying images. A copy of the written consent form is available for review by the editor-in-chief of the journal.

Case report

A 63-year-old man presented to our hospital with persistent left shoulder pain. He had fallen off his bicycle 5 months earlier, was examined at another hospital, and diagnosed with a left shoulder contusion. The patient had no significant medical history. Physical examination revealed no tenderness; however, elevation and horizontal internal rotation of the shoulder joint aggravated pain. The Constant score was 76. The American Shoulder and Elbow Surgeon (ASES) score was 78. Findings of plain radiography revealed a left distal clavicle fracture corresponding to Neer classification type II (Fig. 1A). Computed tomography (CT) revealed atrophic nonunion with osteosclerosis (Fig. 1B). Three-dimensional CT revealed a distal clavicle nonunion with a 12-mm distal bone fragment (Fig. 1C and D). The patient was diagnosed with distal clavicle nonunion, and surgery was scheduled because shoulder pain interfered with activities of daily living.

Surgery was performed with the patient in the beach chair position under general anesthesia. An 8-cm skin incision was made longitudinally just above the distal clavicle. The nonunion site was connected by fibrous tissue (Fig. 2A) that was removed (Fig. 2B), and the fracture site medullary canal was opened with a Kirschner wire. The continuity between the distal bone fragment and the rhomboid ligament was confirmed; however, the conoid ligament was ruptured. We grafted cancellous bone from the iliac crest into the nonunion site (Fig. 2C). After reducing the bone fragments, we placed a SCORPION® NEO plate (Aimedic MMT, Tokyo, Japan). Following the insertion of three cortical screws proximally and one distally, the plate arms were bent using a specialized instrument to firmly grasp the distal fragment and bone graft (Fig. 2D).

Postoperatively, the left arm was immobilized in a sling for 3 weeks. The pain gradually subsided, and the patient resumed heavy work without pain. One year postoperatively, both the Constant and ASES scores were 98, and plain radiographs confirmed bony union with no separation of the coracoclavicular distance (Fig. 3).

Discussion

In this case, osteosynthesis using a scorpion plate and autologous cancellous bone graft resulted in satisfactory functional outcomes, and a bony union was achieved for a symptomatic distal clavicle nonunion with a small distal fragment.

To date, surgical procedures for symptomatic nonunion of distal clavicle fractures included distal clavicle excision [2,6],

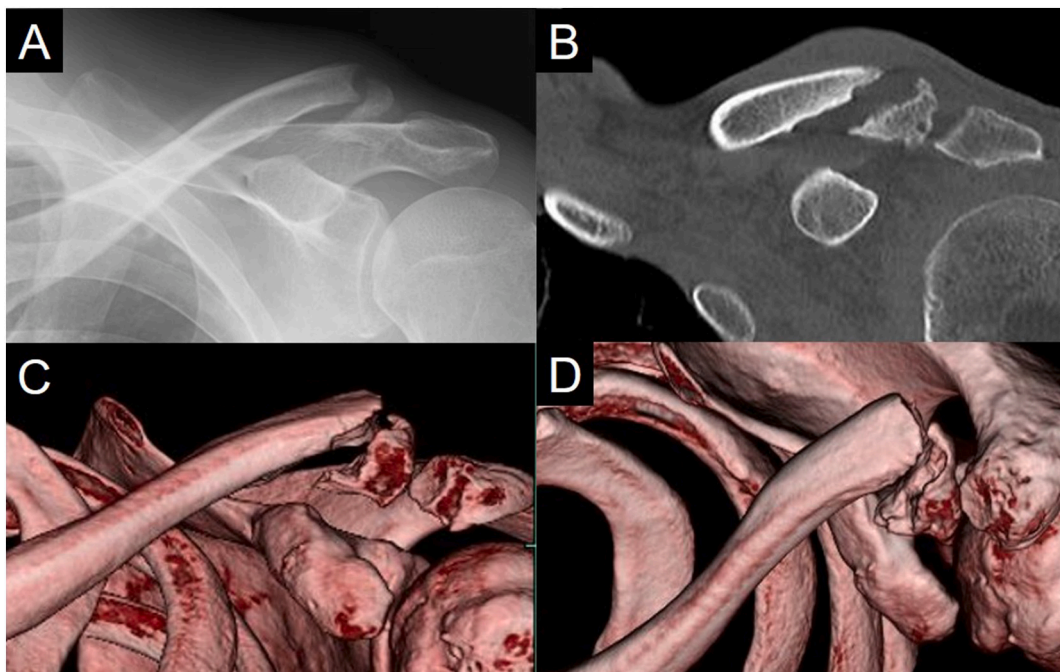


Fig. 1. Preoperative findings of radiography and computed tomography (CT) of the left clavicle. Plain radiographs showed the distal clavicle nonunion (A). CT findings revealed atrophic nonunion with osteosclerosis at the fracture site (B). 3D-CT showed distal clavicle nonunion with a small, 12-mm, distal bone fragment (C and D).

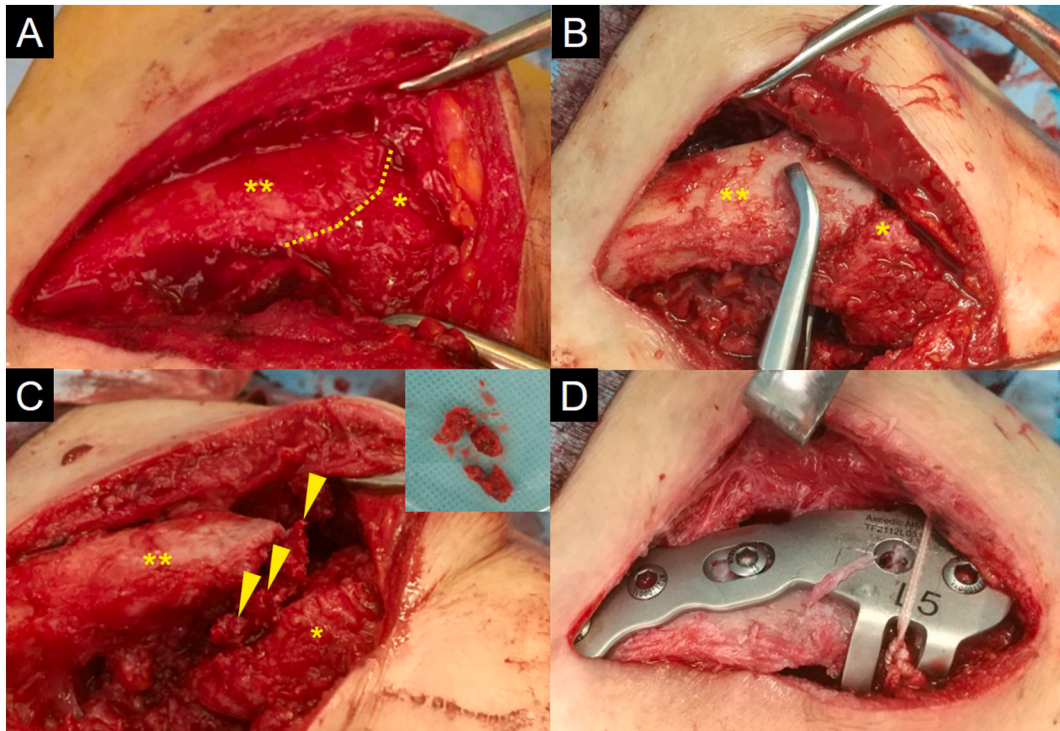


Fig. 2. Intraoperative findings. The nonunion site was connected by fibrous tissue (dot-dash line) (A). We removed this fibrous tissue, opened the medial canal with a Kirschner wire, and reduced the proximal (double asterisk) and distal (single asterisk) bone fragments (B). We grafted cancellous bone (arrow heads) from the iliac crest into the nonunion site (C). After three cortical screws were inserted proximally and one cortical screw was inserted distally, the plate arms were bent using a specialized instrument so that they firmly grasped the distal fragment and bone graft (D).

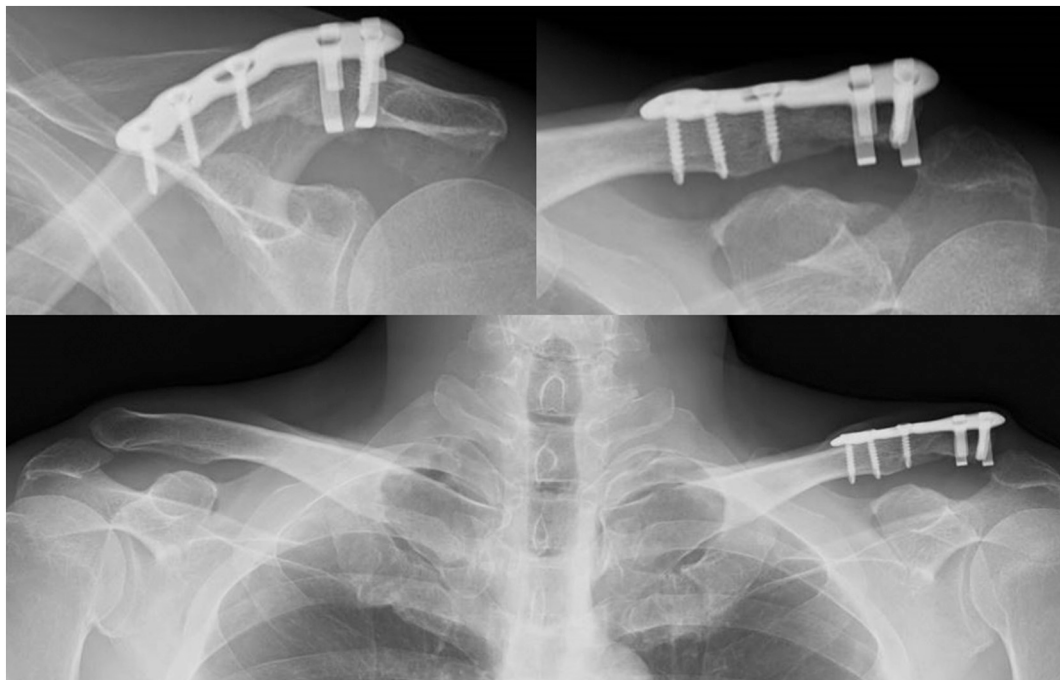


Fig. 3. Plain radiographs recorded 1 year after surgery, showing bony union at the nonunion site and no separation of coracoclavicular distance.

osteosynthesis using interfragment screws [2], locking plates fixed proximally to the acromioclavicular joint [3,7,8], or a hook plate [7,9]. Distal clavicle excision for distal clavicle nonunion has provided excellent functional outcomes in some cases, whereas pain and limited range of motion remain in other cases [6]. In distal clavicle excision, the partial removal of the deltoid or trapezius muscle insertion may cause functional impairment [10]. Locking plate fixation with autologous bone graft is a relatively common procedure for distal clavicle nonunion and has been reported to provide a satisfactory functional outcome [3,7]. However, plate fixation is indicated only in cases where the distal fragment is sufficiently large to accommodate the necessary number of screws because the distal bone fragment is fixed by screws. Small distal bone fragments (≤ 2 cm) may have a negative effect on postoperative outcomes of plate fixation for distal clavicle nonunion [3]. Moreover, a relatively large study in which distal clavicle nonunion was treated with a locking plate showed that recalcitrant nonunion occurred in 4/14 (29 %) of the patients [8], suggesting the possibility that in some cases secure fixation cannot be achieved with a locking plate alone. To address this problem, several studies have shown that plate fixation requires temporary fixation with Kirschner wires [3,7] or a postoperative Velpeau spica cast [3]. The hook plate provides rigid fixation of the distal fragment, and a solid bone union is obtained by combination with an autologous bone graft [9]. However, a case of postoperative peri-implant fracture, believed to be caused by stress concentration on the disused atrophic clavicle owing to symptomatic nonunion, has been reported [7].

Osteosynthesis using a scorpion plate has three advantages over other surgical procedures. First, the scorpion plate allows fixation of distal bone fragments and autologous bone grafts with two plate arms instead of a large number of screws. This avoids further fragmentation of distal bone fragments and bone grafts, as well as being advantageous for the rigid fixation of small distal fragments and achieving a bony union at the nonunion site. Second, postoperative coracoclavicular separation was not observed in this case, suggesting that osteosynthesis using a scorpion plate can eliminate additional fixation with Kirschner wires or reconstruction of the coracoclavicular ligaments, even in distal clavicle nonunion with a coracoclavicular ligament injury. A previous clinical study showed that osteosynthesis using a scorpion plate alone achieved high bone union without significant coracoclavicular separation for acute unstable distal clavicle fractures, such as Neer type II and V fractures [4]. Third, in contrast to hook plates, scorpion plates secure distal clavicular fragments without straddling the acromioclavicular joint. Consequently, they do not necessitate postoperative activity restrictions or implant removal to prevent acromial osteolysis or subacromial impingement. However, because the scorpion plate does not use locking screws, pullout strength may be reduced in osteoporotic bone, which could be a limitation. Moreover, similar to other precontoured locking plates, scorpion plates, may necessitate implant removal due to implant-related pain [4]. Fortunately, in this particular case, the patient did not experience plate irritation and expressed no interest implant removal.

In summary, we present a surgical treatment for the nonunion of distal clavicle fractures using a scorpion plate and an autologous bone graft. This procedure is especially beneficial for cases with small distal bone fragments because the grasping arms of the scorpion plate allow secure fixation of the distal bone fragment and bone graft without further fragmentation.

Prior presentations

This manuscript has not been published or presented elsewhere in part or in entirety.

Ethics approval and consent to participate

Consent to participate is not applicable in this type of study. A statement of the ethics committee was not required from this anonymized case report in accordance with the legislation of the Institutional Review Committee of our institution.

Consent for publication

Written informed consent was obtained from the patient for publication of this case report and any accompanying images. A copy of the written consent is available for review by the editor-in-chief of this journal.

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Declaration of competing interest

The authors (Yuya Yokohama, Ryogo Furuhashi, Atsushi Tanji, Shota Fujita) have no interests to declare.

Data availability

Data that support the findings of this study are available from the corresponding author on reasonable request.

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Not applicable.

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