Tension Suture Fixation Using 2 Washers for Proximal Humeral Fractures

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We describe a new technique of tension suture fixation for proximal humeral fractures using 2 washers to increase fixation strength. After plate fixation, a 3.5-mm cortical screw, fitted with a 3.5- and 4.5-mm washer, was inserted at the longitudinal combi-hole of the plate shaft and fixed incompletely. Number 5 nonabsorbable sutures incorporating the rotator cuff tendons were then placed anteriorly, laterally, and posteriorly. The sutures were passed into the 4.5-mm washer and tied between the rotator cuff tendon and the washer. When the 3.5-mm cortical screw with the 2 washers was completely fastened, the 4.5-mm washer was moved downward to the screw hole, and tensile force was transmitted through the sutures. This study shows that supplementary tension suture fixation using 2 washers for proximal humeral fractures can provide more tensile force and additional stability to prevent fixation loss and varus deformity.

The surgical treatment of proximal humeral fractures continues to be challenging, especially in patients with osteoporosis. Although various techniques have been described (eg, plate and screw fixation, intramedullary nailing, percutaneous pin fixation, tension band wiring, transosseous suture fixation, and hemiarthroplasty), no consensus has been reached regarding the best treatment option.

Materials and Methods

Ten patients with proximal humeral fractures underwent plate and screw fixation with tension sutures using 2 washers. Participants were 3 men and 7 women, with an average age of 57.5 years (range, 39-69 years). Average follow-up was 13.8 months (range, 12-21 months). All patients were evaluated using the American Shoulder Elbow Surgeons (ASES) scoring system.

Abstract: The surgical treatment for proximal humeral fractures is challenging, especially in patients with osteoporosis. Locking plates and intramedullary nails have been widely used with satisfactory results, but previously reported complications have not been substantially reduced. Several authors have emphasized the importance of maintaining soft tissues around the proximal humerus with respect to limiting displacement and maintaining stability. To prevent postoperative complications, such as fixation failure and malunion, several supplementary suture techniques using nonabsorbable sutures that allow for the incorporation of the rotator cuff as a fixation point have been described.
Surgical Technique

Under general anesthesia, the patient is placed in the supine position on a radiolucent table. The fracture site is exposed by a standard deltopectoral approach. Fragments of the fracture are provisionally reduced with Kirschner wires and sutures placed through the rotator cuff tendon and then fixed using a PHILOS plate (Synthes, West Chester, Pennsylvania) (B, C). Photograph showing the initial placement of the PHILOS plate (D).

After PHILOS plate fixation for a proximal humeral fracture, the 3.5-mm cortical screw is removed at the longitudinal combi-hole of the plate shaft. A screw 2-mm longer than the 1 previously inserted is fitted with 2 washers (3.5 and 4.5 mm) is reinserted and incompletely fixed (Figure 2).

Four to five #5 nonabsorbable braided sutures (Ethibond, Somerville, New Jersey) incorporating the rotator cuff tendons are placed anteriorly, superiorly, and posteriorly. The sutures are passed into the 4.5-mm washer and tied between the rotator cuff tendon and the 4.5-mm washer (Figure 3). Finally, the cortical screw is fastened completely. The 4.5-mm washer is moved downward to the screw hole, and tensile force is transmitted through the sutures (Figure 4).

Results

All cases had bony union at an average of 18.8 months (range, 11-25 months). The average ASES score was 88.8 (range, 63.3-100). No postoperative complications, such as fixation failure, varus malunion, and infection, were observed, with the exception of 1 case of a stiff shoulder.

Discussion

Although the management of fractures and fixation devices continuously evolves, the treatment of proximal humeral fractures in elderly patients with osteoporosis remains challenging. Precontoured locking plates and locking intramedullary nails have been used for proximal humeral fractures, and good clinical outcomes have been obtained.1,3,5

Micic et al3 and Park et al5 described intramedullary nailing with tension band suture fixation for proximal humeral fractures and suggested that tension band sutures placed between the head or washer of the interlocking screw and the rotator cuff could reduce complications and increase fixation strength. Other authors have described supplementary suture revision surgery, especially in elderly patients with osteoporosis.2 Repetitive contractile forces generated by the rotator cuff predispose fracture constructs to varus displacement, migration of tuberosity fragment, collapse, and subsequent screw cutout.2,7

For these reasons, the concept of supplementary suture fixation has been recently emphasized. Several authors have advocated the use of supplemental sutures to counter the natural deforming forces of the rotator cuff, to achieve anatomy reduction and restoration of the medial calcar, and to prevent postoperative complications.2,4,7

Micic et al3 and Park et al5 described intramedullary nailing with tension band suture fixation for proximal humeral fractures and suggested that tension band sutures placed between the head or washer of the interlocking screw and the rotator cuff could reduce complications and increase fixation strength. Other authors have described supplementary suture
fixation by tying nonabsorbable sutures to the plate through the suture eyelet with locking plate fixation. However, it is difficult to provide tension, and the knots may eventually loosen.

Our technique provides tension between the rotator cuff and the 4.5-mm washer. When a 3.5-mm cortical screw with 2 washers is fastened, the 4.5-mm washer is moved downward toward the screw hole, and the tension is transmitted through the sutures. Our technique allows for early shoulder range of motion exercises by increasing fixation strength in addition to locking plate fixation.

However, a shortcoming of our study is that we did not perform a biomechanical study to confirm maintenance of the suture tension. Further biomechanical and prospective randomized clinical studies are required to better understand the role of supplementary suture fixation.

CONCLUSION
Supplementary tension suture fixation using 2 washers for the treatment of proximal humeral fractures can provide more tensile force and additional stability to prevent fixation loss and varus deformity.

REFERENCES