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Optimum Tension for the Bridging Sutures in Trans-Osseous Equivalent Rotator Cuff Repair

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Summary:
Increasing bridging suture tension over 90N did not improve contact area, although it did increase contact force and pressure. Furthermore, bridging suture tension did not significantly affect ultimate failure loads. Therefore, considering the risks for over-tensioning of bridging sutures, it might be clinically more beneficial to not setting the bridging suture tension over 90 N.

Abstract:
Trans-osseous equivalent (TOE) rotator cuff repair can increase contact area and contact pressure between the repaired rotator cuff tendon and bony footprint, and show higher ultimate load to failure and smaller gap formation among various rotator cuff repair techniques. However, it has been suggested that the medial rotator cuff failure after TOE repair may result from too much increased bridging suture tension by compromising intratendinous blood supply. Therefore, authors would like to determine the optimum bridging suture tension in TOE repair by evaluating supraspinatus footprint contact and construct failure characteristics at different tensions.

Eighteen fresh frozen cadaveric shoulders were randomly divided into 3 groups. All cadaveric shoulders were constructed with TOE configuration using same medial suture anchor (Healix®, Depuy Mitek, Raynham, MA) placing a Tekscan® pressure sensing pad between repaired rotator cuff tendon and footprint.

Among eighteen cadaveric shoulders, nine shoulders were used for footprint contact characteristics measurement. Using a Tekscan® pressure measurement system (Tekscan Inc, South Boston, Massachusetts), the contact force, pressure, peak pressure and area between rotator cuff tendon and the greater tuberosity were quantified for bridging suture tension of 60N, 90N, and 120N at glenohumeral abduction angles of 0°, 30° and humeral rotation of internal rotation 30°, 0°, and external rotation 30°. Tension was applied using custom-made tensiometer, attachable to the Versalok® system. To avoid the effects of the previous measurements and the stress-relaxation phenomenon, we exerted the designated tension manually each time after humeral head positioning, and tension was reduced to 0 after every measurement.

After footprint contact characteristics measurement, Tekscan® pad was removed and final TOE construct were made. Designated tension was applied according to groups. Groups 1 and 2 with 60N, 120N of Versalok® (Depuy Mitek, Raynham, MA) respectively, and Group 3 with the maximum tension of ReelX® (Stryker Endoscopy, San Jose, CA). After that, all the eighteen TOE construct were subjected to cyclic and load to failure tests using an Instron® materials testing machine (model 3365) with a load cell capacity of 5 kN and a video digitizing system (VDS®; WINAnalyze; Micromark, Berlin, Germany). The ultimate load, stiffness, hysteresis, strain, and failure mode were evaluated.

In the footprint contact characteristics measurement, as the bridging suture tension increased, contact force, pressure and peak pressure increased significantly at all positions (all $p < 0.05$). However, regarding the contact area,

Paper #19

even though there were significant differences between 60N and 90N except for one position (30° abduction and 30° external rotation), no significant differences were found between 90N and 120N at all positions. Regarding construct failure test, there were no significant differences in any parameters according to different tensions or anchor types (all $p > 0.05$).

According to the current data, increasing bridging suture tension over 90N did not improve contact area, although it did increase contact force and pressure. Furthermore, bridging suture tension did not significantly affect ultimate failure loads. Therefore, considering the risks for over-tensioning of bridging sutures, it might be clinically more beneficial to not setting the bridging suture tension over 90 N.