FIXATION STRENGTH OF SUTURE ANCHORS AFTER INTRAOPERATIVE FAILURE OF THE FIRST ANCHOR

**Khabie, V.,** **Glousman, R. E.,** **Liang, M.,** **Culwell, J.,** **Ebramzadeh, E.**

*The J Vernon Luck, Sr, MD Orthopaedic Research Center, Orthopaedic Hospital, 2400 South Flower Street, Los Angeles, California 90057, 213-742-1379, Fax 213-742-1353

**INTRODUCTION:** Tendon anors are commonly used in securing soft tissue to bone. In regions of limited bone stock, when the suture anchor or the suture break during surgery, the surgeon is forced to salvage the previously created drill hole after removal of the initial suture anchor. Although suture anchor pull-out strength has been studied in a variety of models, the fixation strength of suture anchors placed in salvaged drill holes is not known. The purpose of this study was to determine the pull-out strength of four commercially available suture anchors placed in salvaged drill holes. The pull-out strength of initial suture anchors was compared to that of suture anchors placed in salvaged drill holes.

**METHODS:** Ten of each of four suture anchor types were included in freshly drilled holes, ten in salvaged holes, in ten freshly frozen human cadaveric tibiae, with random assignment of the anchor types among the tibiae. The four anchor types were: Innovative Devices ROC 2.8 mm Fastener; Arthrex 2.4 mm FASTak; Linvatec Mini-Revo Screw; and the Mitek G2. All anchors were inserted according to manufacturer’s instructions and by individuals experienced with the device and procedure. All anchors were threaded with 80 lb (356 N) Test Spectra Izorline Fiber to minimize the likelihood of suture breakage. Half of the anchors were tested in freshly drilled bone tunnels, and served as controls for the remaining half which were tested in salvaged holes. A salvage setting was created by fixing an anchor and then removing it. The anchor types differed in salvage methods; Mini-Revo Screw and FASTak were unscrewed, ROC Fastener was drilled through and Mitek G2 was placed directly onto the preexisting anchor. Failure strength was measured using a servo-hydraulic MTS load frame, using a displacement rate of 12.5 mm/s. Data was collected at a sampling rate of 3.6 kHz. Failure mode was recorded as suture breakage, suture cutout, anchor breakage or anchor pullout.

**RESULTS:** Compared to fixation in freshly drilled holes, in salvaged holes, the FASTak anchor had a significantly smaller mean pull-out strength (162±72 N versus 84±55 N) (F(1,18)=9.5, P<0.003). In contrast, compared to fixation in freshly drilled holes, in salvaged holes, the other three suture anchor types had nearly the same or greater pull-out strength: Mini-Revo Screw, 134±67 N versus 154±51 N, ROC Fastener, 170±60 N versus 174±97 N and Mitek G2, 263±139 N versus 253±118 N. Compared to the three other suture anchors, the Mitek G2 had significantly greater mean pull-out strength, both initially and in salvaged holes (P<0.05). The most common failure mode was suture anchor pull-out, accounting for 74% of all failures. With the FASTak, in every case, the anchor pulled out. With all types, anchor breakage and suture failure at the anchor eyelet occurred 10% of the time. With the Mini-Revo Screw, suture failure occurred most frequently, in 7 of 20 cases.

With the Mitek G2, initial anchors could not be removed; therefore, the second Mitek was placed on top of the initial in the same bone tunnel, resulting in migration of the initial anchor by an average of 18 mm. With the Mini-Revo suture breakage at the eyelet occurred frequently. With the ROC Fastener, polyethylene anchor, plastic debris was generated during the salvage procedure.

**DISCUSSION:** The strength of the suture commonly used with these anchors is 100 N. Fixation strength with the FASTak in salvaged holes was below this threshold. However, pull-out strength of all other anchors tested in both initial and salvaged cases was greater than 100 N. The strength of the Mitek G2 was approximately 2.5 times suture strength, greatly increasing the likelihood of suture breakage rather than anchor failure in the clinical setting. The strength of fixation with the Mitek G2, Mini-Revo and the ROC Fastener demonstrated no decrease in pull-out strength from initial to salvaged repairs.

In summary, the FASTak anchor demonstrated a decrease in fixation strength after the salvage procedure. In situations of limited bone stock, previously created drill holes may be used for suture anchor revision when using the Mini-Revo, ROC Fastener and Mitek G2 anchor with no substantial decrease in pull-out strength.