Introduction: There are 2 main flexor tendons in the hand, the FDS and FDP. These flexor tendons are kept from “bowstringing” off of a digit in flexion by a series of pulley ligaments, thus maintaining balance between joint range of motion and mechanical advantage of the tendon. The A-2 and A-4 ligaments have been shown to be the most important in this process (Figure 1).

Figure 1: Anatomy of the Finger Flexor Tendon Pulley System - Note location and size of pulleys A-2 and A-4 compared to the remaining ligaments in the pulley system. Also note relation to joints: MCP, PIP, and DIP

When surgically repairing a flexor tendon under a pulley, “venting” of the pulley maybe necessary for proper exposure of the underlying tendon. Studies have shown that 50% of the A-2 pulley and 75% of the A-4 pulley can be transected without significant drops in joint angular rotation. However, location of the transection, either proximal or distal, may play a role as well. The objectives of this study are to provide preliminary evidence for the role of location of pulley transection on dynamic joint angular rotation.

Methods: Index and little fingers of 4 fresh-frozen cadaver hands were studied. The MCP, PIP, and DIP joints of each finger were fitted with 10K Ohm potentiometers. These potentiometers were fixed to the joints with 0.045 K-wires using a template. The specimen was positioned dorsal side down and maintained in neutral wrist flexion. The FDP tendon, which spans across the potentiometers were recorded using DT VEE data acquisition software. The data was converted to corresponding angles of rotation and plotted.

Each finger underwent three separate trials with five recordings for each trial. Trial 1 examined the intact finger. Tendon excursion required to touch fingertip to palm was measured and recorded. The motor was then set to apply this standard amount of excursion for each recording. Voltages and their corresponding joint angles were acquired. Trial 2 examined the dissected digital pulley system. A-2 and A-4 pulley lengths were measured and recorded. Exactly 50% of the proximal or distal A-2 or A-4 pulleys were then transected keeping the remaining digital pulley system intact. This was repeated for five recordings. Trial 3 examined complete A-2 and A-4 pulley transection in the same manner.

Results: The average tendon excursion required for full finger flexion was noted to be 3.7 cm (3.0-4.0 cm). FDP excursion is shown with intact pulleys (Figure 2).

The distribution of partial release of A-2 pulley is shown (Figure 3).

Figure 2: The average A-2 pulley length was 2.28 cm (1.4 - 2.7 cm), while the average A-4 length was 1.11cm (0.7 - 1.5 cm).

When the proximal portion of A-2 is released, over 40% of the DIP range of motion is lost as well as 12% of MCP range of motion. Furthermore, the amount of tendon excursion required to initiate joint motion is increased from 90-120%.

When the distal portion of A-2 is released, the PIP joint is most affected with a 25% loss of range of motion. Only a 20% increase in tendon excursion is noted prior to joint motion.

Proximal A-4 release displays over 60% loss of MCP range of motion while requiring 15-25% more tendon excursion to initiate joint motion (Figure 4).

Discussion: The results demonstrate that compared to proximal A-2 transection, distal A-2 transection results in less change in both dynamic ROM and tendon excursion.

A different trend is seen in the A-4 pulley: although distal A-4 release loses less range of motion than a proximal release, a distal release requires up to 275% more tendon excursion for joint flexion initiation (compared to 15-25% of a proximal release).

These findings suggest that distal A-2 and proximal A-4 pulley release might better preserve intrinsic biomechanics in the finger. This preliminary evidence may give suggestions regarding current surgical practice. However, in the case of the A-4 pulley, future clinical research is necessary to determine which of these parameters, either initiation of flexion or ROM, is functionally more significant.


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