The Effect of Sequential Flexor Tendon Pulley Sectioning and Reconstruction on Joint Range of Motion and Tendon Load

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**INTRODUCTION**

- The A2 and A4 flexor pulleys are important in maintaining proper finger biomechanics.
- Injury to the A2 and A4 following sharp lacerations or crush/iatrogenic injury can result in tendon bowstringing.
- It is unclear how deficient pulleys and subsequent reconstructions at different wrist positions affect actual flexor tendon loads in addition to joint range of motion (ROM).
- We conducted a study to characterize the effects of sequential A2 and A4 pulley sectioning and reconstruction on joint ROM and flexor tendon load.

**METHODS**

14 digits (index, long, ring fingers) from 5 freshly frozen cadaveric hands (3 Females, 2 Males; avg age: 71.8 years) were tested

A novel in-vitro finger motion simulator was designed and used to achieve full simulated active finger flexion/extension under load control at different wrist positions (wrist neutral, 30° wrist flexed, 30° wrist extended)

Tendon loads were collected using in-line load cells
Joint range of motion were collected using minute electromagnetic trackers inserted laterally to the joints of interest

**Protocol**

- Intact ➔ 25% A2 cuts (until 100%) ➔ A2 Rec
- A2 Release ➔ 50% A4 cuts (until 100%)
- A4 Rec ➔ A4 Release ➔ A2 Rec + A4 100%
- A2 100% + A4 Rec ➔ Full A2 + A4 Rec

2-way Repeated Measures ANOVA tests were conducted

**RESULTS**

- Full sectioning of both A2 and A4 pulleys resulted in:
  - Reduced MCP ROM and FDP tendon load by 9.1±7.1 N and 2.3±1.9 N respectively with wrist in neutral.
  - Reduced FDP load by 3.6±3.5 N with wrist flexed
  - Reduced FDP load by 3.5±1.7 N with wrist extended

**CONCLUSION**

- Sectioning of the A2 and A4 pulleys in all wrist positions showed statistically significant effects on reducing MCP ROM and FDP tendon loads.
- Pulley reconstructions restored metrics with no significant difference compared to the intact state, reinforcing their utility by reducing bowstringing and restoring natural joint biomechanics and tendon loads.
- The new simulator’s capability to measure in-line tendon loads has provided additional tendon load information that compliments the state of knowledge on joint ROM in the context of pulley reconstructions.