3-5-2016

The H-taping method for prophylactic or temporary treatment of partial A2 pulley tears during rock climbing: a biomechanical study

Rachel Tufaro

Alex Telis

Dustin Larson

Deana Mercer

Christina Salas

The H-Taping Method for Prophylactic or Temporary Fixation of Partial A2 Pulley Tears During Rock Climbing: A Biomechanical Study

Rachel Tufaro, BS[1,2]; Alexander Telis, MD, MS[1]; Dustin Larson, MD[1]; Deana Mercer, MD[1]; Christina Salas, PhD[1,2,3]

1. Department of Orthopaedics & Rehabilitation
2. Center for Biomedical Engineering
3. Department of Mechanical Engineering

The University of New Mexico, Albuquerque, NM

INTRODUCTION

- Closed digital annular pulley tears are common in the rock climbing community. Partial or complete tears of the A2 pulley occur due to forceful contraction of the tendon mostly occurring when the fingers are in a crimp grip position. (Fig. 1) The most common method of prophylactic and temporary fixation of the A2 pulley is circumferential taping, but this method has been shown to be ineffective against pulley tears[1].

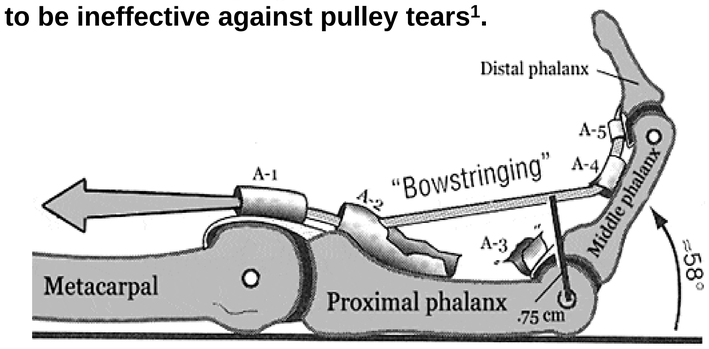

Figure 1: A2 pulley tear due to forceful contraction of the tendon.

PURPOSE

- We present a biomechanical study investigating an alternative taping method proposed by Schoffl et al[2]. This method, known as "H-Taping", allows for simultaneous protection of the A1-A3 pulleys. We investigate this taping method for prophylactic and temporary treatment of A2 pulley tears.

METHODS

- Fourteen matched pairs of fresh-frozen cadaveric hands with forearms were used in this study (range 50-98 y/o; mean 73 y/o):
  - Four fingers (index [IF], long [LF], ring [RF], small [SF]) from each hand were tested individually
  - IF: Compared intact vs. partially torn (50%) A2 pulleys, untaped with Digital Image Correlation (DIC) to measure bowstringing
  - LF: Compared intact vs. torn A2, taped
  - RF: Compared intact A2 pulleys, taped vs. untaped
  - SF: Compared torn A2 pulleys, taped vs. untaped
- The flexor digitorum superficialis (FDS) and flexor digitorum profundus (FDP) tendons for each finger were identified and sutured together for loading
- The "H-tape" was applied and normalized to cover 75% of the proximal and middle phalanx of each taped finger (Fig. 2)

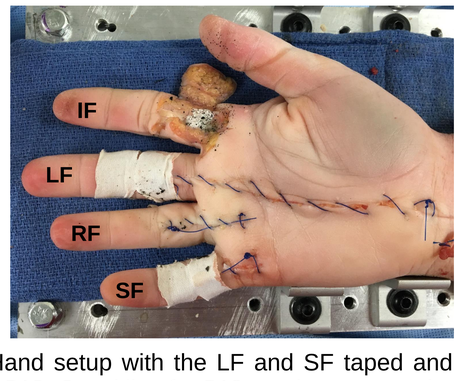

Figure 2: Hand setup with the LF and SF taped and the IF A2 pulley exposed for DIC. Speckling for DIC can be seen on the IF pulley.

METHODS

- The finger was placed in a custom tensile testing fixture designed to position the hand in a rock climbing crimp grip; metacarpophalangeal joint flexed 60 degrees, proximal interphalangeal joint flexed 90 degrees, and distal interphalangeal joint hyperextended (Fig. 3)
- Tendons were loaded at 30 mm/min until failure occurred

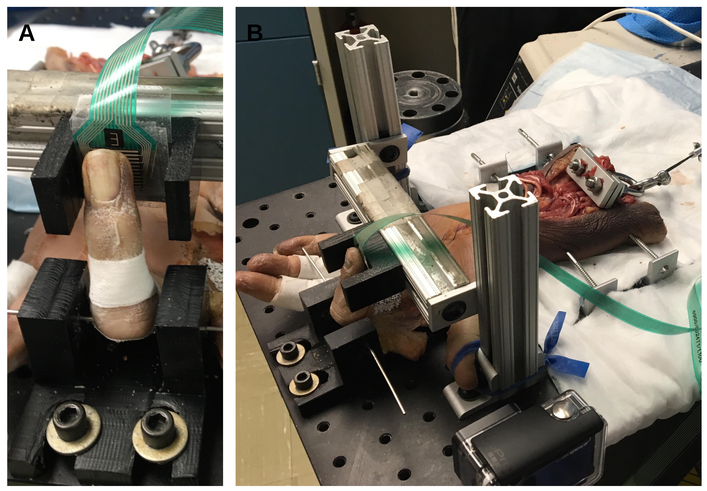

Figure 3: A. Finger pinned in crimp grip with the fingertip placed on force sensor. **B.** Experimental testing fixture showing the specimen restrained proximally with tendons in clamp for applied load.

- Tendon force was measured by a load cell on the actuator; fingertip force measured by Tekscan sensors
- Ultimate tensile load was defined as the peak load prior to A2 pulley failure
- A multivariate analysis of variance (MANOVA) test at a 10% level of significance was used for statistical comparison of data

RESULTS

- The intact pulley (IF analyses) allows greater force to be applied to the tendon prior to failure (Intact 190.00 N; Torn 152.88 N) and permits a marginally greater force at the fingertip (Intact 82.73 N; Torn 43.30 N; Fig. 4)

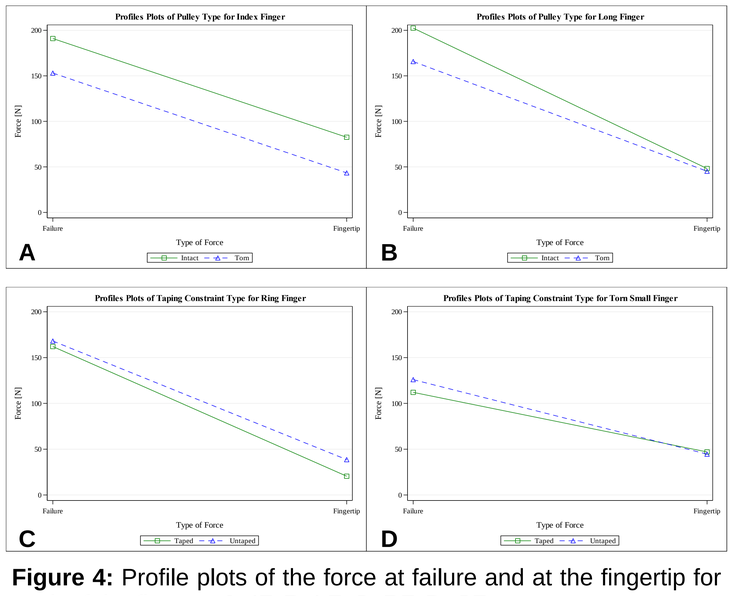

Figure 4: Profile plots of the force at failure and at the fingertip for each of the fingers. **A.** IF, **B.** LF, **C.** RF, **D.** SF

RESULTS

- Adding tape to an intact (RF analyses) or torn (SF analyses) pulley does not allow for a greater applied force to the tendon (p=0.69 and 0.39, respectively) or an increase in force at the fingertip (p=0.12 and 0.92, respectively)
- The average amount of bowstringing measured by DIC was 3.78 mm for the intact pulley and 4.21 mm for the torn pulley. There was no significant difference in the amount of bowstringing between the torn and intact pulleys (p=.23; Fig. 5)

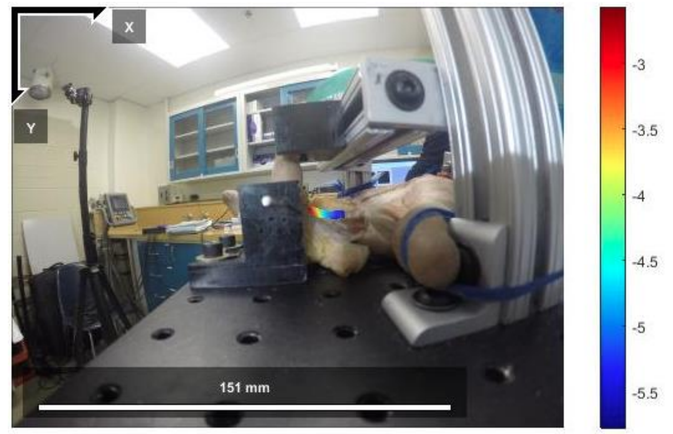

Figure 5: Digital image correlation of the index finger to show the amount of bowstringing that occurred during loading prior to failure

CONCLUSIONS

- H-taping does not allow for increased applied force to the tendon and does not increase the force at the fingertip in specimens with an intact A2 pulley
- H-taping of a torn pulley does not increase the allowable applied force to the tendon or increase the force at the fingertip to the level of an intact A2 pulley

CLINICAL RELEVANCE

- The results do not support H-taping as a prophylactic or temporary fixation measure against A2 pulley injury

ACKNOWLEDGMENTS

- This study was supported in part by the National Center for Research Resources and the National Center for Advancing Translational Sciences of the National Institutes of Health (NIH) through Grant Number UL1 TR000041. The content is solely the responsibility of the authors and does not necessarily represent the official views of the NIH.
- Special thanks to Fares Qeadan for providing statistical assistance on this study

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