Multiple flexor tendon pulley ruptures in a division 1 collegiate football player

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Abstract

Injuries to the hand and digits are common in football players. To our knowledge, there have been no reports on multiple flexor tendon pulley ruptures in football players treated non-operatively through splinting and taping techniques. A 22-year old collegiate defensive lineman sustained an injury resulting in complete disruption of the annular 2, 3, 4, and cruciate 1 and 2 pulleys. The patient was successfully treated with serial custom splints for 12 weeks. Our splinting and taping techniques and timing of these have not been previously described. This case illustrates a successful treatment option in football players with multiple flexor pulley ruptures.

Introduction

Upper extremity injuries in football are common due to the full contact nature of the sport. Specifically, injuries to the hand and digits are a significant source of morbidity for players of all levels. The flexor pulley system is a complex structure made up of five annular (A1-A5) and three cruciate (C1-C3) pulleys in the index, long, ring, and small fingers, through which the flexor digitorum profundus (FDP) and flexor digitorum superficialis (FDS) run; the anatomy of the thumb pulley system is slightly different and beyond the scope of this case report. The location of the pulley dictates its function and the pulleys located in between the joints (A2, A4) are most critical to prevent bowstringing and often considered the most biomechanically important.

Classically, flexor pulley injuries have been reported in rock climbers. Recent literature has also described this injury in baseball players, Kendo players, and people performing activities of daily living. To our knowledge, multiple flexor pulley ruptures have not been described in football players and we present our encounter with this unique injury and our nonoperative management through novel splinting and taping techniques.

Case Report

A 22-year old right hand-dominant male, Division 1 collegiate football defensive lineman, presented with pain localized to his left ring finger metacarpophalangeal (MCP) joint. The patient was playing in a game and grabbed a jersey in the midst of tackling another player, when his flexed left ring finger was suddenly jerked into extension. He had immediate pain and swelling but was able to continue playing. Upon completion of the game, he presented to the athletic training staff.

The patient’s chief complaint was pain. He denied numbness, tingling, and prior injuries to the left ring finger. Past medical and surgical histories were noncontributory. The patient had no allergies and did not take any daily medication (prescription or non-prescription). Examination of the left ring finger revealed diffuse swelling with no visible or palpable deformity. The volar aspect of the ring finger MCP and proximal interphalangeal joint. The patient was able to flex at both the MCP and distal interphalangeal joints and full extension of the ring finger revealed no arthritic changes.

During the day of injury, fluoroscopy was negative for fracture or acute osseous abnormalities. Prior to advanced imaging, differential diagnosis included flexor tendon injury/strain and/or flexor tendon pulley injury. Diagnostic magnetic resonance imaging (MRI) revealed complete disruption of left ring finger A2, A3, A4, C1 and C2 pulleys with associated surrounding soft tissue edema (Figure 1). There was also clinical evidence of bowstringing of the flexor tendon over the proximal and middle phalanges. The patient was diagnosed with ruptures of the left ring finger A2, A3, A4, C1, C2 pulleys.

After a discussion of nonoperative and operative modalities the patient elected to be managed non-operatively due to timing of his final collegiate season. On the day of presentation, the patient was given two options for bracing. One option was a custom molded clamshell orthosis, with convexities over the volar mid-portions of the proximal and middle phalanges to put pressure on the flexor tendon towards the phalanges. Tape straps were fashioned to make snug as possible. The second option was a thermoplastic splint molded in slight flexion with pressure points at the proximal and middle phalanx (Figure 2). Due to comfort both during and outside of football he chose the thermoplastic molded splint. The patient wore this full time for six weeks. He was instructed to only remove the splint to let the digit air out, but was instructed to maintain his finger in full extension during this time. During games and practice, this splint was over-wrapped with athletic tape to hold it to the hand in order to avoid inadvertent removal. He did undergo repeat MRI three weeks later with brace on (Figure 3A) and off (Figure 3B), with improvement of flexor tendon bowstringing and decreased edema noted. At six weeks, the patient was instructed to wear this splint only during practice, games, and sleep. During the daytime, the patient was instructed to wear pulley ring splint to allow active flexion and extension (Figure 4). At 12 weeks, the patient was instructed to continue wearing the pulley ring splint only while playing football. Patient was re-examined eight weeks after date of injury. The patient was
noted to have a 5-10° extensor lag at the left ring finger PIP joint. A new extension splint was made to ensure full PIP extension; again, focused molding over the volar mid-portions of the proximal and middle phalanges was performed to keep the tendon reduced against the phalanges. In addition, a narrower, more rigid pulley ring splint was fabricated to allow full flexion of the digit. At 12 weeks, the patient was noted to have a 5° extensor lag at the PIP joint, which was passively correctable. There was full flexion with no evidence of bowstringing and the patient had excellent grip strength. At this point, the patient had played in 11 football games with no issues noted. The patient was instructed to continue wearing the pulley ring splint while playing football and to follow up as needed.

**Discussion**

Flexor pulley ruptures in football players have not been reported previously. The classic presentation of flexor pulley ruptures has been described in rock climbers.5-7 Rock climbing has been described as a biomechanically unique activity that defies human anatomy, structured to support body weight through upper limbs rather than lower limbs; specifically, only the distal phalanges are responsible for supporting the majority of the weight at small ledges.12 The position of the digit that leads to pulley rupture has been described as a “crimp” position, where the PIP joints are flexed to 90-100° and the DIP joints are hyperextended.6

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**Figure 1.** Sagittal T2 weighted MR image with fat saturation of the ring finger shows bowstringing of the flexor tendon at the proximal phalanx (solid arrow) and middle phalanx (open arrow) with edema (asterisk) between the tendon and the bone consistent with rupture of the A2, A3, A4, C1, and C2 pulleys.

**Figure 2.** Thermoplastic splint molded in slight flexion with pressure points at the proximal and middle phalanx.

**Figure 3.** Sagittal T2 weighted MR images with fat saturation of the ring finger obtained three weeks later with the hand splint in extension (A) and flexion (B) shows decreased bowstringing of the flexor tendon at the proximal phalanx (solid arrow) and middle phalanx (open arrow) and decreased edema (asterisk) from the multiple pulley injuries.
In this position, bowstringing of the flexor tendons applies very high forces to the flexor tendon pulleys. In our case, the mechanism of injury was forced hyperextension of the digit. Although this may be considered a more sudden, traumatic mechanism, the flexor tendons still apply a high force to the pulleys, consistent with the “crimp” position described in rock climbers. A grading system of flexor pulley injuries has been described to help guide treatment and includes four grades. Grade I are strains, grade II are complete A4 rupture or partial A2 or A3 rupture, grade III are complete A2 or A3 rupture, and grade IV are multiple pulley ruptures or a single rupture of A2 or A3 with associated lumbrical muscle or collateral ligament injury. Treatment can often times be dictated by grade of injury and nonsurgical management is typically selected for grade I-III injuries. Based on this grading system, our case would be considered grade IV, which literature has suggested should be treated surgically.

The decision was made to treat the patient non-operatively for several reasons. As a senior, with aspirations of a National Football League (NFL) career, showcasing a Division 1 collegiate football player. A case report details a unique injury involving multiple flexor pulley ruptures in a Division 1 collegiate football player. A high index of clinical suspicion and understanding of this injury are paramount to its identification and ultimate treatment goals. We hope that our successful outcome with nonsurgical management through taping and taping techniques will enhance the existing literature and raise awareness of varying treatment options.

Conclusions

Our case report details a unique injury involving multiple flexor pulley ruptures in a Division 1 collegiate football player. A high index of clinical suspicion and understanding of this injury are paramount to its identification and ultimate treatment goals. We hope that our successful outcome with nonsurgical management through taping and taping techniques will enhance the existing literature and raise awareness of varying treatment options.

References


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