CASE REPORT

A Non-surgical Intervention for Triangular Fibrocartilage Complex Tears

Susan J. Barlow[1,2]*

[1]Department of Physical Therapy, The University of Tennessee at Chattanooga, Chattanooga, TN 37403, USA

[2]Siskin Hospital for Physical Rehabilitation, 1 Siskin Plaza, Chattanooga, TN 37403, USA

Abstract

Background and Purpose. The current literature contains no reports of treatment options other than surgery following failed conservative management of a triangular fibrocartilage complex (TFCC) tear. The purpose of this study is to describe the use of a novel brace as a non-surgical intervention for TFCC tears. **Methods.** This paper is a case study of a subject with a magnetic resonance imaging-confirmed TFCC tear. As an alternative to surgery, he consented to wear a novel brace for 12 weeks after conservative management of his injury had failed. His recovery from injury was monitored with a weight-bearing tolerance test and the disabilities of the arm, shoulder and hand (DASH) outcome measure. **Results.** An increase in weight-bearing tolerance and upper extremity use was evident immediately after donning the brace. After 12 weeks, the subject demonstrated a return to normal weight-bearing tolerance and normal DASH outcome measure scores. These improvements were still evident at a 1-year follow-up appointment. **Discussion.** Utilizing this novel brace resulted in functional status improvement in a subject with a TFCC tear as demonstrated by significant changes in his DASH outcome measure scores. This case study demonstrates the first non-surgical alternative treatment for a TFCC tear after conservative management has failed. Copyright © 2016 John Wiley & Sons, Ltd.

Received 11 May 2015; Revised 9 November 2015; Accepted 28 February 2016

Keywords

braces; musculoskeletal pain; physical therapy modalities; wrist injuries

***Correspondence**

Susan J. Barlow, 615 McCallie Ave., Department of Physical Therapy, #3253, University of Tennessee at Chattanooga, Chattanooga, TN 37403, USA.

E-mail: Susan-Barlow@utc.edu

Published online in Wiley Online Library (wileyonlinelibrary.com) DOI: 10.1002/pri.1672

Introduction

The function of the hand and wrist is dependent on the distal radioulnar joint (DRUJ) (Zimmerman and Jupiter, 2014). This joint permits the transfer of loads from the forearm to the hand and allows for wrist mobility. The DRUJ is stabilized by the triangular fibrocartilage complex (TFCC) that is composed of an articular disc and multiple ligaments that provide attachment to bone (Palmer and Werner, 1981; Ahn *et al.*, 2006). The TFCC is important for providing wrist stability, grip, weight bearing and rotational loading tasks. Injury to the TFCC results in ulnar-sided wrist pain that limits the ability of the subject to use the hand for functional tasks (Vezeridis *et al.*, 2010; Watanabe *et al.*, 2010).

Triangular fibrocartilage complex tears are classified as either type I (traumatic) or type II (degenerative) (Palmer, 1990). Type I tears are further classified depending on where the traumatic lesion is located in the TFCC, and type II tears are divided based on the severity of the tear. Diagnosis of a TFCC injury is made with a thorough history, examination of symptoms and the 'press test', which has 100% sensitivity for TFCC tears (Lester *et al.*, 1995). This preliminary diagnosis is then confirmed with the use of magnetic resonance (MR) imaging or MR arthrography (Smith *et al.*, 2012).

Treatment for a TFCC injury is initially conservative management. Typically, the subject's wrist is immobilized in a cast or splint for 4–6 weeks. This may be followed by cortisone injection into the wrist joint (Palmer, 1990; Henry, 2008; Park *et al.*, 2010). Lesions occurring in the peripheral 20% of the TFCC have a better chance for healing during conservative treatment because this area has an adequate blood supply (Jaffe *et al.*, 1996) (Lester *et al.*, 1995; Shih *et al.*, 2002; Park *et al.*, 2010).

If conservative treatment is not successful in alleviating the patient's pain, current literature indicates that surgery is the only treatment option available (Palmer, 1990; Ahn *et al.*, 2006; Henry, 2008). The type of surgery performed can be an open repair or more commonly an arthroscopic repair or debridement (Park *et al.*, 2010). Even with a minimally invasive arthroscopic repair, 6–12 weeks are required for a full recovery (McAdams *et al.*, 2009). Additionally, surgery does not always result in alleviation of pain in every subject with a TFCC injury (Estrella *et al.*, 2007).

The purpose of this study is to describe the use of the WristWidget brace in the non-surgical management of a TFCC tear (Figure 1) (WristWidget, 2007). To achieve this purpose, a case study that details the use of this brace by a subject who was diagnosed with an MR imaging confirmed TFCC tear is presented.

Figure 1. The WristWidget brace is made of flexible material and Velcro closures that mould to the wrist without compressing the ulnar head (WristWidget, 2007)

Methods

Design

Single-subject case report

This research study (project number 13-128) was approved by the Institutional Review Board of the University of Tennessee at Chattanooga (FWA00004149). The subject signed an informed consent form prior to the start of this study.

Subject

The subject is a 45-year-old man who is 5′7″ tall and right-hand dominant. He presented with ulnar-sided left-wrist pain following performance of a yoga hand-stand pose. MR imaging confirmed the presence of a partial type IB tear of the TFCC at the site of the ulna styloid attachment. Medical management of his injury included local injection with cortisone and a volar forearm (wrist cock-up) splint worn for 6 weeks (Boyd *et al.*, 2009). This conservative treatment failed to improve his wrist pain. He was recruited from the clinic where he was receiving treatment and agreed to participate in this study as an alternative to impending surgery.

Procedures

The WristWidget is a novel brace designed to support the wrist of a subject diagnosed with a TFCC tear. This brace is a minimalist design that is secured with a Velcro closure (Figure 1) (WristWidget, 2007). It holds the wrist securely in place while allowing full wrist motion and functional use of the hand.

Wrist weight-bearing tolerance was determined using a modified version of the 'press test' that allows quantitation of changes in weight-bearing tolerance during the healing process (Lester *et al.*, 1995; WristWidget, 2007). The subject was asked to press his unaffected palm onto a non-digital scale with the elbow extended and the wrist in a fully extended position. Visual inspection was employed to ensure that the subject was placing pressure through his entire palmer surface to ensure that he is not compensating with his radial side. The number of pounds of pressure he was able to place through his extended wrist was recorded to the nearest pound. This test was repeated, and an average of the two trials was recorded. The number of pounds of pressure recorded for the uninvolved extremity was used as the standard for full weight-bearing tolerance in this subject. This weight-bearing test was then repeated with the involved extremity. The subject was instructed to discontinue weight bearing at the first appearance of pain. Again, two trials were performed, and an average of the trials was recorded. Next, the WristWidget brace was donned on the involved wrist, and the aforementioned test was repeated. This weight-bearing test was repeated with the involved upper extremity every 14 days, while the subject was wearing the brace. On the 12th week, the weight-bearing test was performed first with the brace and then without. Finally, this test was repeated during a 1-year follow-up appointment without the subject wearing the brace.

Additionally, the subject was asked to complete the disabilities of the arm, shoulder and hand (DASH) questionnaire as a functional assessment tool (Hudak *et al.*, 1996). This 30-item self-report questionnaire allows the subject to rate their level of function with specific activities of daily living using a 5-point scale (1 = no difficulty and 5 = unable). This outcome measure has test–retest reliability of 0.96 and a high construct validity ($r > 0.69$) for measuring changes in individuals with upper extremity dysfunction (Beaton *et al.*, 2001). The outcome assessment did not include the optional work and sports modules. The subject completed all 30 items in this questionnaire during his initial examination. He later completed the DASH at the end of 12 weeks and 1 year after his initial examination. The formula used to score the DASH was $[(\text{sum of } n \text{ responses}/n) - 1] \times 25$.

The subject was instructed to wear the brace during both waking and sleeping hours, removing it only for bathing, until his weight-bearing tolerance reached 60 lb. After this weight-bearing tolerance was reached, he was instructed to remove the brace at night but continue full time use during the day (WristWidget, 2007). The subject wore the brace as indicated previously for a total of 12 weeks.

Results

One of the impairments resulting from a TFCC tear is ulnar-sided wrist pain with weight bearing (Lester *et al.*, 1995; Vezeridis *et al.*, 2010; Watanabe *et al.*, 2010). To allow quantitation of the decreased weight-bearing tolerance caused by the pain associated with a TFCC tear, a modified version of the ‘press test’ was utilized (Lester *et al.*, 1995; WristWidget, 2007). Briefly, the subject was asked to put as much pressure as he could through his hand with a fully extended elbow and wrist onto a non-digital scale. This test was performed in duplicate, and the average of the two values was recorded. The amount of pressure applied through the uninvolved upper extremity established a normative value for maximal weight-bearing tolerance (Vincent *et al.*, 2014). The subject was able to exert 80 lb of pressure through his uninvolved hand in this weight-bearing test. This pressure represents 100% of his full weight-bearing capacity. He was limited to 59% of his full weight-bearing capacity (47.5 ± 3.5 lb) in his involved hand secondary to ulnar-sided wrist pain from his TFCC tear. Interestingly, he demonstrated an increase to 84% (67.5 ± 3.5 lb) in this weight-bearing test with his involved hand immediately after donning the WristWidget brace for the first time. These results suggest that this subject who was experiencing ulnar-sided wrist pain with weight bearing due to a TFCC tear demonstrated an increase in weight-bearing capacity immediately after donning the WristWidget brace.

Because an immediate improvement in the weight-bearing capacity of the involved hand was observed, the effects of long-term use of this novel brace were investigated. The weight-bearing test was repeated with the WristWidget donned on the involved upper extremity every 2 weeks. The number of pounds of pressure that the subject could exert through the palm of his involved extremity while wearing the brace with the elbow extended and the wrist in a fully extended position was recorded to the nearest pound. This test was performed in duplicate, and the average of the values was recorded. This weight-bearing test was then repeated with the brace on the involved extremity at 2-week intervals. Average values for the amount of pressure able to be tolerated during the weight-bearing test were calculated and recorded. After 6 weeks of wearing time, the subject reached 76 lb of pressure in the weight-bearing tolerance test (Figure 2). He was

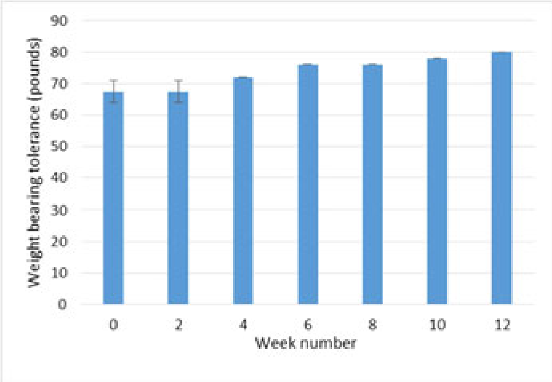

Figure 2. Time course of change in weight-bearing tolerance with use of the WristWidget. Error bars indicate the standard deviation for each time point

able to demonstrate an 80-lb weight-bearing capacity, equivalent to 100% of his weight-bearing capacity, in his involved upper extremity in this test after 12 weeks of time both with and without the brace (Figure 2 and data not shown). He continued to demonstrate 100% weight-bearing capacity in this test at his 1-year follow-up appointment without using the brace. These results suggest that consistent use of this brace over a period of 12 weeks resulted in full weight-bearing capacity in this subject's involved upper extremity as demonstrated by the weight-bearing tolerance test.

To objectively quantify his functional improvement, a DASH questionnaire was utilized (Hudak *et al.*, 1996). Research has confirmed the specificity and sensitivity of this outcome measure in subjects that have functional limitations secondary to upper extremity disorders (Beaton *et al.*, 2001). The available scores of this outcome measure range between 0 and 100 with the higher DASH score representing more dysfunction. During the initial examination, the subject scored 40 on the DASH before donning the brace. After 12 weeks of intervention, his DASH score improved to 0, which indicates no dysfunction. This 40-point difference on the DASH far exceeds the minimum clinically importance difference of >15 points (Beaton *et al.*, 2001). At this point, the subject discontinued the use of the brace. Additionally, even without the use of the WristWidget for 9 months, his DASH score remained at a value of 0 during his 1-year follow-up appointment. These data suggest that after 12 weeks of wearing the WristWidget brace, the subject demonstrated functional improvement as evidenced by the DASH outcome measure.

Discussion

According to the current literature, after conservative management has failed, the only option for regaining full functional use of the hand in subjects with an injury to the TFCC is surgery (Palmer, 1990; Ahn *et al.*, 2006; Henry, 2008). This case study, therefore, demonstrates the first described alternative to the non-surgical management of TFCC injuries after conservative treatment has failed. The subject of this study increased his weight-bearing tolerance immediately after donning the WristWidget for the first time. During the 12 weeks of this study, the subject had functional use of his hand. Examining the time course of intervention with the brace reveals a slow steady increase in weight-bearing tolerance (Figure 2). During this time, the subject continued with the recommended wearing schedule and did not use additional medication or therapy. After only 12 weeks of intervention with the brace, this subject's DASH outcome scores were consistent with a significant increase of function. After this time, he was able to return to all pre-morbid functional activities without the use of the brace and was completely asymptomatic.

Natural healing of TFCC tears has been shown to occur in approximately 40–50% of patients with ulnar-sided wrist pain during 4–6 weeks of conservative treatment following injury (Lester *et al.*, 1995; Park *et al.*, 2010). The healing during conservative treatment depends on the location of the tear because the innermost 80% of the TFCC has a poor blood supply (Jaffe *et al.*, 1996). The subject of this case study was diagnosed with a partial TFCC located in the peripheral region at the ulnar styloid attachment site. Even so, he remained symptomatic and limited in his function after 6 weeks of conservative treatment.

Standard conservative treatment can include either a short arm cast or either a volar forearm (wrist cock-up) or sugar-tong splint (Boyd *et al.*, 2009; Park *et al.*, 2010; O'Brien and Thurn, 2013). All of these options are effective in limiting wrist motion, and placing the injured tissue is a position to allow natural healing to occur. No difference was found in the rate of healing when casting versus splinting was utilized (Park *et al.*, 2010). Each of these options also limits upper extremity function. In comparison, the WristWidget is a minimally restrictive brace that was designed to allow compression of the radius and ulna thereby promoting closer approximation of the healing tissue

(WristWidget, 2007). The subject of this case study had a peripheral TFCC tear and therefore good blood supply to promote healing. The efficacy of the WristWidget on promoting healing of other types of TFCC tears remains to be determined.

If conservative treatment fails, then the patient is a candidate for surgery if they still have pain, weakness or loss of DRUJ stability resulting in decreased function (Kakar *et al.*, 2010). If the person refuses surgery, then few alternative options exist to help them to stabilize their DRUJ and regain pain-free use of their upper extremity. One of these alternatives is the simple-DRUJ orthosis (O'Brien and Thurn, 2013). This brace is designed to help control DRUJ instability while still allowing functional movement of both the wrist and forearm. The O'Brien study describes a case history that details the use of this brace by a patient with DRUJ instability. They report that the patient has experienced less pain after wearing the orthosis for a period of 2 years (O'Brien and Thurn, 2013). In comparison, the subject of this case study was able to perform all tasks requiring the use of his effected upper extremity after only 12 weeks of consistent WristWidget use as evidenced by the changes in his DASH outcome measure scores. Another literature report found that functional fracture braces are useful for stabilizing the DRUJ (Millard *et al.*, 2002). This study was performed on cadavers and therefore limited to examining the effect of the braces only on DRUJ stability and not upper extremity function.

There are many factors that may have contributed to the positive outcomes for the subject of this case study. The individual was young, had no significant past medical history, the injured wrist was on his non-dominant hand and the injury was traumatic in nature. In the future, a clinical trial will be performed to provide statistical evidence for the effectiveness of this brace in the management of TFCC tears in a broader population.

Implications for physiotherapy practice

Injury to the TFCC of the wrist results in decreased functional use of the hand. The current literature supports the use of conservative management as the initial treatment option followed by surgery if conservative management has failed to increase upper extremity function. The results of this case study suggest that the WristWidget brace may be an alternative to surgery when conservative treatment has failed.

Acknowledgements

I thank Wendy Medeiros, OTR, for identifying the subject of this case study and assistance with data collection and Autumn Gipson for critically reading the manuscript.

REFERENCES

Ahn AK, Chang D, Plate AM. Triangular fibrocartilage complex tears: a review. Bulletin of the NYU Hospital for Joint Diseases 2006; 64: 114–118.

Beaton DE, Katz JN, Fossel AH, Wright JG, Tarasuk V, Bombardier C. Measuring the whole or the parts? Validity, reliability, and responsiveness of the disabilities of the arm, shoulder and hand outcome measure in different regions of the upper extremity. Journal of Hand Therapy 2001; 14: 128–146.

Boyd AS, Benjamin HJ, Asplund C. Splints and casts: indications and methods. American Family Physician 2009; 80: 491–499.

Estrella EP, Hung LK, Ho PC, Tse WL. Arthroscopic repair of triangular fibrocartilage complex tears. Arthroscopy 2007; 23: 729–37 737 e1.

Henry MH. Management of acute triangular fibrocartilage complex injury of the wrist. Journal of the American Academy of Orthopaedic Surgeons 2008; 16: 320–329.

Hudak PL, Amadio PC, Bombardier C. Development of an upper extremity outcome measure: the DASH (disabilities of the arm, shoulder and hand) [corrected]. The Upper Extremity Collaborative Group (UECG). American Journal of Industrial Medicine 1996; 29: 602–608.

Jaffe R, Chidgey LK, Lastayo PC. The distal radioulnar joint: anatomy and management of disorders. Journal of Hand Therapy 1996; 9: 129–138.

Kakar S, Carlsen BT, Moran SL, Berger RA. The management of chronic distal radioulnar instability. Hand Clinics 2010; 26: 517–528.

Lester B, Halbrecht J, Levy IM, Gaudinez R. "Press test" for office diagnosis of triangular fibrocartilage complex tears of the wrist. Annals of Plastic Surgery 1995; 35: 5.

Mcadams TR, Swan J, Yao J. Arthroscopic treatment of triangular fibrocartilage wrist injuries in the athlete. American Journal of Sports Medicine 2009; 37: 291–297.

Millard GM, Budoff JE, Paravic V, Noble PC. Functional bracing for distal radioulnar joint instability. Journal of Hand Surgery. American Volume 2002; 27: 972–977.

O'brien VH, Thurn J. A simple distal radioulnar joint orthosis. Journal of Hand Therapy 2013; 26: 287–290.

Palmer AK. Triangular fibrocartilage disorders: injury patterns and treatment. Arthroscopy 1990; 6: 125–132.

Palmer AK, Werner FW. The triangular fibrocartilage complex of the wrist — anatomy and function. Journal of Hand Surgery. American Volume 1981; 6: 153–162.

Park MJ, Jagadish A, Yao J. The rate of triangular fibrocartilage injuries requiring surgical intervention. Orthopedics 2010; 33: 806.

Shih JT, Lee HM, Tan CM. Early isolated triangular fibrocartilage complex tears: management by arthroscopic repair. Journal of Trauma 2002; 53: 922–927.

Smith TO, Drew B, Toms AP, Jerosch-Herold C, Chojnowski AJ. Diagnostic accuracy of magnetic resonance imaging and magnetic resonance arthrography for triangular fibrocartilaginous complex injury: a systematic review and meta-analysis. Journal of Bone and Joint Surgery (American) 2012; 94: 824–832.

Vezeridis PS, Yoshioka H, Han R, Blazar P. Ulnar-sided wrist pain. Part I: anatomy and physical examination. Skeletal Radiology 2010; 39: 733–745.

Vincent JI, MacDermid JC, Michlovitz SL, Rafuse R, Wells-Rowsell C, Wong O, Bisbee L. The push-off test: development of a simple, reliable test of upper extremity weight-bearing capability. Journal of Hand Therapy 2014; 27: 185–191.

Watanabe A, Souza F, Vezeridis PS, Blazar P, Yoshioka H. Ulnar-sided wrist pain. II. Clinical imaging and treatment. Skeletal Radiology 2010; 39: 837–857.

Wristwidget. Wrist Widget TM, 2007 [Online]. Available: http://www.wristwidget.com [Accessed April 28, 2015 2015].

Zimmerman RM, Jupiter JB. Instability of the distal radioulnar joint. The Journal of Hand Surgery, European Volume 2014; 39: 727–738.