Graston Technique® Combined with Therapeutic Intervention as an Alternative Treatment for a Grade III UCL Thumb Sprain: A Disablement Model Case Study

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ABSTRACT

Nonoperative measures have been shown to have positive effects on thumb ulnar collateral ligament (UCL) sprains considered less than complete. This case presents evidence supporting Graston Technique® (GT) plus therapeutic exercise in order to decrease pain and stiffness in a collegiate football athlete who sustained a grade III UCL sprain. The results showed that there was a reduction in pain level above the minimal clinically importance difference, and ROM improved throughout the three-week intervention. The findings of this case study provide minimal support for an alternative treatment to reduce pain and stiffness in a grade III UCL sprain, with further research needed.

Key Phrases
College and university patient population, patient-reported outcomes, therapeutic exercise

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INTRODUCTION

The term Skier's Thumb refers to the acute mechanism of injury associated with the ulnar collateral ligament (UCL) of the first metacarpophalangeal (MCP) joint.[1,2] The term Gamekeeper's thumb, similar in nature, is characterized by chronic repetitive stresses placed on the same joint.[1,2] For this case study, Skier's thumb is a more accurate representation of the injury in question. Injury to the thumb MCP joint is considered common in athletics.[3] According to a study conducted by Werner et al, 63% of isolated UCL sprains examined on a single NFL team required surgical intervention.[3] Surgery is a common treatment method for grade III thumb UCL sprains while non-operative treatment is vastly accepted for grades I and II.[4] Yet, a systematic review indicated that there is no consensus regarding surgical indications for thumb UCL injuries.[5] A previous investigation of non-operative intervention for UCL injuries has shown favorable results, including patient satisfaction and grip strength.[6] Additionally, treatment of canine grade III ligamentous injury has suggested that conservative treatment with early mobilization has improved tensile strength compared to surgical treatment with immobilization.[7]

Non-surgical conservative treatment of a UCL injury includes a recommended early immobilization of the injured MCP joint followed by therapeutic intervention.[8] Early immobilization aims to protect the injured joint by restricting motion.[9] The duration of immobilization is a fine balance between too long, which may lead to joint stiffness, and too short, which may not allow sufficient healing time.[8] Although joint protection through immobilization is necessary, motion loss and/or muscle atrophy can occur at its expense.[9] Suggested immobilization time ranges from 3 to 12 weeks, but the outcomes associated with such extended immobilization are unknown.[8,10] The treatment principles which allow motion while concurrently avoiding additional injury are sought after because of its evidenced support in decreasing pain and inflammation throughout the healing process.[9]

Instrument assisted soft tissue mobilization (IASTM) has been found to cause physiological changes

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and acts as an enhancement to the healing process of ligaments via significant increase in proportion of blood vessels and fibroblastic activity.[11-13] It has also been shown to improve collagen formation in injured ligaments of rodent models.[13] The current case study specifically addresses the proliferative phase of healing, where collagen formation occurs. At approximately 3 days following an injury, injured soft tissue begins to repair and regenerate and continues over the next 3 to 6 weeks.[14] Over several weeks, angiogenesis, fibroplasia, generation of new epithelial tissue and wound contraction occur, as the damaged cells at the site of injury are replaced with scar tissue.[14] As the new collagen tissue matrix is forming, the new blood supply is supporting the tissue with nutrients, resulting in the formation of a vascularized bulk of immature connective tissue.[14] The developing tissue includes type I and type III collagen; type III being especially significant because of its power to form cross-links that provide stabilization to the healing tissue.[14] Instrument assisted soft tissue mobilization can be considered controlled local microtrauma, causing local inflammation in the tissue in an effort to support the healing process. Multiple treatments of IASTM have been shown to increase tissue perfusion when initiated one week following injury of a ligament.[12] Additionally, IASTM combined with rehabilitation exercises has been suggested as an alternative to surgical intervention.[12,13] The Graston Technique ® (GT) is a form of IASTM and is widely used across medical rehabilitation professions such as athletic training, physical therapy, and occupational therapy. The Graston Technique® uses stainless steel instruments specifically designed to apply controlled forces to muscles, tendons, and ligaments of the body.[12,13] The aim of completing GT and therapeutic exercise in the current case study was to improve the limitations reported in a grade III thumb UCL sprain.

PATIENT INFORMATION

The patient was an 18-year-old male NAIA collegiate football athlete who presented to the athletic training facility with pain and swelling in his right thumb. Mechanism of injury (MOI): the patient reached across his body to deflect an incoming pass, the football hit his open palm and hyper-abducted his first MCP joint of the right hand. Otherwise, the patient was considered healthy and free from injury. The uniqueness of this case has two parts. The first aspect of uniqueness is that the injury sustained was diagnosed as a grade III sprain, and surgery was not recommended by the referred hand specialist. Conservative rehabilitation for the injury immediately began and continued during the three weeks prior to seeing the hand specialist. Upon evaluation, the specialist recommended that all treatment be ceased, and the patient be placed in a thumb spica splint throughout the day and allowed to return to sport. A removable hard cast was provided for practice and game competition. The second portion of uniqueness concerns the treatment provided in this case study, as the use of GT combined conservative rehabilitation for treatment of a grade III thumb UCL sprain is the first report to our knowledge.

DIFFERENTIAL DIAGNOSIS AND EVALUATION

The patient was initially evaluated the same day of injury by the athletic training staff, which included the head athletic trainer and athletic training student. Upon inspection of the hand there was moderate swelling and mild bruising along the thenar eminence and point tenderness in the first MCP joint. There were no symptoms of numbness or tingling and no obvious deformities noted. The patient had no previous history of hand injuries. The patient reported that his thumb felt "stiff and as if it was throbbing." A decrease in flexion, extension, and abduction due to pain was

observed of the patient's active range of motion (AROM). The assessment of passive range of motion (PROM) showed a decrease in flexion and abduction. The strength deficits that were observed in grip, flexion, extension, abduction and adduction were observed and confirmed through subjective bilateral comparison. Manual muscle tests (MMTs) were attempted but unable to be completed due to pain. Joint laxity was discovered through a valgus stress test of the first metacarpophalangeal joint. Special tests exhibited negative results in tap/percussion test, tuning fork, and varus stress test. The patient was believed to have sustained a moderate to severe sprain of the UCL in the first MCP joint. The patient was placed in a wrist and thumb soft splint for immobilization for approximately 5 days until he was able to see the team physician. No rehabilitation took place during this time, other than the application of cold modalities via ice tub or ice bag. The recommendation to the patient was that the splint was only removed when necessary (i.e., showers and therapeutic treatment) but otherwise worn day and night. The patient was referred to the team physician who confirmed the findings of the athletic trainer and athletic training student. The team physician recommended that the patient continue with splinting and provided a referral to a hand specialist. The patient continued to wear the soft thumb splint until his appointment with the hand specialist. Sport participation had ceased since the time of initial evaluation by the athletic trainer. Non-steroidal anti-inflammatory drugs (ibuprofen) was suggested on an as-needed basis for pain. During this time, there were no restrictions noted by the team physician for controlled rehabilitation of the hand.

BODY STRUCTURE AND FUNCTION

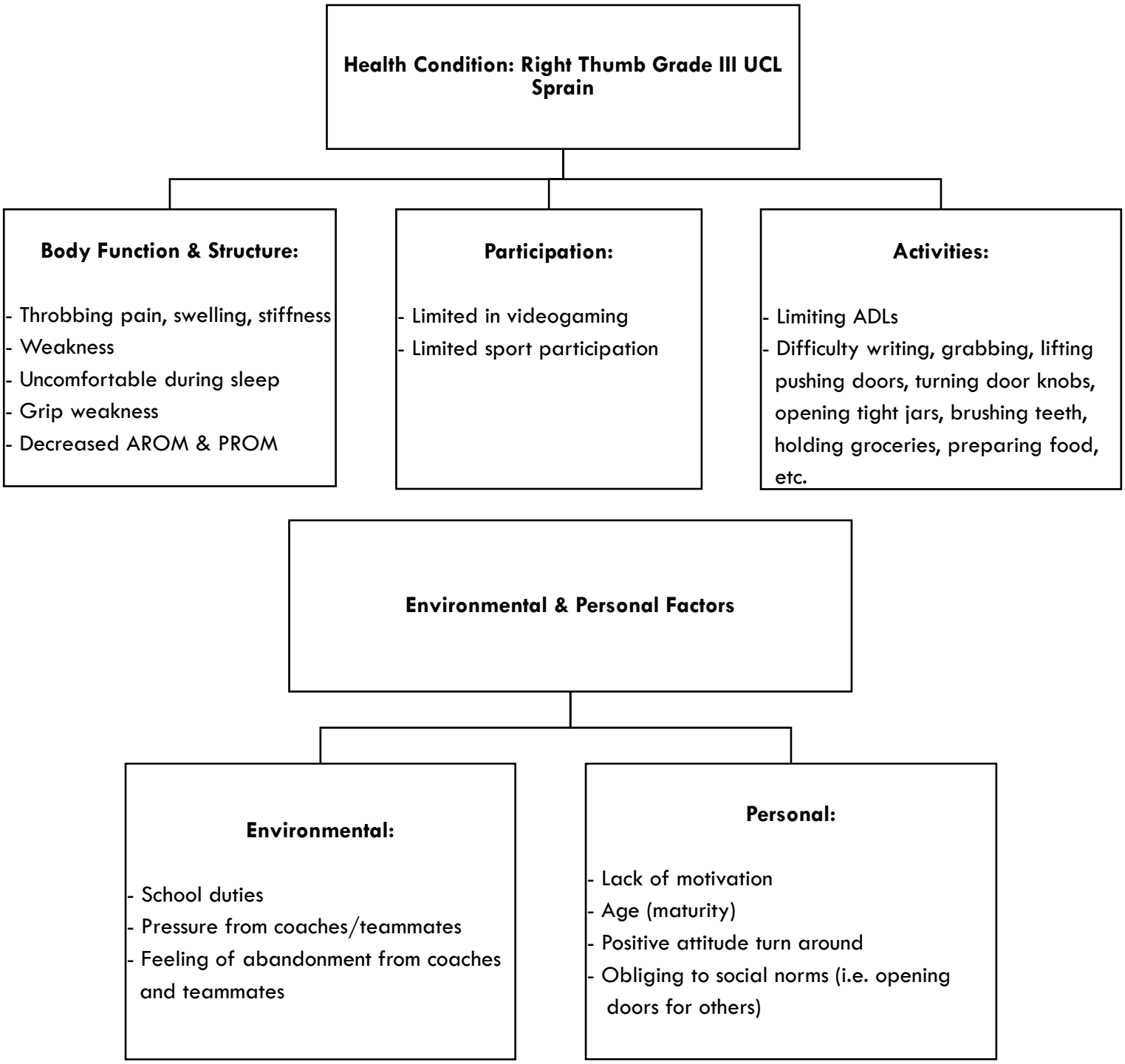
The patient identified as right hand dominant and reported limitation in activities of daily living (ADLs), social leisure, and sport participation. The patient reported severe difficulty turning doorknobs, opening jars, writing, gripping a toothbrush, lifting weights, gripping a video game controller, shaking someone's hand, and catching a football. The impact of the injury on the patient is illustrated using the International Classification of Functioning, Disability and Health (ICF) Disablement Model[15] in Figure 1.

ACTIVITY AND PARTICIPATION

The athletic training staff, team physician, and patient agreed that the patient would not engage in football practice until evaluated and cleared by the orthopedic hand specialist. Additionally, the patient was not participating in any other physical activity involving the use of his right hand. However, the patient was able to continue cardiovascular exercise in the athletic training facility and allowed to participate in conditioning with his team. At school, he reported and inability to write legibly and effectively type notes on his computer without restriction or pain. The patient explained on multiple occasions that he did not feel as if he could function properly in everyday life because anything involving his right hand was limited.

Socially, there were moments where the patient felt excluded from leisure activities because he could not participate with his friends. During rehabilitation, the athletic training staff would ask about the patient's life outside of football. He admitted there were moments he felt dispirited while hanging with friends because it often revolved around playing videogames. Given the injury to his thumb, holding a console controller was difficult. The athletic training staff saw the importance of treating the whole person and assisted the patient with psychosocial coping strategies of conversation and positive affirmation. The athletic training staff and patient began to use daily tasks/results as an opportunity to help discover and appreciate the small victories of rehabilitation (i.e., decrease in pain, stiffness).

Figure 1: Disablement model: Impact of Injury



ENVIRONMENTAL AND PERSONAL FACTORS

Regarding psychosocial considerations of the injury, the patient had reported that he felt indirect pressure and feelings of abandonment from his

coaches and teammates because he could no longer actively participate in practices or games. There was a lack of motivation because he felt his worth was dependent on football. Since the patient was without football and was limited in daily activities, he was hesitant to begin rehabilitation. After completing one full week of treatment, the patient's perceived pain improved. These results gave the patient hope, as he reported that he felt more motivated to continue the process and work hard in rehabilitation. This psychosocial finding was similar to a systematic review which noted that patient compliance may improve with decreased pain achieved through IASTM.[16] The patient began to slowly participate in everyday activities and noted feeling less extrinsic pressures.

INTERVENTION

The treatment for the first week included immobilization and cryotherapy to manage pain and swelling until he was seen by the team physician. Once evaluated by the team physician, the patient was allowed to begin conservative hand therapy until he was seen by the hand specialist, approximately three weeks later. Duri ng this time, the patient reported to the athletic training facility five days per week. The intervention included GT and therapeutic interventions to address ROM and strength deficits. The Graston Technique® was selected as an intervention based on previous work which demonstrated improved range of motion of the thumb after eight sessions of combined GT and active release therapy during immobilization.[17] In the current case, GT was administered by two providers certified in GT (head athletic trainer and athletic training student) two times per week with at least 48 hours in between application, and therapeutic exercise was performed at every appointment. This method of combining daily exercise with GT twice per week is consistent with a previous reported case of subacute lumbar injury.[18]

The Graston Technique® requires the treatment area be heated with either a modality or with a warm-up of the soft tissue before application of the technique, followed by treatment with therapeutic exercises after treatment.[19] For this treatment, the patient performed 10 minutes of heating (paraffin bath: in an extended position, his hand was dipped 7 times with a 3 second hold in wax before the next dip) prior to GT. The intervention was administered for 10 minutes, using the GT2 and GT6 instruments. The treatment time selected is consistent with previous work where GT was applied to an acute ankle injury for 10 minutes.[20] There are several strokes that require distinctive techniques; in the present case, brushing and scooping were the two strokes that were used. Brushing requires a brush stroke motion up and down, similar to the stroke of painting. Scooping requires a motion in a U-shaped pattern, similar to scooping ice cream. Following GT, therapeutic exercises were instructed and performed. The patient began with soft putty for 10 minutes (hand motions included pinching, squeezing, pulling, rolling, and smashing) in order to restore abductor pollicis longus, abductor pollicis brevis, and flexor pollicis brevis strength, followed by an additional 15 minutes of wrist and hand strengthening exercises (grip, finger flexion, finger extension, wrist flexion, wrist extension, ulnar deviation, and radial deviation). The same exercises were completed on days when GT was not performed in order to continue strengthening the wrist and hand.

Approximately three weeks after seeing the team physician and completing the intervention of GT and therapeutic exercise, the patient was evaluated by the hand specialist who determined that the soft thumb splint was not rigid enough for immobilization during ADL's. The recommended plan of care was that the patient continuously wears a rigid splint for immobilization and rehabilitation should cease. The specialist created a different rigid removable cast for football activities, and the patient was allowed to participate in football activities contingent upon wearing the removeable cast during practice and game competition.

OUTCOMES

Throughout the treatment process, the chief complaints were pain and stiffness of the right thumb. The patient's pain was monitored using the Numeric Pain Rating Scale (NPRS).[21,22] The tool has been found valid (r = 0.94, 95% CI = 0.93-0.95) in assessing acute pain.[23] The rating of stiffness, although subjective in nature, was attempted to be captured through ROM testing. Given the patient's concerns with his ability to function, the outcome measure of Quick Disabilities of Arm, Shoulder, and Hand (QuickDASH) was completed by the patient. The QuickDASH is an assessment tool used to measure functional ability and symptoms in individuals with any musculoskeletal disorder of the upper extremity.[24] No other patient-reported outcome measures were used by the athletic training staff.

NPRS: Pain was measured weekly using the NPRS. The patient was asked to rate his current, best, and worse state of pain within a 24-hour period on a scale from 0 (no pain) to 10 (worst pain imaginable). The three numbers were added together, and an average was calculated (sum of pain rating divided by number of ratings).[21,22] For example, in the initial evaluation the patient reported a current pain rating of 6, best pain rating of 0, and a worse pain rating of 8 within a 24-hour period; 6 + 0 + 8 divided by 3 = 4.67 average. The NPRS categorizes pain as either mild (score of 1-4), moderate (5-6), or severe (7-10).[25] Previous work has demonstrated that the minimal clinically importance difference (MCID) is a reduction of one point.[26] During the first week of intervention the patient's NPRS score was 4.67, and week two's average was 2.67. During the third week of the intervention the NPRS score was 1.33, which remained unchanged the following week when the therapeutic intervention was discontinued per the hand specialist's recommendation.

ROM: Range of motion measurements during the 3-week GT and therapeutic intervention period are displayed in **Table 1**. Flexion measurements were taken using three landmarks: distal arm was positioned dorsal midline of proximal phalanx, center point was positioned dorsal aspect of MCP, and proximal arm was positioned dorsal midline of metacarpal. Abduction measurements were taken using 3 landmarks: distal arm was positioned lateral midline of first metacarpal, center point was positioned lateral aspect of radial styloid, and proximal arm was positioned lateral midline of second metacarpal. Thumb opposition was assessed through visual observation by the athletic training staff. The tip of the thumb was observed attempting to touch the MCP joint on the palmar side of the involved hand. During the initial week of treatment, the patient was unable to complete thumb opposition to his 4th and 5th MCP joints. At

Table 1: Weekly ROM Measurements of Patient's Right Thumb

ROM	Week 1	Week 2	Week 3
Flexion	35°	40°	46°
Abduction	50°	55°	58°
*Opposition (visual)	Able 2-3	Able 2-4	Able 2-5

*Ability to successfully complete opposition to MCP joint of digits 2-5.

the conclusion of week three, the patient could successfully complete opposition by touching his thumb to MCP joint. Measurements were not completed following the cessation of GT and therapeutic exercise. Although, it is important to note that the patient reported an increase in stiffness within the weeks following cessation of therapeutic intervention.

Quick DASH: This assessment was used to assess the patient's ability to perform ADLs and sport specific activities. The QuickDASH consists of 11 items of ADL and 4 items in each of the optional work or sports/performing arts modules. Each item is rated on a scale from 1 (no difficulty) to 5 (unable), and the overall scoring ranges from 0 (no disability) to 100 (most severe disability).[24] The patient first completed the QuickDASH with sport module upon initial evaluation with the athletic training staff. The work module portion of the quick DASH was not included because the patient was not employed. The outcome measure was completed every 1 to 2 weeks. Prior to the intervention of GT and therapeutic exercise the patient scored 50/100 in ADLs and 75/100 in the sport module. Overall scores decreased throughout the intervention and continued to decrease after the intervention was halted. By the end of week 7, the patient scored 0/100 in both ADL and the sport module.

DISCUSSION

Medical providers share a desire to help improve the quality of life of individuals in need. The option of conservative intervention is increasing as patients consider the factors which play a role in deciding surgical versus non-surgical interventions. There are various reasons one might choose conservative treatment over surgery. These reasons include, but are not limited to, financial stability, health insurance coverage, mental fears/adaptations, physical risks, and loss of time of work/sport. Additionally, similar outcomes have been reported when examining conservative versus surgical treatment of both partial and full thickness ligamentous tears.[12] The current case study provides an example of a potential beneficial non-operative treatment option that warrants further exploration. Specifically, the results of the treatment option of GT combined with therapeutic exercise suggest an effectiveness in decreasing the patient's perceived pain and stiffness following a grade III thumb UCL sprain. Historically, chief complaints of a grade III thumb UCL sprain are pain, decreased ROM, and instability.[27] It should be noted that instability was not a symptom reported by the patient in the current case. The Graston Technique® combined with therapeutic exercise was chosen as the treatment of choice in this case study to address both pain and stiffness. The results of this case study suggest an improvement of two of the three common chief complaints, both pain and ROM. Our findings showed that there was a reduction in pain level each week above the minimal clinically importance difference. Additionally, ROM improved each week, and opposition was restored to normal after the three-week intervention. It should be noted that in addition to the GT and therapeutic exercise, the patient was instructed to wear a soft splint continuously, which may have been a factor in the outcomes. It is speculated splinting would decrease pain by protecting the joint from further disruption. Interestingly, the primary reason for immobilizing acute soft-tissue injuries was for pain relief, while loss of motion was cited as the main reason to not immobilize, according to more than two-thirds of physicians polled.[9] It is speculated that since GT and supervised therapeutic exercise was being completed once a day, ROM was able to be improved despite immobilization. Our findings are consistent with a previous literature review which reported that IASTM decreases pain as well as improves range of motion in acute injuries.[28] It is theorized that the ability of IASTM to assist in healing of ligamentous injury is

due to its effects on collagen, including maturation and remodeling, through localized blood flow.[12,13,29] Scar tissue is thought to impede mobility and therefore oxygen supply to the injured area.[28] Through the controlled repetitive microtrauma elicited by GT, a reinitiating of the inflammatory process may have led to enhanced tissue perfusion,[12] which in turn allowed for fibroblastic proliferation.[28] Tissue perfusion followed directly with therapeutic exercise may have played a role in the ability of the joint to reach improved ROM. This may be a reason why it is recommended that stretching and strengthening exercises are recommended to immediately follow the application of GT.[19]

The results established from the Quick-DASH presented noteworthy information. The patient reported an initial 50-75% disability to 0% in the ADL and sport module, respectively, over a period of six weeks. We suggest two main reasons why there was such a dramatic change in scores. One theory is that the treatment decreased pain, which allowed him to participate in more activities, aiding in an improved level of physical function. It was evident that pain was diminishing throughout the intervention; however, when treatment was terminated the level of disability continued to drop. It is possible that the patient felt less disabled due to the allowance of sport participation by the hand specialist, which would explain the continued improvement in scores after the intervention was terminated.

Although there were promising scores in disability index, ROM, and pain ratings in favor of GT and therapeutic exercise, there are limitations that need to be addressed. First, it would have been helpful to continue measuring ROM once the intervention ceased to determine if the initial improvements were temporary. The authors acknowledge that the termination of the intervention may have played a role in the overall healing process, and the hand specialist's judgement to cease treatment is unknown to have helped or hindered the outcome measures. The goniometric assessment could have also been measured by a second clinician to assist in accuracy – intra-rater reliability may have played a role in this case. Additionally, a second measurement tool besides ROM could have been used to assess the patient report of stiffness. Lastly, the addition of a psychosocial patient-rated outcome measure may have been helpful in indicating a reason for the decrease in disability score. It is believed that multiple extrinsic and intrinsic factors may have played a key role in the improvements seen, and future investigations should consider adding a psychosocial outcome measure when the QuickDASH is used.

CLINICAL BOTTOM LINE

The findings suggested in this case study demonstrate that GT combined with therapeutic exercise and soft splinting may be beneficial to patient-reported limitations of a grade III thumb UCL sprain. This case study found that there were improvements in pain and ROM of the affected joint during a three-week intervention. Future research should investigate the effectiveness of initiating GT and therapeutic exercise at various time points of immobilization of thumb UCL sprains.

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