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Short-Term Effect of Manual Therapy & Taping on Subacute Ankle Sprains with Potential Syndesmotic Sprain: A Case Series

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ABSTRACT

Study Design: Case Series

Background: Syndesmotic ankle sprains can occur in up to 17% of ankle trauma and can lead to long-term disability. This study describes the management of seven patients with subacute, high-grade ankle sprains with concerns of concurrent syndesmotic strain utilizing manual therapy and rigid sports taping.

Methods: Seven active duty military members with clinically diagnosed, high-grade ankle sprains and concern for syndesmotic sprain participated in this case series. All patients received multi-modal treatment consisting of manual therapy, rigid sports taping, progressive exercises, and proprioceptive training. Decrease in Numeric Pain Rating Scale (NPRS) following manual therapy and taping treatment, number of sessions before discharge, and the Global Rating of Change (GROC) at discharge were retrospectively reviewed.

Results: All patients demonstrated an immediate decrease in NPRS following treatment on average of 5 points (range, 3–8 points) with a functional asterisk sign. The improvement in pain and function was maintained until the next treatment session with a mean GROC score of +3. The mean time until recovery was 5.4 weeks (range, 1–8 weeks).

Discussion: A multimodal approach for patients diagnosed clinically with high-grade ankle sprains and concern for syndesmotic sprain was useful to immediately reduce pain and improve function, and improvements were maintained throughout the duration of care. This study is the first to assess a combination of manual therapy and rigid sports taping for the treatment of suspected syndesmotic ankle sprains, and more stringent research is needed to validate the findings.

Level of Evidence: Therapy, 4

KEYWORDS

Mobilization with movement; rigid sport taping; high ankle sprain

Background

Ankle sprains have been noted to be the most common foot and ankle injury, and the most common sports-related injury in those seeking medical care [1]. Syndesmotic ankle sprains have been shown to be a disabling lower extremity injury and a challenge for health-care professionals to treat[2]. The term syndesmotic ankle sprain has been used to refer to any injury involving the distal tibiofibular joint to include the interosseous membrane, posterior inferior tibiofibular ligament (PITFL) and anterior inferior tibiofibular ligament (AITFL), inferior transverse tibiofibular ligament, and the interosseous ligament[3]. While there is a general consensus in the grading of lateral ankle sprains of grade I–III using level of function, ligamentous laxity, hemorrhaging, point tenderness, swelling, and total ankle motion [4,5], there is a lack of consensus in diagnosing syndesmotic sprains. Current syndesmotic grading systems assess syndesmotic injury with clinical examination [3,6], stress radiography[7], and/or magnetic resonance imaging (MRI)[8], but are still debated in the literature.

Meanwhile, epidemiologic data show that lateral ankle sprains occur in 15–45% of all sports-related injuries[5], syndesmotic ankle sprains have been shown to occur in 11–17% of the athletic population [3], up to 74% of all ankle injuries in ice hockey[9], and can be disabling to a patient for up to, and greater than six months[7]. Prospective studies in military populations show an incidence of syndesmotic sprains at 17% of all ankle sprains[7]. The data vary greatly with comorbidities based on different athletic populations. Brown et al. showed syndesmotic sprains to be highly associated with anterior talofibular ligament (ATFL) sprains (74%), bone marrow contusions (78%), as well as osteochondral defect (OCD) lesions (48%) in non-athletic populations[10]. However, other studies show little to no damage to the ATFL in Olympic athletes[11], as well as only a 6% correlation with marrow contusions[7]. Finally, it has been noted that while

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Table 1. Patient demographics, mechanism of injury, acuity and functional impairment.

	Age	Sex	Mechanism of Injury	Time Until 1st Treatment (Days)	Asterisk Sign
Patient 1	22	Male	Motorcycle MVA	28	Single Leg Hop
Patient 2	24	Male	Soccer	29	Ambulation
Patient 3	33	Male	Stepped off curb	9	Weight Bearing
Patient 4	31	Male	Stepped off curb	74	Ambulation
Patient 5	39	Male	Soccer	18	Toe Walking
Patient 6	28	Male	Basketball	14	Ambulation
Patient 7	28	Female	Basketball	26	Squatting

a relatively common comorbidity of lateral ankle sprains, syndesmotic injuries are often under-evaluated[12].

Grading of lateral ankle sprains have been previously defined as grade I–III in relation to loss of function, ligamentous laxity with anterior drawer or talar tilt tests, hemorrhaging, point tenderness, total ankle motion loss, and edema measured by figure-of-eight measurement [4,5]. However, the grading and diagnosis of syndesmotic ankle sprains continues to prove challenging. While there have been many tests described to assess the distal syndesmotic joint, the squeeze test[13], the external rotation stress test[14], a dorsiflexion maneuver[15], and syndesmotic tenderness [8] have been published extensively throughout the literature. A recent systematic review with meta-analysis revealed pooled sensitivity (Sn) of syndesmotic tenderness as .92 (95% CI: .79-.98) and dorsiflexion lunge as .75 [95% CI .64-.84][15]. Pooled specificity (Sp) was also highest for the squeeze test at .85 (95% CI .81-.89), and the external rotation stress test at .78 (95% CI .73-.82)[15].

In the last 10 years, a great deal of evidence has emerged regarding the treatment of acute, lateral ankle sprains. The most recent clinical practice guidelines note that there is 'Grade A' evidence to support the use of manual therapy techniques including lymphatic drainage, anterior-to-posterior joint mobilizations, as even manipulations in combination with therapeutic exercise to reduce edema, improve foot mobility, and normalize gait parameters[1]. Taping or using an ankle brace for protection is also supported with the same 'Grade A' evidence to improve time and rates of both return to sport and return to work as well as patient satisfaction with treatment[1]. Despite this growth of evidence in treating lateral ankle sprains, little has surfaced in regard to conservative treatment of syndesmotic injuries. Therefore, the primary goal of this case series is to report manual therapy and rigid sport taping treatments, which were effective in immediately reducing pain and increasing function in patients with high-grade ankle sprains with concern for concurrent syndesmotic injury.

Methods

Participants

Seven, consecutive, active duty military patients (six males, one female) with an average age 29 years (mean = 29.3, median = 28.0, range 22–39) and history of a lateral ankle sprain with large functional limitations were retrospectively reviewed for this study. All patients were referred by their primary care provider or emergency room physician to physical therapy at David Grant Medical Center, California, and all had mechanisms for inversion of ankle sprains, which occurred during a range of activities (Table 1). At the time of presentation to physical therapy, patients ranged 9–74 days from the time of their injury (mean = 28.3 days, median = 26.0 days). All patients had greater than 4/10 pain on a Numeric Pain Rating Scale (NPRS) with some aspect of weight-bearing (ambulation, hopping, or running). Due to continued symptoms and weeks having passed since the initial injury, the researchers classified each participant as subacute, which falls in line with previous definitions of subacute ankle sprains of injuries, which are still undergoing maturation[4], average of 40 days since injury[16], or between 2 and 10 weeks since injury[17]. One of the subjects exceeded this timeframe at 10.5 weeks after injury, but was evaluated and treated similarly to the other subjects. Prior to beginning physical therapy, four of the seven patients received standard radiographs of Anterior to Posterior (AP), lateral, and mortise views, and all were negative for syndesmotic sprain. No stress radiographs were ordered, but MRI was ordered in one patient which confirmed a 'grade 1–2 tibiofibular sprain' in Patient 1. Upon presentation to physical therapy, none of the patients were participating in unit fitness training, and three of the seven were issued ankle braces – either lace-up or air-cast. All patients signed written consent for examination and treatment, and each gave consent to have their data reviewed for the purpose of retrospective review. Finally, this retrospective review and results were approved for release by the Special Warfare Training Wing Public Affairs office.

Table 2. Special test results at initial evaluation.

	Heel-Thump	Dorsiflexion Test	Syndesmotic Tenderness	Syndesmotic Squeeze	External Rotation Stress Test	Total
Patient 1	+			+	+	3
Patient 2	+	+	+	+		4
Patient 3	-	+		+	+	3
Patient 4		+	+	-	+	3
Patient 5	+	-	+	-		2
Patient 6		+		+	+	3
Patient 7		-	+	+	+	3

Tests that were positive are indicated with a (+), negative tests are indicated with a (-), while tests which were not performed are left blank.

At the time of the initial physical therapy evaluation, the subjects completed standard medical intake forms, and underwent a routine history and physical examination. History included the patient's severity, progress, and current asterisk sign (Table 1).

One of three physical therapists conducted a physical examination, which included ruling out fracture with Ottawa Ankle Rules and/or assessment of radiographs, and ruling out neurological impairment with myotome and sensation assessment. The examination then proceeded to gait assessment, edema assessment, range of motion, manual muscle testing, and functional examination to include squat, heel and toe walking, and if possible, double and single leg hopping. Location of pain and a qualitative assessment of each functional examination were recorded. Special tests were also used to further diagnose syndesmotic injury, including anterior drawer and talar tilt [1,4,5], heel-thump [18,19], dorsiflexion test [7,19], squeeze test [14,20,21], external rotation stress test [14,21], and syndesmotic tenderness[8]. These tests were used at the treating physical therapists' discretion. Immediate changes in verbal NPRS at rest and with the most painful activity were assessed immediately following interventions at each encounter. Also, the 15-point Global Rating of Change (GROC) scores were assessed via intake at each follow-up encounter. Finally, the number of physical therapy sessions prior to discharge was also assessed.

While all patients also presented with grade II–III lateral ankle sprains as defined by Malliaropoulos [4,5], there was a clinical suspicion for a concurrent syndesmotic injury due to the presence of two or more special tests listed in Table 2. The heel-thump test has been described in the literature; however, reliability and validity data are not yet available [18,19]. The dorsiflexion maneuver has also been described as excessive passive dorsiflexion in an attempt to place maximum stress on the AITFL. As the intermalleolar distance increases by 1 mm in full dorsiflexion, the AITFL reaches maximum tension and could be painful with this maneuver if injured [18,22]. Finally, syndesmotic tenderness has also been used to determine prognosis of syndesmotic ankle sprains in National Football League athletes with longer lengths of tenderness proximal to the AITFL correlated to increase in prolonged disability[8]. However, all tests in this paragraph lack studies establishing validity and reliability.

The syndesmotic squeeze test has evidence on reliability (Kappa = .50) [20] and also has been shown to have favorable diagnostic capability (Sn .30, Sp .94; Positive likelihood ratio [+LR] 5.0, Negative likelihood ration [-LR] .73) using MRI as a reference [14,23]. Finally, the external rotation stress test has the best reliability of all of the tests (k = .75) [20] but its diagnostic capability is also less than ideal (Sn .20, Sp .85; +LR 1.3, -LR .94) [14,23].

Intervention

Following evaluation, all patients received multimodal treatment consisting of manual therapy and rigid sports taping at the first encounter before beginning a progressive therapeutic exercise program consisting of pain-free, in-clinic, and home-based range-of-motion (ROM), strengthening, and proprioception



Figure 1. Graded anterior to posterior mobilizations.



Figure 2. Mobilization with movement. distraction force is applied by provider and patient moves through pain-free active range of motion of ankle dorsiflexion & plantarflexion.

exercises. Therapeutic exercise was prescribed at the physical therapist's discretion and progressed as tolerated by the patient. In addition to therapeutic exercises, manual therapy was performed to address ROM impairments. Manual therapy consisted of graded Anterior to Posterior (AP) mobilizations of the talocrural joint in an open-packed position with patient tolerance progressing as able to a grade IV+ AP mobilization (Figure 1). Patients then underwent mobilization with movement where the provider would provide a long-axis distraction to the talocrural joint, and the patient would move the ankle through a pain-free range of motion of ankle dorsiflexion and plantarflexion (Figure 2), and then ankle inversion and eversion (Figure 3).

In an effort to provide stability and protection for the distal tibiofibular joints, rigid sports tape (Leukotape P, BSN medical) was used to approximate the fibula to the tibia (Figure 4). In this novel technique, the bottom edge of the tape was placed over the most distal end of the tibial shaft at the flare of the malleolus. The tape was placed at approximately a 45-degree angle and laid on the skin proximally. The tape was pulled with



Figure 3. Mobilization with movement. distraction force is applied by provider and patient moves through pain-free active range of motion of ankle inversion and eversion while in ~20 deg of plantarflexion.



Figure 4. Candy-stripe taping: in effort to approximate the fibula to the tibia, rigid sports tape was applied in nearly circumferential pattern anchoring from the medial malleolus and attempting to approximate the fibula to the tibia. note, foot is usually supported during duration of taping.

Table 3. NPRS & GROC results, time until discharge & GROC upon discharge.

	Initial Visit NPRS w/ Asterisk Sign	Initial Visit NPRS w/ Asterisk Sign Post-Intervention	1st Follow-Up GROC w/ Asterisk sign	1st Follow-Up NPRS w/ Asterisk Sign	Time Until Discharge (# of Visits)	GROC Upon Discharge
Patient 1	3/10	0/10	5	0/10	3 weeks (7 visits)	7
Patient 2	7/10	0/10	6	3/10	4 weeks (5 visits)	7
Patient 3	7/10	0/10	3	3/10	8 weeks (6 visits)	7
Patient 4	6/10	0/10	1	3/10	8 weeks (7 visits)	7
Patient 5	8/10	2/10	4	3/10	4 weeks (6 visits)	7
Patient 6	4/10	1/10	NT*	2/10	5 weeks (7 visits)	7
Patient 7	7/10	2/10	NT*	2/10	4 weeks (3 visits)	6

* Not Tested

a moderate amount of effort in an attempt to stabilize the distal syndesmotic joint. In order to avoid neurovascular compromise, care was taken to ensure the tape was not circumferential. All patients were instructed to remove the tape after 4 days and to take the tape off in water to decrease chances of dermal irritation. Other than the first patient who experienced no pain after the first treatment was performed, all patients were taped more than once. No skin preparation was performed, and none of the patients experienced any adverse reaction to the tape applied directly to the skin. Others have described a technique similar to this in an effort to translate the fibula[24], to the author's knowledge, this is the first known attempt to stabilize the distal syndesmotic joint.

Results

Five of the seven patients presented with grade II lateral ankle sprains as previously defined with either 'loss of some function,' positive anterior drawer test, negative talar tilt test, range of motion limitations between 5 and 10 degrees, and/or edema 0.5 cm to 2.0 cm. [4,5] Two more patients (Patients 5 & 6) presented with grade III lateral ankle sprains with positive talar tilt tests, total ankle ROM motion limitations >10 degrees or edema >2.0 cm.[4][5],

In our small sample size, all but one patient had three or more positive special tests for syndesmotic injury as well. Most notably, the external rotation stress test and syndesmotic squeeze tests had the highest frequency of positivity (5 of 7 patients),

followed by the dorsiflexion maneuver and the syndesmotic squeeze (4 of 7 patients), and finally the heel-thump (3 of 7).

All patients demonstrated immediate clinically significant decreases in NPRS following manual therapy and rigid-sport taping of an average of 4.9 points (mean = 4.9, median = 6, range, 3–8 points) during their functional asterisk sign (Table 3), and these improvements were maintained throughout the duration of care. Further analysis shows that the pain and functional improvement were maintained until the next treatment session with an average GROC of +3 (Table 3). The average time until recovery was 5.4 weeks (mean = 5.4, median = 4, range 1–8). Due to the operations tempo of the military units, these sessions were spread throughout one to two months and were not standardized.

In all patients, this combined manual therapy and taping treatment were able to immediately reduce pain with asterisk sign to 2/10 or less. Combined with a graded ROM, strengthening, and proprioceptive training, these results were maintained until the next follow-up. Due to the nature of the study, the low sample size, and the fact that not all tests were performed on all patients, any post-hoc analysis was not attempted.

Discussion

The goal of this case series was to overview a novel treatment for high-grade ankle sprains with concern for concurrent syndesmotic ankle sprains. Our outcomes demonstrate that the combination of manual therapy and rigid sport taping can be effective in the treatment of those who present with grade II–III lateral ankle sprains with objective findings of concurrent syndesmotic ankle sprains. To the author's knowledge, this is the first study to assess the combined effect of manual therapy and taping in those with clinical findings of syndesmotic ankle sprains. The results demonstrated immediate improvement of a functional asterisk sign utilizing manual therapy and taping. These improvements exceed the minimally clinically important differences of ≥2 points for the NPRS [25] and, once discharged, ≥+3 on the GROC [25,26]. These improvements were sustained until the next visit.

While previous research has focused on the treatment of ankle sprains of the ATFL or calcaneofibular ligament (CFL), to the authors' knowledge, there has been no research on the conservative treatment of syndesmotic ankle sprains using manual therapy or taping. The above results are in-line with recent research and clinical practice guidelines [1,4] outlining that manual therapy [27,28] or taping [29] can be successful for lateral ankle sprains. While this study aligns with previous research in treating lateral ankle sprains, it also shows effectiveness in using both treatments simultaneously.

There were many limitations of this study, the first of which is the utilization of a clinical examination to assess injury to the syndesmosis. Standard radiographs were obtained in four individuals, and all were negative, which correlates with the low reported sensitivity in de César et al.'s work of all 56 radiographic studies being negative despite MRI evidence of AITFL injury [14]. MRI remains the gold standard for diagnosis, and only one patient had MRI imaging available, which was positive[8]. While radiographs, MRI, and even ultrasound are becoming more readily available, the majority of clinicians remain reliant upon clinical examination only to assess the integrity of the syndesmosis. Of the five tests performed, the syndesmotic squeeze and the external rotation stress test are the only two that have had diagnostic properties correlated with MRI, and these tests were positive in a majority (five) of the patients.

Another major limitation is the discrepancies in the evaluation of these individuals. While they all met clinical criteria for grade II–III ankle sprains, the evaluation of syndesmotic injury was less than ideal. Other limitations of the current study include delays in presenting to physical therapy, and a large time between follow-up visits. However, in the patients treated in this study, the average time to return to training is only one to two weeks longer than professional American football players [30,31] and is similar to return times for professional hockey [9] and cadets at West Point Military Academy despite these populations' daily access to care[7].

Lastly, it is important to note that clinical assessment of syndesmotic ankle sprains remains limited. Future studies should assess the correlation between the clinical examinations and imaging.

Conclusion

This case series demonstrates that in seven patients who presented with high-grade lateral ankle sprains with concern for associated syndesmotic ankle sprain, all showed immediate improvement with a combined treatment of manual therapy and rigid sports taping. With the addition of therapeutic exercise, improvements were sustained until the next visit. While more research is warranted, in this population, manual therapy and rigid sports taping appear to be clinically effective.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Notes on contributors

Major Shumway currently serves as the Flight Commander for Physical Therapy and Chiropractic Clinics at Langley Air Force Base, VA. After graduating University of Wyoming's ROTC program in 2009, he attended the Army Baylor DPT Program and has served in the Air Force for 12 years. In 2015, Josh deployed to Al Dhafra Air Base, UAE where he served as Officer in Charge of Physical Therapy. The next year, he was one of the first to attend the new Tactical Sports and Orthopedic Manual Physical Therapy Fellowship. He is dual board certified in Orthopedic and Sports Physical Therapy, is an item writer for the Orthopedic Board exam, and is currently completing his Doctor of Science studies through Bellin College. His lanes of research include outcome measure correlation & predictability, manual therapy, syndesmotic ankle sprains, rhabdomyolysis, bone stress injuries, and injury prevention – the last of which he has presented on twice at the national level. Prior to his time at Langley AFB, Major Shumway was the Chief of Human Performance for the Special Warfare Training Wing.

Dr. Vraa is a co-founder of the USAF Tactical Sports and Orthopaedic Manual Physical Therapy Fellowship Program where he serves as Senior Faculty, mentoring fellows and teaching didactic coursework. Prior to moving to Colorado, he spent over a decade treating complex pain patients in private practice. He has lectured and taught at a number of physical therapy schools in the upper Midwest including creating the orthopedic content for a candidacy DPT program. Derek is a board certified orthopedic clinical specialist, a certified strength and conditioning specialist, certified in dry-needling and completed his Fellowship training in Orthopaedic Manual Physical Therapy through Regis University in Denver, CO. He has spoken at CSM, AAOMT, the United States Air Force Advanced Training Course, the United States Air Force's Embedded PT Symposium, has 6 published abstracts, and authored a chapter in the Travell, Simons & Simons Myofascial Pain and Dysfunction 3rd edition textbook. Additionally, Derek serves as the AAOMPT Academic and Clinical Faculty Special Interest Group Vice-President and as an IFOMPT External Auditor for AAOMPT/ACOMPTE.

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