Successful treatment of a guitarist with a finger joint injury using instrument-assisted soft tissue mobilization: a case report

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Finger injuries are common and can greatly affect a musician's quality of life. A 55-year-old man, who had injured the proximal interphalangeal joint of the left index finger 6 months prior to any intervention, was treated with a manual therapy approach incorporating instrument-assisted soft tissue mobilization (IASTM). Initial examination findings included self-reported pain and functional limitations and physical impairments that significantly impeded his ability to play the acoustic guitar. He was treated once a week for 6 weeks with IASTM, joint mobilization, therapeutic exercise, and ice massage. Additionally, a home exercise program and self-care instructions were provided. The patient gained positive outcomes with improvements in pain (Numerical Pain Rating Scale while playing the guitar: initial 5/10, discharge 1/10) and function (Disability Arm Shoulder Hand Sports-Performing Arts Optional Module: initial 75; discharge 6.25), each reaching a minimum clinically important difference. Importantly, he was able to play the guitar with minimal to no pain as desired. Physical measures also improved, including an immediate gain in finger range of motion with IASTM alone. Manual therapy approaches integrating IASTM may provide an effective conservative treatment strategy for patients with finger/hand conditions in the performing arts and other patient populations.

Keywords: Finger/hand, Physical therapy, Instrument-assisted soft tissue mobilization, Massage, Manual therapy

Conflict of Interest Statement

None of the authors have any conflict of interest related to this project. Additionally, none of the authorship team is being paid or will receive a financial incentive if they get a manuscript on instrument-assisted soft tissue mobilization (IASTM) published.

Background

Hand and finger injuries are frequently treated by clinicians and may have particularly dire effects on a musician's functional performance and quality of life. In a study on the incidence of upper extremity (UE) injuries, the finger (38.4%) was the most commonly injured body region requiring a visit to the emergency department. A fall or blow (32.6%) is the most common cause of hand trauma in musicians. Sprains/strains account for 24.4% of these injuries in the general population, with fractures being the most frequent.[1] Injuries of the hand/finger can be devastating to the career and avocation of performing artists such as musicians.[2] Treatment approaches that are efficient and effective are needed in order to address musculoskeletal dysfunctions of the finger/hand in the instrumentalist population.

Musculoskeletal conditions of the finger typically respond to conservative management, such as serial casting to regain motion, splinting to protect or mobilize, therapeutic exercise, or manual therapy.[3–5] Finger injuries do not usually require surgery except in some cases of severe flexion contracture, complete collateral ligament, or tendon laceration/ruptures.[4,5] It is unclear in the literature whether one approach is superior to the other in managing conditions affecting the finger region.

Conservative interventions, such as manual therapies, are used in a variety of musculoskeletal conditions.[6] Soft tissue mobilization (STM) is a form of manual therapy used to manipulate the soft tissue in order to mobilize restrictions and promote tissue healing and repair. There is evidence suggesting that STM is therapeutically beneficial, although the research remains limited both in quantity and quality.[7] Cross-fiber massage (CFM) is a type of

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massage in which mobilizing forces are applied through the skin typically in a transverse direction to underlying collagen fiber alignment.[8,9] Instrument-assisted STM (IASTM) is a type of STM that utilizes rigid devices to augment soft tissue examination and treatment. IASTM has been proposed to provide CFM in a more precise manner than by hand alone.[10] Preliminary animal model studies comparing the effects of IASTM-treated, with contralateral untreated injured, soft tissue structures have shown increased fibroblast recruitment and activation in injured tendon[11,12] and improved biomechanical, histological, and vascular properties in the healing ligament.[13,14] Case reports and pilot studies using IASTM have also demonstrated promising outcomes for diagnoses such as patellar tendinopathy,[15] chronic ankle pain,[16] plantar fasciitis,[17] post-natal calf pain,[18] knee pain,[19] carpal tunnel syndrome,[20] cumulative trauma disorders,[21] and lateral epicondylitis/epicondylosis.[22–24]

Currently, there are no known clinical studies on the use of IASTM for any conditions affecting the finger in an instrumentalist. The purpose of this case report is to report the therapeutic outcomes of a patient with an injured proximal interphalangeal (PIP) joint of the left second (index) finger that was treated with a manual therapy approach including IASTM.

Patient Characteristics

A 55-year-old man with the medical diagnosis of chronic left second finger PIP joint pain was referred by a physician to physical therapy (PT) for examination and treatment. The patient was a book editor with an avocation of playing the acoustic guitar. He had no known co-morbidities, nor was he taking any medications. He had not received any prior treatment related to this injury. Radiographs were normal. He was right-hand dominant. Prior to examination, the patient signed an informed consent approved by the Indiana University Institutional Review Board.

Examination

The patient had injured his left second PIP joint when he caught his finger in an 'awkward position', pulling it into a combined motion of extreme adduction and extension, due to a fall on ice 6 months prior to his initial PT visit. His primary complaint was of pain persisting along the lateral (radial) aspect of the second PIP joint, which interfered with his ability to play the acoustic guitar on a daily basis. The patient's goals were to restore full-functional index finger motion and return to playing his guitar without pain.

He reported a pain level per the numeric pain rating scale (NPRS, 0–10) of 4/10 at the time of examination, 3/10 on average, 5/10 at worst (when playing the guitar or with a direct and abrupt stress to the PIP joint lateral collateral ligament), and a 0/10 at best (at rest). He reported being 'unable to play the guitar unless enduring significant pain'. The NPRS has been shown to be valid, reliable (test–retest reliability ICC=0.74), and responsive to change.[25,26] Pain-relieving measures included occasional compression wrapping of the joint and running his finger under warm water to 'get it moving'. Exacerbating factors were chording on the guitar and any activity that stressed the radial aspect of the joint, such as pushing open a door or opening a jar lid. The Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire was used as a self-reported outcome measure for function. Other self-administered disability questionnaires are available; however, a systematic review has shown the DASH to have the best clinimetric properties overall. It can detect large and small differences over time and is applicable to all UE joints.[27–29] His overall disability/symptom score on the DASH was 40 points (i.e., 40% disability). His score on the DASH Work Module (optional) was zero (0) indicating that he had no difficulty (0% disability) with his job as an editor. However, importantly, his score on the DASH Sports/Performing Arts Module (optional) was 75 (75% disability) indicating severe difficulty in playing the guitar (the musical instrument most important to him), including difficulty with his usual technique, pain, quality of performance, and amount of time spent playing. Specifically, he experienced his worst pain while abducting his fingers and adding downward pressure on the strings when chording. He stated that his pain was worse when beginning chording but that it would diminish somewhat after warming up. His playing time was limited to a maximum of 15 minutes, compared to 'more than an hour' prior to injury. No numbness or sleep disturbance was reported. He denied any hand or finger pain or any functional difficulty prior to this incident.

Systems review of the patient's physiological and anatomical status was unremarkable except for the site of injury. The neuromuscular system was screened, and it was determined that gait, functional mobility, balance, and motor function were unimpaired. Vital signs were not measured since no risk factors for cardiovascular or pulmonary disease were identified on screening and no signs of cardiopulmonary distress were observed. The UE integumentary system was intact with no visible scars, normal color and temperature; although chronic swelling around the involved joint was noted. The patient's posture, gross strength and range of motion (ROM) of the cervical region and upper extremities were unimpaired except for the injured finger. Height and weight measures were not obtained. His

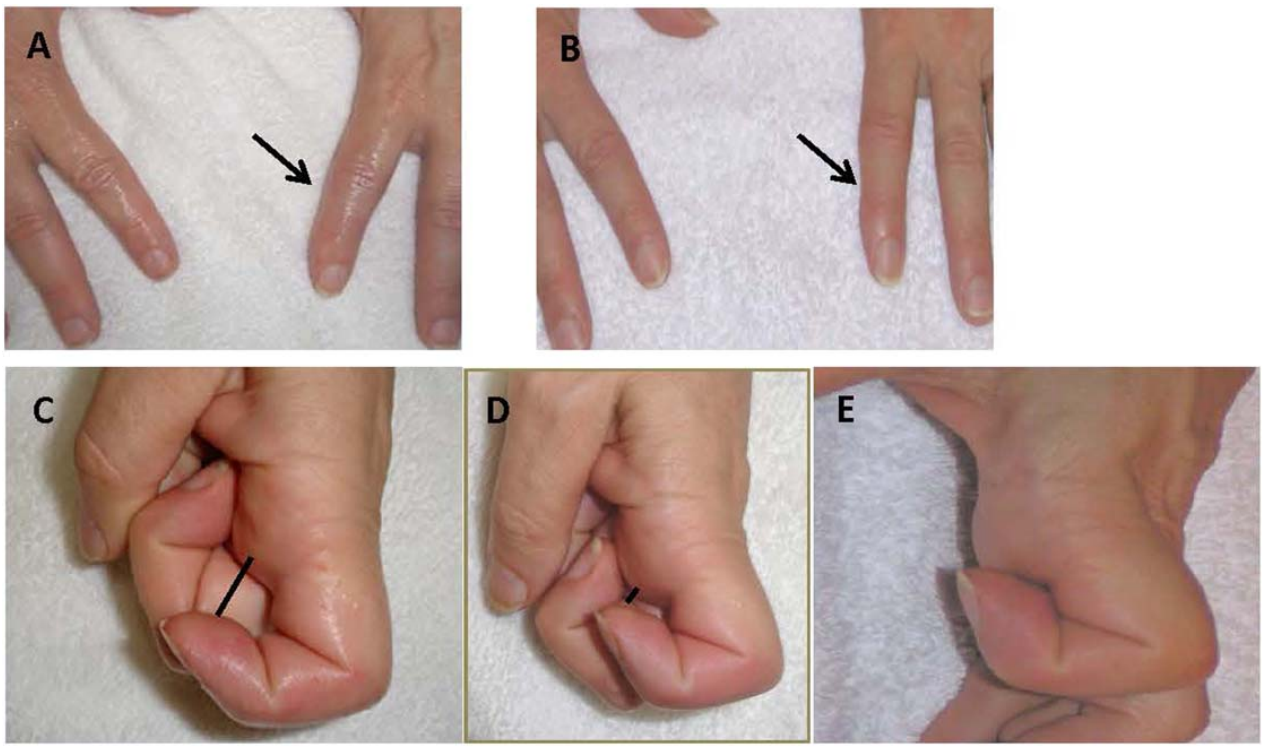

Figure 1 Observation of left second finger PIP joint peri-articular edema and functional ROM at initial and discharge assessments. Upon initial evaluation (A), swelling in the area of the second PIP joint was observed (arrow). At discharge (B), the contour of the second finger PIP joint was more visible due to decreased edema (arrow). Limited second finger functional AROM was observed upon initial assessment (C) before IASTM treatment; but improved functional AROM was immediately observed following IASTM only performed during the initial assessment visit (D); and at discharge (E), full-functional AROM in flexion was obtained. The line in (C) and (D) depicts the distance from the finger pad of the distal phalanx to the metacarpal phalangeal joint pad; no distance between these landmarks is observed in (E).

communication ability, affect, and cognition were intact and age appropriate.

The patient-specific task of playing his acoustic guitar was used as an objective activity measure. It was observed that he had difficulty achieving pressure during full finger abduction while chording. The patient demonstrated strength deficits in his gross motor grips (power, hook) and fine motor grips (tip pincher, lateral key) as measured by hand-held and finger dynamometers, respectively, using an average of three repeat measures. The lateral key grip was the most impaired. Intrarater reliability and validity for determining hand and pinch grip strength, using a dynamometer, are very high if the mean of three trials and a standardized test position are used.[30,31]

Physical examination tests and measures revealed several impairments of body structures and function (Table 1). Visual observation of the left index finger PIP showed signs of peri-articular edema (Fig. 1). Circumferential measurement was slightly increased at the PIP joint line compared to the right. Left second finger PIP active and passive ROM (AROM/PROM) were restricted in flexion and extension as measured with a finger goniometer. Metacarpal phalangeal joint extension was also limited. One study demonstrated that the measurement error ($\pm 3.5^{\circ}$) for goniometry of the index finger was well within the acceptable standard ($\pm 5^{\circ}$) and had a very high intrarater reliability (0.99), although its construct validity was inclusive.[32] Figure 1 portrays peri- articular edema at initial (A) and discharge assessment (B), and also depicts the left index finger flexion functional AROM before initial assessment (C), immediately after the IASTM treatment, during the initial visit (D), and at discharge (E). Two-point sensory discrimination (reliability 0.922 for 4 out of 5 trials)[33] was diminished on the lateral aspect of the left distal phalanx, as measured by an esthesiometer. The normative value for the inter-point distance in this region is 2.6 mm.[34,35] Manual muscle testing found that the second finger flexor digitorum superficialis and profundus (FDS and FDP) strength diminished on the left compared to the right. Joint mobility tests (distraction, anterior, and posterior glide) were minimally restricted on the left compared to the right second finger PIP joint (left 2/6=slight decreased movement; right 3/6=normal).[36] The joint mobility restrictions corresponded to limitations in the quality (i.e., capsular)[36,37] and quantity of left second finger PIP joint flexion and extension found during PROM testing. However, the left second finger PIP joint lateral (radial) ligament stress testing was positive for pain with slightly increased laxity (4/6). The reliability of joint play testing in the finger

Table 1 Self-reported outcomes and objective findings for initial and discharge assessments.

PT examination			Initial assessment		Discharge assessment	
Self-reported findings						
Numerical Pain Rating Scale (NPRS)			Best: 0/10 Worst: 5/10 ('frequent') Average: 4/10 Playing Guitar: 5/10		Best: 0/10 Worst: 4/10 ('rarely') Average: 0–1/10 Playing Guitar: 1/10	
Disabilities of Arm, Shoulder and Hand Index (DASH) [points=% disability]			Overall: 40 Work: 0 Sports/Performing Arts: 75		Overall: 29.2 Work: 0 Sports/Performing Arts: 6.3	
Objective findings			Right	Left	Right	Left
Circumference: 2nd PIP joint line			70 mm	72 mm	70 mm	70 mm
Sensory: 2 pt. discrimination, 2nd distal phalanx			2 mm	3.5 mm	2 mm	2.5 mm
Active/Passive Joint ROM: (*=painful)	MCP	Flexion	0–90°/0–90°	0–90°/0–90°	0–90°/0–90°	0–90°/0–90°
		Extension	0–35°/0–50°	0–30°/0–35°	0–35°/0–50°	0–35°/0–40°
	PIP	Flexion	0–95°/0–110°	0–80°/0–85°*	0–95°/0–110°	0–95°/0–100°
		Extension	0°/0°	–20°/–15°	0°/0°	–5°/0°
	DIP	Flexion	0–35°/0–35°	0–30°/0–30°	0–35°/0–35°	0–30°/0–35°
		Extension	0°/0–5°	0°/0°	0°/0–5°	0°/0°
Strength: *dynamometer* (**=painful) (*=slightly painful) (3 Trial Average)						
	Power Grip		86lbs	61lbs	90lbs	68lbs
	Hook Grip		85lbs	60lbs	85lbs	78lbs
	Tip Pincher Grip		4lbs	2.5lbs	4lbs	4lbs
	Lateral Key Grip		15lbs	11lbs**	13lbs	13lbs*
Manual Muscle Test						
	Flexor Digitorum Superficialis Flexor Digitorum Profundus		5/5	4/5	5/5	4.5/5
			5/5	4/5	5/5	5/5
Palpation (Description is for left upper extremity; no soft tissue abnormalities or tenderness detected on right)	Initial		Soft tissue tenderness and restricted mobility along lateral PIP joint and middle and proximal phalanges. Medium-sized, fibrotic, painful nodules localized at the flexor myotendinous junction in the forearm.			
	Discharge		Improved soft tissue mobility quality; tenderness only with deep pressure at the PIP joint line on the lateral aspect. Fibrotic nodules smaller and non-painful at the flexor myotendinous junction.			
Joint Play (Description is of left 2nd PIP joint; joint mobility was normal and painless on right)	Initial		Abnormal PIP joint mobility: limited longitudinal distraction and anterior and posterior glide (2/6); slightly increased laxity (4/6) and pain with stress to the lateral collateral PIP joint ligament.			
	Discharge		Symmetrical PIP joint mobility (3/6) except for very slight laxity (3–4/6) with stress to the lateral collateral PIP joint ligament, but with decreased pain.			

Six-month follow-up phone interview
PT follow-up phone interview was performed 6 months after PT discharge. Patient reported improvements with less pain while function had remained at the levels indicated at the time of discharge.

The most significant findings were decreased pain and improved physical measures enabling him to play the acoustic guitar with minimal to no pain as desired. Positive treatment outcomes were maintained per a 6-month follow-up phone call.
PIP: proximal interphalangeal; MCP: metacarpophalangeal; ROM: range of motion; DIP: distal interphalangeal.

joints is not indicated in the literature; however, other studies have shown acceptable reliability in the spine and carpals.[37,38]

Palpation of the soft tissue quality/condition was performed manually and with IASTM instruments (Graston Technique®, Indianapolis, IN). The IASTM technique used in this report consists of contoured, stainless steel instruments specifically designed for different shaped and sized body regions. The instruments also have an angled edge that permits specific and precise application of force.[10] The most significant palpation finding was a painful and thickened left second finger PIP lateral collateral ligament. Fibrotic restrictions were also palpated along the medial and lateral aspects of the middle and proximal phalanges; and tender, fibrotic nodules were detected at the myotendinous junction of the left forearm flexors.

All self-reported outcomes and physical performance tests and measures are detailed and compared (left vs right; and over time) in Table 1. Initial and discharge assessments and interventions were performed by a single physical therapist (30 years licensed practice), certified in manual therapy with 20 years of experience in IASTM.

Clinical Impression

A 55 year-old man guitar player presented to PT 6 months after sustaining a traumatic injury to his left index finger PIP joint which had been pulled into extreme adduction and extension due to a fall on ice. His primary complaint was pain interfering with his ability to play the acoustic guitar. Upon evaluation of the initial examination findings, a PT diagnosis, prognosis, and plan of care were established. It was determined that the patient had the following impairments of body structures and function: (1) decreased grip and finger strength; (2) chronic swelling; (3) diminished two-point sensory discrimination; (4) limited active and passive finger ROM; (5) impaired joint mobility; and (6) abnormal soft tissue mobility. His primary functional limitation was a limited ability to play his guitar. His working PT diagnosis was impaired joint mobility, motor function, muscle performance and ROM associated with ligament and joint capsule disorder.[39] The findings were consistent with a PIP joint sprain, in particular, the lateral collateral ligament, and a possible strain of the finger flexors of the left second finger.[40,41] Primary treatment goals were to restore the patient to his prior level of function and to significantly reduce his pain. The prognosis was good for achieving the anticipated goals and expected functional outcomes by the time from treatment since the patient appeared motivated, was cognitively aware, and did not have any co-morbidities. An excellent prognosis was not established due to the chronic nature of the condition. The plan of care consisted of a manual therapy approach to target the physical findings, including STM, specifically IASTM, therapeutic exercise, ice massage, joint mobilization (JM) as appropriate, home exercise prescription (HEP), and self-care instructions once per week for 6 weeks (6 sessions total). This intervention strategy is consistent with the standard of practice for the PT diagnosis.[39]

Intervention

Although the patient's condition was chronic (6 months post-injury), he began in the sub-acute phase of rehabilitation, with priority placed on reducing residual, chronic, peri-articular joint edema and restoring full, pain-free ROM before emphasis was placed on strengthening or return-to-full function. Treatment frequency was once-a-week for the duration of 6 consecutive weeks (6 total sessions). Each session lasted approximately 30 minutes in total and consisted of IASTM (10 minutes total/session) using stroke techniques per the manufacturer's training guidelines.[10] To briefly summarize the IASTM approach, soft tissue quality throughout the hand and forearm was initially examined using scanning strokes with the instruments; followed by treatment of detected soft tissue abnormalities/restrictions with strokes that progressed from proximal to distal, superficial to deep, and broad to localized; ending with 1 minute of instrument-assisted CFM focused on the region of second finger lateral collateral PIP ligament (Fig. 2). IASTM was followed by JM and therapeutic exercises. Grade I mobilizations were used initially during all sessions for pain reduction; followed by anterior and posterior glides (grades III and IV) with the PIP joint carefully maintained in neutral alignment, in order to restore limited joint motions while avoiding any potentially damaging stress to the lateral collateral ligament. Therapeutic exercise initially focused on active and passive ROM of second finger flexion/extension and stretching of the finger flexors to patient tolerance was applied. Once the patient could perform active motion throughout the available pain-free range, grip and finger strengthening exercises were added. Finally, ice massage was applied for 5 minutes at the end of each treatment session. An HEP was prescribed (including finger joint flexion/extension AROM/PROM, finger flexor stretching, and eventually grip strengthening exercises). Self-care instructions included self-administered CFM by hand alone to the radial aspect of his left second finger PIP joint (1–3 minutes, 2 ×/day), followed by ice massage (5 minutes). The patient was able to appropriately demonstrate his HEP and self-administered CFM

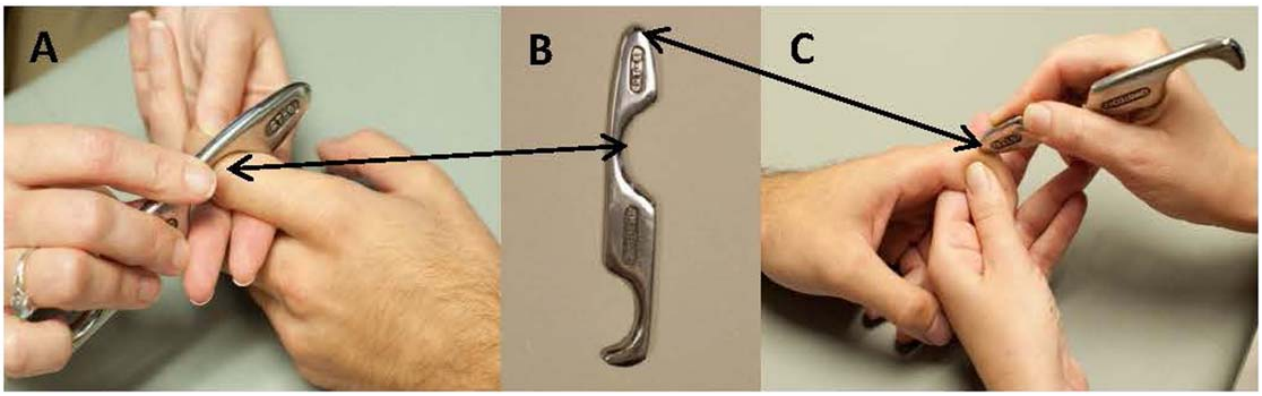

Figure 2 IASTM in the region of the left second finger PIP joint. (A) and (C) show IASTM techniques using different edges of the GT-6 instrument pictured in (B). (A) depicts use of the curved edge for small, convex-shaped body surfaces sweeping in a manner to decrease edema; and (C) demonstrates use of the narrow tip of the instrument for direct CFM to the lateral collateral PIP joint ligament.

after instruction and upon follow-up at subsequent visits.

Outcomes

Reassessment of all self-reported and physical performance tests and measures occurred immediately following the final treatment session. His self-reported pain level while playing the guitar (NPRS initial 5/10; discharge 1/10) and on average (NPRS initial 4/10; discharge 0–1/10) had improved by a reduction of 4 and 3 points, respectively. His worst pain (NPRS initial 5/10; discharge 4/10) occurred less frequently and only if he 'caught his finger on something' but never while playing the guitar. The NPRS minimal detectable change (MDC) is 2.5 points and the threshold for minimum clinically important difference (MCID) is 1.1 points.[25,26] His functional ability had improved per the overall DASH disability/symptom score (initial 40; discharge 29.2), and most importantly, he had realized significant gains on the optional DASH Sports/Performing Arts module (initial 75; discharge 6.25). The DASH has been shown to have construct validity ($r>0.69$) and excellent test–retest reliability (ICC=0.96), also its responsiveness is comparable to or exceeds that of the joint-specific measures for use across the entire UE.[27] The MDC for the DASH is 10.5 and the MCID is 10.2.[27–29] Therefore, the patient's improvement of 10.8 in his DASH score was clinically significant.

The patient-specific task of playing his guitar was re-examined as the primary objective functional measure. He demonstrated no difficulty in applying pressure during full-finger abduction while chording upon observation. Gains in gross and fine motor grip strength performance were demonstrated.

Physical test and measures gains were also realized. In particular, he demonstrated decreased edema surrounding the left second finger PIP joint and enhanced 2-point discrimination along the lateral aspect of its distal phalanx. Improved functional ROM immediately was observed following only IASTM during the first session and at discharge (Fig. 1) and gains in AROM/PROM were nearly symmetrical to the uninjured side. FDS and FDP strength also improved. Manual and IASTM palpation found the soft tissue mobility mostly symmetric compared to the non-involved side. The only abnormal findings were mild discomfort to deep, localized pressure with the instruments at the lateral second PIP joint line and a minimal amount of non-tender fibrotic nodules remained palpable at the left flexor myotendinous junction. Also, joint play movements were symmetrical except for very slight laxity (3–4/6) during applied stress to the lateral collateral ligament, although less painful. All findings are compared over time (initial to discharge assessment) in Table 1.

During a 6-month follow-up phone interview, the patient subjectively reported continued improvements in pain with less-frequent episodes and intensity of worst pain. Functional improvements had been maintained. He continued to play the guitar as desired for more than 1 hour with minimal to no pain.

Discussion

A 55-year-old male guitarist with a left second finger PIP joint injury was successfully treated in an efficient and effective manner using a manual therapy approach including IASTM in combination with joint mobilization, therapeutic exercise, and ice massage. Self-reported pain and functional measures significantly improved. The most important gain was in the patient's activity/participation level; specifically, he was able to play the guitar with minimal to no pain for as long as desired. Other positive outcomes were decreased peri-articular edema, enhanced sensation, nearly symmetrical active and passive joint ROM and strength, increased joint

mobility, and improved soft tissue quality. Long-term gains in pain and function were reported.

In order to understand how the symptoms were treated successfully with this targeted manual therapy approach, it is necessary to consider the patient's mechanism of injury and functional implications to a musician. Normal motion of the PIP requires intact bone and articular surfaces, unrestricted tendon gliding and integrity of the capsule and collateral ligaments. Disruption of any of these structural components can lead to abnormal finger motion and hand function.[5] Unlike sports injuries that usually involve high impact in this region, most instrumentalist's conditions involve repetitive movements of the wrist and hand.[42] The demand for peak performance is felt to contribute to the cumulative micro-trauma associated with overuse or repetitive stress injuries (RSI) in the performing arts.[43] Histopathological assessment of surgical samples from patients with UE RSI related to overuse, such as tendinopathies, have found the co-existence of degenerative connective tissue changes and inflammation, resulting in a failed healing response.[44] However, in this case report, the probable cause of the patient's persistent pain and dysfunction was a direct result of an injury, not RSI, which may limit the ability to extrapolate findings since it is not representative of most musicians who seek care. Although the etiology was not cumulative trauma due to his work/music, poor instrument fit or abnormal playing technique, it is nonetheless possible that his attempts to continue playing the guitar post-injury perpetuated and exacerbated his problems.

Positive outcomes seen in this case study were likely related to treatment since the patient had pain and dysfunction due to an isolated injury that occurred 6 months prior to this episode of care without any improvement. In addition, he had not had any other form of treatment or medication for this condition. Although the overall treatment effect cannot be isolated to IASTM, gains in functional active ROM were immediately observed following only IASTM intervention at the initial session.

The concept of IASTM is not a new. In fact, the use of rigid tools to assist massage techniques dates back to ancient cultures.[7,45] This case report is the first to explore the use of IASTM on a finger condition affecting an instrumentalist and may have potential impact on this area of clinical practice. Consideration of patient ergonomics during specific task performance should be incorporated into future models investigating the use of IASTM in the performing arts. Treatment requires an individualized approach with musicians since the type and fit of instrument has major implications.[46,47] The use of IASTM with other UE conditions, especially cumulative trauma associated with RSI, including occupational medicine UE conditions, would be useful. Interestingly, UE dysfunction is common in physical therapists[48] and osteoarthritis of the first carpometacarpal joint is the second most common reason for manual therapists to stop working.[49] There is a need to determine optimal treatment dosages (pressure, frequency, rate) as an important future direction for IASTM research.

Examiner bias is a potential limitation in this study since all initial and discharge re-assessments and interventions were performed by a single physical therapist; however, patient self-reported outcomes did significantly improve. The fit of and how the patient played his instrument could have been explored more thoroughly as a means to expedite functional recovery. The reliability of joint play testing in this region may be another limitation. Also, assessment of soft tissue quality, whether performed by hand alone or instrument-assisted, is difficult to objectively quantify.

A guitarist with a traumatic finger injury resulting in chronic pain and functional limitations was treated in an effective and efficient manner using a manual therapy approach which included IASTM. IASTM provides a promising conservative treatment option for conditions affecting the finger and hand in the performing arts and other patient populations.

Disclaimer Statements

Contributors MTL participated in the conception, design, initial drafting and revision of the manuscript. AB, EG and GC participated in the initial drafting and revision of the manuscript.

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Ethics approval IRB.

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