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Case report

Ultrasound-guided, percutaneous injection of steroids as a treatment for symptomatic adhesions between the lumbrical and interosseous muscles of the hand: A case report

Injection percutanée et guidée par ultrasons de stéroïdes, pour le traitement des adhérences symptomatiques entre les muscles lombricaux et interosseux de la main: à propos d'un cas

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ABSTRACT

Adhesions between lumbricales and interossei muscles are known as "saddle deformities." Clinical diagnosis of saddle deformities of the hand requires a high index of clinical suspicion; this specific injury is often missed or remains undiagnosed using conventional X-ray or MRI techniques. Although the "gold standard" for treatment is surgical release of the adhesions, ultrasound-guided steroid injections at the site of adhesions could be considered a promising treatment option prior to surgical management and, as illustrated in this case, is shown to provide adequate pain relief and positive outcomes for the patient.

RÉSUMÉ

Les adhérences entre les muscles lombricaux et interosseux sont connues sous le nom de "déformations en selle". Le diagnostic clinique des "déformations en selle" de la main nécessite une forte suspicion clinique; cette lésion spécifique est souvent méconnue ou reste non diagnostiquée dans le cadre des techniques classiques et conventionnelles de radiographie ou d'IRM. Le traitement de référence consiste à la libération chirurgicale des adhérences musculaires. Les injections écho-guidées de stéroïdes sur le site des adhérences pourraient être considérées comme une prometteuse option de traitement avant la prise en charge chirurgicale et, comme dans notre cas, il est démontré que ces injections soulagent efficacement la douleur du patient et lui apportent des résultats positifs.

1. Introduction

We present a case in which ultrasound-guided, percutaneous injections of steroids were used to treat symptomatic adhesions between the lumbrical and interossei muscles of the hand (also known as "saddle deformities").

Intrinsic hand muscles consist of four lumbricales, three palmar interossei, four dorsal interossei, the thenar, and hypothenar muscles. These muscles are separated into compartments by fascia. The four lumbrical muscles originate proximally from the tendons of the flexor digitorum profundus muscle; they run along the radial side to insert distally on the lateral side of the proximal phalanges and into the dorsal hood of the extensor retinaculum. Their action is to flex the metacarpophalangeal joint (MCP) and

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extend the interphalangeal joints (PIPs) of the 2nd, 3rd, 4th and 5th digits. The four dorsal interossei muscles (DIs) originate proximally as bipennate muscles from the adjacent metacarpals and attach distally to the 2nd, 3rd and 4th proximal phalanges. Their action is to abduct the 2nd, 3rd and 4th digits and to assist lumbrical action. The palmar interossei (PI) comprise three unipennate muscles originating proximally from the palmar surfaces of the 2nd, 4rd and 5th metacarpals, and they insert distally to the 2nd, 4rd and 5th proximal phalanges. The action of the palmar interossei is adduction of the phalanges [1].

Several conditions, such as trauma, burns, infections [2], cerebrovascular accidents, cerebral palsy, connective tissue diseases, and surgical interventions with prolonged immobilization of the hand can disrupt the fascial planes and cause adhesions, known as "saddle deformities." Watson et al. [3] first coined the term "saddle deformity" when they described posttraumatic interosseous-lumbrical adhesions. The name comes from the topographical anatomy of the lumbricales muscles, interossei muscles, and the deep transverse metacarpal ligament (dTML). These adhesions can form between the intrinsic muscles, the dTML, or the MCP capsule. The adhesions can impair the free excursion of the intrinsic muscles, thus affecting the hand and finger's range of motion. Pain can be triggered with any movement of the affected hand, decreasing functional activities.

Currently, conventional treatment centers on conservative management of symptoms; this treatment includes rest, Nonsteroidal Anti-inflammatory Drugs (NSAIDs), modification of activities, splinting the affected hand, and rehabilitation therapy. Such therapy is guided by an occupational therapist who assists the patient with stretching and strengthening the intrinsic muscles. If symptoms fail to improve with conservative treatment, the treatment moves to invasive hand surgery to release these adhesions, thus mobilizing the affected ligaments and muscles [4–6].

2. Case presentation

2.1. Patient's story

A 35-year-old white male came to the outpatient clinic with pain in his right hand originating on the lateral side of the dorsum. He had fallen onto his hand, palm-side down and fingers outstretched, 6 months prior to his visit. The patient described the pain as dull and aching and ongoing since his fall. He reported that his pain affected his ability to participate in sports, grip weights, and to do push-ups; he also experienced pain during activities of daily living such as those that involved gripping objects (e.g. opening jars, holding objects). The patient denied pain radiating to the arm and any numbness or tingling in the ulnar, median, or radial nerve distribution. The patient's history was negative for prior neck injuries or fractures.

Therefore, at this initial visit, we used a 10-point, patient-reported, visual analog scale (VAS) score, where 0 meant "no pain" and 10 was "the worst possible pain"; the patient rated his pain a 6 on the VAS. Our initial treatment approach was conservative. We prescribed rest, activity modification, NSAIDs, acetaminophen, hand therapy, a resting-hand brace, and occupational therapy.

Four weeks later, at the patient's scheduled follow-up appointment, he reported a VAS score of 5, showing no significant improvement with only conservative treatment. To assess and determine our next course of action, we took the following steps. First, we conducted a physical examination of the hand that revealed tenderness upon palpation in the second intermetacarpal web space. Next, to determine intrinsic tightness, we compared a flexed PIP joint range of motion (ROM) with the MCP joint in both flexion and extension (also known as a Bunnell test). These actions triggered pain and revealed approximately 30–35 degree of limitation to extension of the PIP joint when the MCP joint was in extension, as compared to the uninjured hand. Such results conclude a positive result for the Bunnell test, indicating intrinsic tightness.

Next, an X-ray was obtained for further examination of the hand. The resulting radiograph showed no abnormalities. Next, an MRI of the affected hand was obtained (Fig. 1). While the initial examination of the MRI results were reported as "normal", further examination revealed potential loss of fascial planes, suggestive of adhesions between adjacent intrinsic hand muscles [7]. Based on the definitive signs found on the physical exam and the positive Bunnell test (and without any conclusive evidence from imaging), the patient was scheduled for an appointment at the musculoskeletal clinic to investigate the cause of his pain. Four weeks later (8 weeks after the initial appointment) we examined both the longitudinal view and the axial view at the point of maximum tenderness (Fig. 2).

In the musculoskeletal clinic, we performed further dynamic hand ultrasound studies on the affected hand and compared those

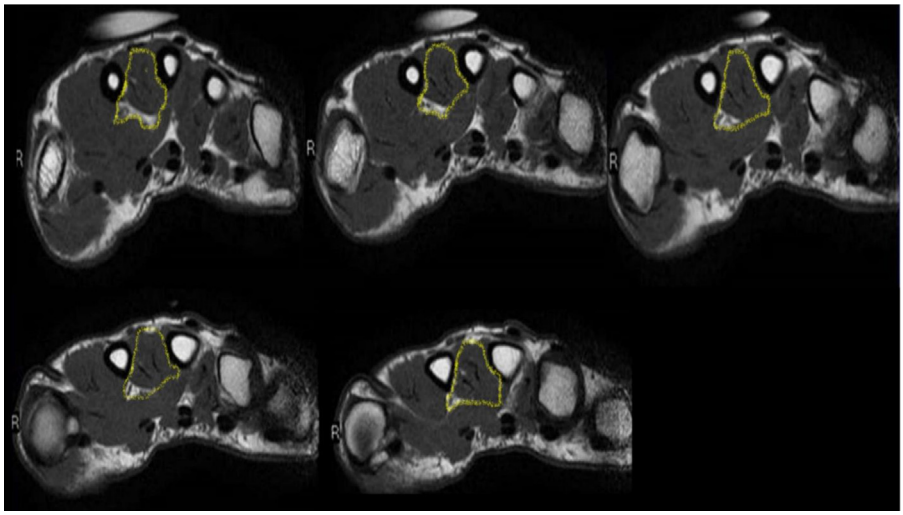

Fig. 1. MRI of the affected right hand with highlighted second web space showing likely adhesions. MRI examination revealed the potential loss of fascial planes and was suggestive of adhesions between adjacent intrinsic hand muscles.

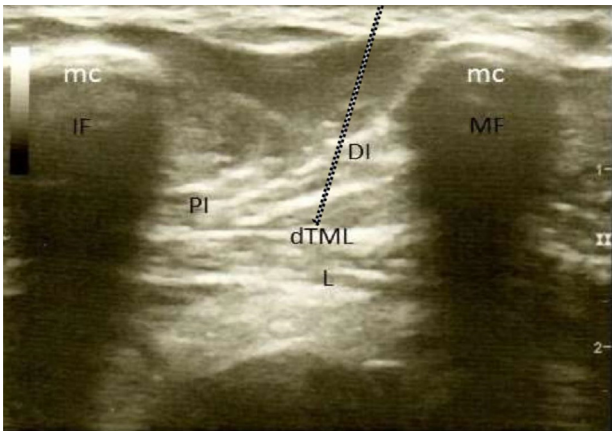

Fig. 2. Ultrasonic dorsal axial view of the affected right hand. An axial view at the point of maximum tenderness is shown and delineates anatomical structures and reveals hypo-echoic areas over the interossei muscles and areas of increased thickness at the deep transverse metacarpal ligament. The pathological area (the patient's adhesions) is highlighted with dotted lines. mc: metacarpal; IF: index finger; MF: middle finger; DI: dorsal interosseous; PI: palmar interosseous; dTML: deep transverse metacarpal ligament; L: lumbrical.

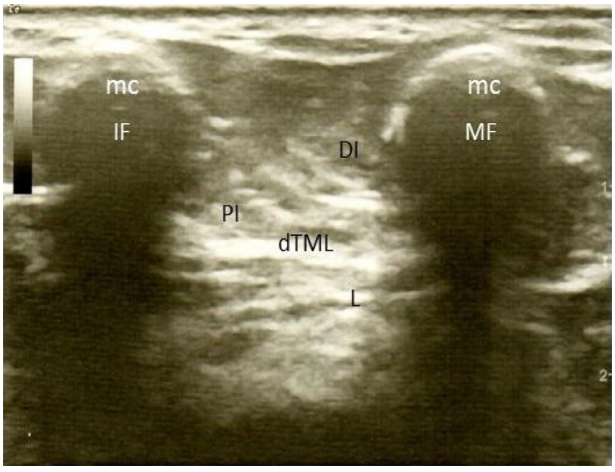

Fig. 3. Ultrasonic axial view of the patient's unaffected left hand. mc: metacarpal; IF: index finger; MF: middle finger; DI: dorsal interosseous; PI: palmar interosseous; dTML: deep transverse metacarpal ligament; L: lumbrical.

to ultrasounds of the unaffected hand (Fig. 3). With no other anatomical pathology in the web space, we could not rule out adhesions between the lumbrical and interossei muscles. We referred the patient to a hand surgeon, who determined no surgical intervention was warranted and that the pain could be expected to improve over time.

The differential diagnosis included ligamentous vs. muscle sprain or tear, neuroma, median neuropathy, Dupuytren's contracture, trigger finger, arthritis, fracture, or dislocation. With no anatomical or radiological evidence to explain the pain, we suspected the cause could be strain or sprain of the intrinsic hand muscles, along with the formation of adhesions between the lumbrical and interossei muscles. After three visits to the clinic and no improvement gained from conservative management, the patient consented to receiving a diagnostic, ultrasound-guided corticosteroid injection directly into the suspected site of the adhesions, between the muscles and the dTML. The outcome was measured using a 10-point VAS score, with 0 meaning "no pain" and 10 the "worst possible pain.

2.2. Method used to administer the corticosteroid injection

The patient sat upright, with the forearm flexed at the elbow at a 90° angle. The affected hand and wrist were placed in a pronated position. Using a linear array, high-frequency 12 MHz GE probe (Boston, MA) model L4-12T-RS, the depth and contrast were adjusted to obtain high-resolution images. The point of maximum tenderness was marked in both axial and longitudinal views. Dexamethasone sodium phosphate, commercially available in USP 4 mg/ml vials, was used for the procedure, along with 0.25% bupivacaine. Standard storage techniques and safety protocols were followed per the manufacturer's recommendations.

The second intermetacarpal space, which contains the 2nd lumbrical, 1st palmar and 2nd dorsal interossei, is shown in Fig. 1 (MRI). Under sterile conditions and with a confirmation in the axial view and the longitudinal axis, the 2nd intermetacarpal space was approached dorsally. The physician gently aspirated the needle to avoid injection into blood vessels. At the level of the dTML, 3–4 ml of the dexamethasone sodium phosphate was injected near the suspected site of the lesion (Fig. 2). The procedure was followed by occupational therapy. This treatment improved pain significantly for a time, according to the self-reported VAS, but was no longer effective by the second week.

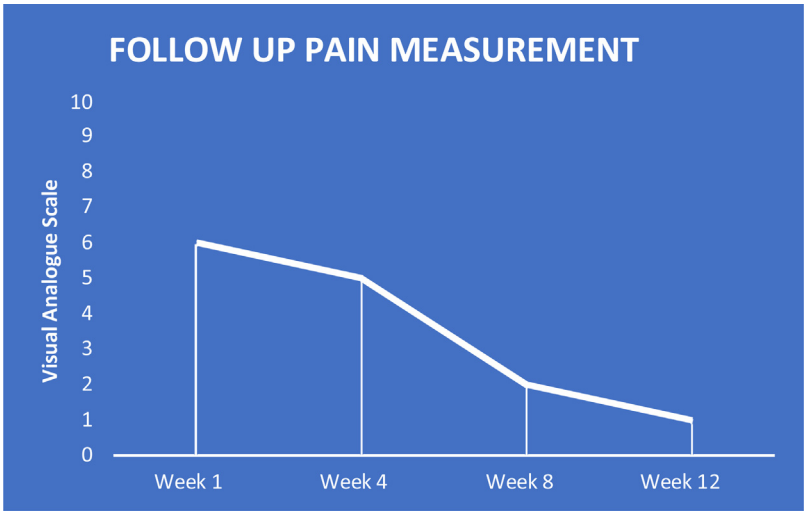

Fig. 4. Shown in the picture is the follow-up patient timeline with weeks on *y*-axis. The *x*-axis shows the visual analog scale of pain score. The patient had marked improvement in pain scores at 12 weeks post-procedure.

At the follow-up visit, the patient requested a second injection. At this time, the procedure was repeated using ultrasound guidance. The dexamethasone sodium phosphate was injected into the same location as in the initial procedure and also included continued hand therapy. The patient had subjective improvement in his hand pain, self-reporting a score of 1 on the VAS, and physical examination with the Bunnell test showed improved PIP joint range of motion of approximately 20–25 degree. An objective assessment with finger goniometer revealed near-normal joint range of motion (0–100 degree) with forced extension of the PIP joint when MCP joint was in extension. In the subsequent follow-up visit at 12 weeks, the patient reported marked pain improvement and was able to tolerate activities that had previously triggered hand pain. Fig. 4 provides a visual representation of the patient's subjective improvement in VAS pain scores (*y*-axis) during the follow-up timeline (*x*-axis).

3. Discussion

Adhesions between the interossei, lumbricales, dTML, and MCP joint capsule are common after hand injuries. These adhesions of the intrinsic hand muscles (or "saddle deformities" [3]) following trauma to the hand can lead to pain triggered by hand or finger movements and can impact hand functionality.

Chicarilli et al. reported that the mean time interval — from onset of symptoms, to diagnosis, and through treatment — is 19 months [4]. A thorough history of the presenting symptoms and a focused physical examination of the fingers to evaluate the range of motion of the MCP, PIP, and DIP joints, including palpation of the intermetacarpal space, can demonstrate pain in the web space. The Bunnell test is performed by flexing the PIP joint and comparing the joint ROM when the MCP joint is in flexion and in extension. If there is any intrinsic tightness, there will be limitation in the flexion at the PIP joint when the MCP joint is in extension. Other tests, such as passive or active assisted abduction or adduction of the involved finger, can point to the site of tenderness in the web space.

Chicarilli et al. [4] reported that 100% of patients diagnosed with adhesions presented with tenderness in the intermetacarpal web space, and 49% of these patients presented with a positive Bunnell test. The diagnosis is often missed, as conventional imaging studies lack specificity. A dedicated hand MRI may be considered when adhesions in the affected hand are suspected [8]. A report by Tan et al. [5] details two cases where preoperative MRI of the hand confirmed the diagnosis prior to surgical intervention.

Once conservative treatments have failed, surgical release of the adhesions is the standard treatment [4,5]. Following surgical intervention, the hand is splinted and most often mobilized on day 5, 6, or 7 [4].

Some limitations and possible bias may be found in our case report. One limitation of this study is the patient's lack of adherence to post-procedure hand exercise program at-home in the first intervention. This could be the reason the first intervention failed after two weeks, but the second intervention was successful.

The limited literature and case reports focusing on adhesions in this area of the hand reflect unrecognized or delayed diagnosis of the condition. Dedicated hand MRI or dynamic musculoskeletal ultrasound examination can be performed when a diagnosis of an adhesion is in question. This case study presents an intervention with ultrasound guidance using steroids and local anesthetic, but we recommend further studies using local anesthetic, which will allow for imaging of the adhesion in motion. Furthermore, research is warranted to be able to generalize the positive results generated in this case study; therefore, we recommend conducting a randomized controlled study with additional subjects and sham controls to confirm the results and measure the true benefit of this therapy.

4. Conclusion

The patient in this case had pain with both palmar adduction and abduction and with finger flexion movements. The adduction and abduction pain indicated the dysfunctional excursion on the palmar and dorsal interossei. Pain when executing a hand grip could possibly be caused by the more complex involvement of all the muscles of the hand, including the lumbricales, joint capsules, the flexor tendons, or the presence of possible adhesions proximal to the dTML near the base of the metacarpals (where the hand muscles originate). Considering the results and conclusions of the above observational studies, intrinsic hand muscle adhesions are common after a hand injury and should be suspected when hand pain presents post-injury.

Ultrasound-guided injection of steroids can be considered a treatment option for adhesiolysis in the intrinsic hand muscles and should be combined with conservative measures for improved outcomes. Furthermore, injection of steroids can reduce the inflammation [8]. One hypothetical conclusion is that the mechanical disruption of the adhesions by the volume of the injectate in the fascial planes of the intrinsic muscles provides symptomatic pain relief, as illustrated in this case report.

Disclosure of interest

The authors declare that they have no competing interest.

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