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ARTICLE

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Interosseous-lumbrical adhesions – a rare condition? A series of five cases

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ABSTRACT

Adhesions between the interosseous and lumbrical muscles involving the deep transverse metacarpal ligament (dTML) can be a cause of chronic pain and reduced range of motion. New reports on this condition are rare. We identified five patients experiencing pain, swelling and decreased range of motion in the metacarpophalangeal (MCP) joints during manual load. The condition was caused by a direct trauma. After not responding to conservative treatment, patients underwent surgery. Time between trauma and surgery was on average 16 months and the mean postoperative follow-up was 8 months. The lumbrical–interosseus junction was exposed by volar or dorsal incision, adhesions were widely released and the distal third of the dTML was resected. This resulted in normal passive excursion of the muscles and the tendon junction. At the mean follow-up time 8.2 months (3–18) after surgery, all patients were pain-free and had gained near normal range of motion in the MCP joints. Interosseous-lumbrical adhesions may be more common than reflected by the literature. Hand surgeons should keep this condition in mind in cases with chronic inter-metacarpal pain after trauma or infection. Surgical exploration is relatively straight forward and tends to lead to gratifying results. Level of Evidence: IV (therapeutic)

Abbreviations: dTML: deep transverse metacarpal ligament; Fig.: figure; MCP: metacaro-phalangeal joint; MRI: magnetic resonance imaging; ROM: range of motion; VAS: visual analog Scale; Lm: lumbrical muscle; Im: Interosseus muscle

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Introduction

Posttraumatic adhesions at the interosseous-lumbrical junction and in between the junction and the deep transverse metacarpal ligament (dTML) were described and entitled 'saddle deformity' by Watson et al. [1].

The adhesions appeared directly distal to the dTML where the interosseus-lumbrical junction is placed tightly around the dTML (Figure 1(A)). Originating directly from the flexor digitorum profundus tendon in the proximal part of the palm, the lumbrical muscle extends distally radial to the flexor tendon sheath and volar to the dTML. Just distal to the dTML where the tendon to the lumbrical muscle converge with the tendon to the dorsal interosseus muscle (laying dorsal to the dTML), forming the interosseus-lumbrical junction which inserts into the extensor hood, adhesions were found (Figure 1(B–D)). During intrinsic muscle activation, the junction slides proximally towards the dTML. Visualized in the coronal plane the lumbrical and the dorsal interosseus muscle can be pictured as 'legs' volarly and dorsally to the dTML which can be imagined as a saddle [1,2]. Adhesions in and around the interosseus-lumbrical junction can cause two different variants of the same problem. Adhesions can form distally, causing narrowing and proximalization of the junction without involvement of the dTML (Figure 1(B)). In this case the proximal sliding of the junction is stopped by the dTML before full proximal excursion is reached, resulting in impaired ability to accomplish full intrinsic plus position (Figure 1(C)). In addition, if the dTML and the metacarpophalangeal (MCP) joint capsule is involved in the adhesion, problems occur in the intrinsic minus position as the interosseus-lumbrical junction is stuck and unable to slide properly in a distal direction (Figure 1(D)). In conclusion, while flexing the MCP joint, the centre of rotation moves more volarly which pulls the interosseus-lumbrical junction volarly and proximally. When the MCP joints are extended and the PIP joints flexed, the junction is pulled in distal direction. Both of these movements can lead to a conflict between the junction and the dTML depending on how the adhesions are formed (Figure 1(B–D)).

Blunt trauma to the distal part of the hand has been described as a causal factor to this condition [1,2]. Furthermore, the condition has occasionally been reported as post-infectious and post-inflammatory [3–5]. There are few reports in the literature about this condition, and most of them are limited to case reports with a short follow-up (see Table 2). We present our experience in five cases with interosseus-lumbrical adhesions and discuss our results in relation to previous publications. The surgical technique is displayed and illustrated in detail, and the outcome with a mean follow-up of 8.2 months (3–18) after surgical release is presented.

Patients and methods

We retrospectively searched the digital databases on performed surgeries for any case of interosseous-lumbrical adhesions in two

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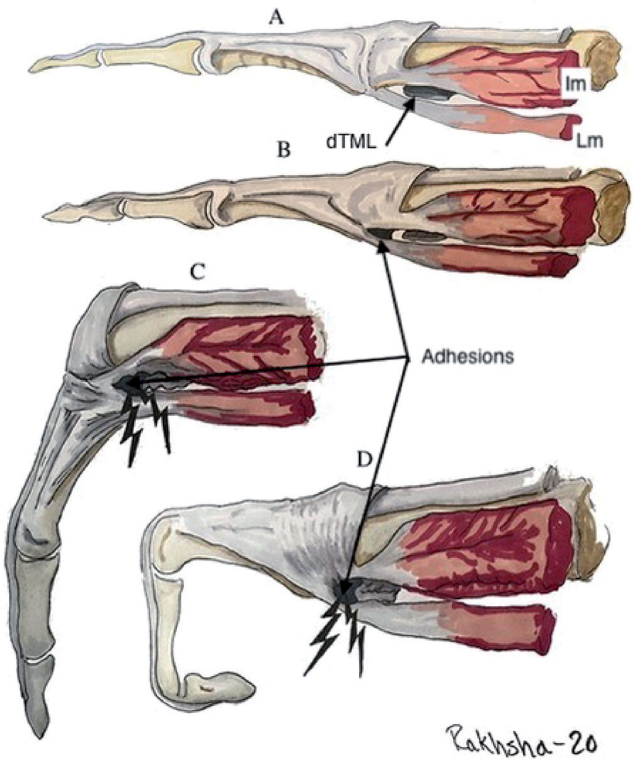

Figure 1. (A–D) Normal anatomic relation between the dTML, the lumbrical and the interosseus muscle (A), Adhesions between the tendons of the lumbrical and the interosseus muscle distal to the dTML (B), Impingement between the adhesions and the dTML in the intrinsic-plus position (C), Conflict when adhesions even involve the capsule shown in the intrinsic-minus position (D) Lm: lumbrical muscle; Im: interosseus muscle; dTML: deep transverse metacarpal ligament.

hand surgical centers and found the following five consecutive cases.

Case 1

A 50-year-old woman suffered a closed mallet injury to the middle finger. Eleven years earlier she had been treated conservatively for a closed rupture of the radial extensor hood to the third MCP joint. Pain on the dorso-ulnar aspect of the third metacarpal head persisted after the mallet injury. Neurological exam showed normal results, ultrasonography and magnetic resonance imaging (MRI) showed slight synovitis of the flexor tendons. Hand therapy and local cortisone infiltration at the A1 pulleys had no effect on the condition. Adhesions were found between the tendons to the third dorsal and second palmar interosseous muscle as well as the third lumbrical muscle, involving the dTML. The adhesions were released and a partial resection of the distal part of the dTML was performed (see Table 1 for details).

Case 2

A 33-year-old male experienced a sudden and severe pain on the volar side of his fourth metacarpal while opening a heavy door with his fourth and fifth fingers. Swelling occurred volar and dorsal to the metacarpal heads and flexion in the ring finger was painful and decreased. An acute surgical exploration of the flexor tendons and pulleys was performed with normal findings. Six months later, pain and local swelling persisted in the area. Possible adhesions between the intrinsic-muscles and the dTML were found on MRI. The suspicion was confirmed at surgery and

Table 1. Characteristics of the study population and results.

				Pre-op		Post-op			MRI		
Case	Gender	Age (in years)	Cause	Pain-free under stress	Pain-free ROM MCP E/F	Pain-free under stress	Pain-free ROM MCP E/F	Time to surgery (in months)	Per-formed	Positiv finding	Follow-up (in months)
1	F	50	Trauma	No	0/0/45°	Yes	0/0/90°	18	yes	no	3
2	M	33	Trauma	No	0/5/10°	Yes	0/0/90°	6	yes	yes	6
3	F	38	Trauma	No	0/0/80°	Yes	0/0/90°	18	no	–	6
4	M	58	Trauma	No	0/0/45°	Yes	0/0/75°	18	yes	yes	18
5	M	44	Trauma	No	0/0/0°	Yes	15/0/100°	18	no	–	8
Mean		45			0/0/36°		3/0/89°	16			8.2

Table 2. Overview over previous published studies.

Study	Year	Patients	Cause	Site of adhesion (web space)	Positive Bunnell Test	Time to surgery (months)	Pain free at last follow-up	Follow up (months)
Watson et al.	1974	12	Traumatic	2nd: 3 3rd : 5 4th: 4	25%	10 (mean)	Yes	6–66
Chicarilli et al.	1986	87	Traumatic (88%) miscellaneous (10%), unknown (2%)	2nd 30% 3rd 42% 4th 25%	49%	19 (range 3–120)	58% excellent, 29% good,8% fair	24 (15–108)
Topper	1997	1	Atraumatic (repetitive use)	Radial index/ MCP capsule	no	Not reported	Yes	6
Tan et al.	2002	2	Traumatic	3rd and 4th	yes	Not reported	Yes	5 and 6
Van der Veen et al.	2009	1	CRPS after multiple surgeries for dorsal wrist ganglion cyst	4th	yes	Conservative (cortisone injections)	Yes	6
Muder and Vedung	2014	1	Infection	2nd	yes	60	Yes	12
Pakeerappa et al.	2019	1	Traumatic	2nd	yes	Conservative (cortisone injections)	No (VAS 1)	3

adhesion in the interosseus-lumbrical junction and scarring in relation to the dTML was released (see Table 1 for details).

Case 3

A 38-year-old woman suffered a hyperextension trauma to her index finger. Pain and swelling occurred immediately between the distal part of the second and third metacarpal bones and persisted over time. Hand therapy did not improve the condition. 18 months later, typical clinical findings were found with pain in the intrinsic plus position and neither MRI nor ultrasonography were used to further clarify the condition. Surgical release of local adhesions around the dTML was performed after identifying typical intraoperative findings (see Table 1 for details).

Case 4

A 58-year-old male suffered a distal radius fracture in a car-accident. A small avulsion fragment was found on the ulnar side of the proximal phalanx of the third ray at the level of the MCP joint indicating a partial avulsion of the collateral ligament. Clinical examination showed a stable MCP joint in both extended and flexed position. Consistent pain and swelling between the third and fourth ray at the level of the dTML prevailed. MRI displayed signs of local inflammation around the junction of the lumbrical and interosseus muscles. Surgical release of the adhesions was performed (see Table 1 for details).

Case 5

A 44-year-old male slipped and smashed the dorsal part of his hand against a steal bar when he was pulling a timber-log. No fractures were found on X-ray. Persistent pain between the third and fourth metacarpals remained after several month of hand therapy. The symptoms increased under repetitive use of the hand in the intrinsic plus position. The diagnosis was confirmed by clinical examination and neither MRI nor ultrasonography were performed. On surgical exploration, adhesions around the dTML were found and released (see Table 1 for details).

Surgical technique

Under general or regional anesthesia all cases but one (Case 1) were exposed by a volar approach. A zig-zag incision is made between the metacarpal bones at the level of the dTML. The interdigital arteries and nerves are identified and protected. The lumbrical muscle is followed distally to the interosseus-lumbrical junction just distal to the dTML. The adhesions between the interosseus and the lumbrical muscles (at the junction) and between the junction and the dTML are identified and released (Figure 2). On the dorsal approach, which was chosen because of the surgeon's experience from a previous case, the junction can be visualized through a straight intermetacarpal incision, following the interosseous muscle, leading palmar to the dTML and the junction to the lumbrical muscle. All scar tissue is resected including the distal third of the dTML to enable a free excursion of the muscle bellies and tendons (Figure 3). After release of the adhesions and the distal part of the dTML, passive excursion of the fingers was performed to ensure that all structures could move freely.

The procedure is followed by immediate post-operative physiotherapy to avoid new adhesions.

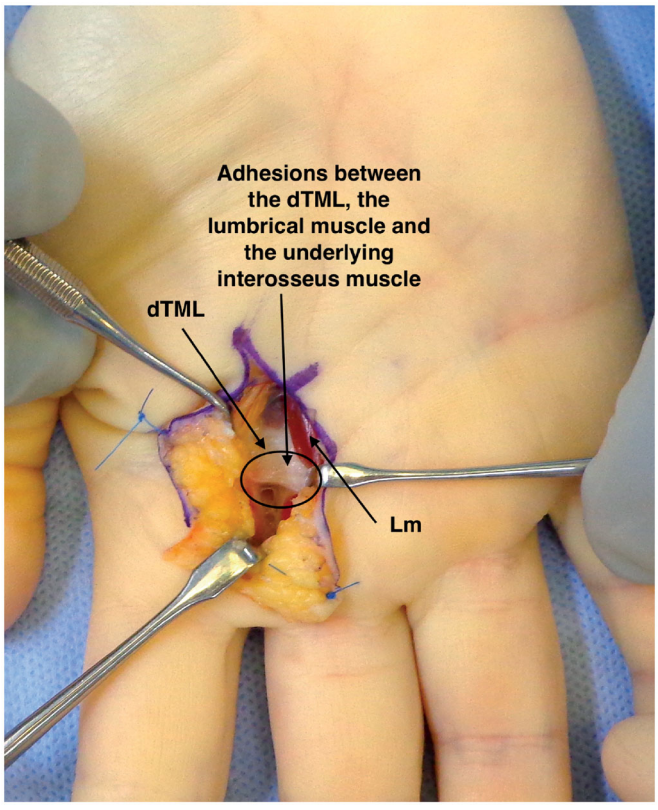

Figure 2. Intraoperative findings with adhesions between the distal part of the tendons from the lumbrical (Lm) and interosseus (not visible) muscle involving the distal part of the dTML.

Results

Two women and three men with a mean age of 45 years (range 33–58) were treated surgically as described above. The mean pre-operative range of motion (ROM) in the affected MCP joints was 0/0/36°. Mean time to surgery was 16 months (range 6–18 months). Hand therapy started immediately after surgery. Four patients experienced a rapid decrease in symptoms and impairment. One patient (case 4) had minor pain and swelling during the first three months after surgery. At the mean follow-up of 8.2 months (3–18) after surgery, all patients were pain-free and had gained near normal range of motion in the MCP joints (mean 3/0/89°). See Table 1 for details.

Discussion

Adhesions of the lumbrical and interosseous muscles around the dTML were described by Watson *et al.* [1]. In this report, the study cohort consisted of twelve patients with disabling intermetacarpal pain gathered between 1966 and 1972. Multiple etiologies were found, such as crush injuries (three), one wringer injury, four blows from metallic objects, one fall on the sidewalk, one laceration with a proximal phalanx fracture after a saw-injury, a car crash with multiple metacarpal fractures and one torsional machine injury. The average time between injury and surgery was 10 months, two cases with 60 and 108 months had been excluded for unknown reasons. The follow-up-time ranged between 6 and 66 months, and all patients were reported to be pain-free.

Chicarilli et al. [2] reported on 87 cases between 1966 and 1982, of which 88% were posttraumatic (49% crush injuries, 28% direct blow, 6% fall on outstretched hand, 5% torqueing stress), 10% were categorized as miscellaneous and 2% as unknown. The

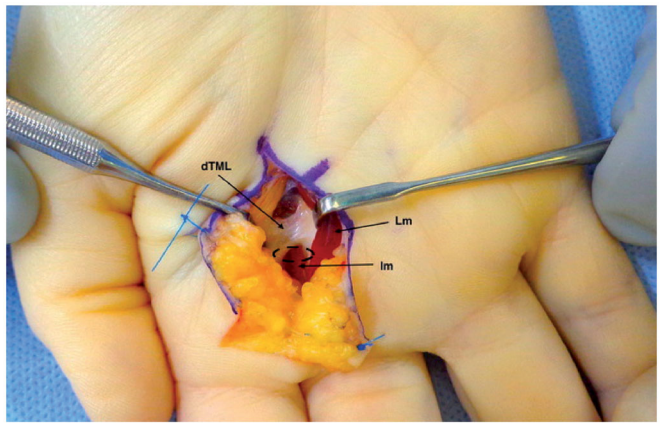

Figure 3. Intra operative imaging after release of the adhesions and resection of the distal third of the dTML, a free excursion of the lumbrical (Lm) and interosseus (Im) muscle is possible. The dotted line outlines the resected part of the dTML.

average time to surgery was 19 months, ranging from 3 to 120 months. The outcome in this study was less successful with 58% reported as excellent, 29% as good and 8% as fair.

The average time to surgery in our study was 16 months, which is about the same time as in the Chicarilli report, indicating that diagnosing this condition may be difficult.

The term deformity is used for describing abnormal shape, malformation, of anatomical structures. We did not identify any abnormality other than adhesions during our surgical explorations and therefore prefer the more descriptive term interosseus-lumbrical adhesion, which gives a more accurate picture of the intraoperative findings.

The area where the adhesions are located is small and thus difficult but not impossible to visualize with MRI. Tan et al. [4] reported two cases with positive high-resolution MRI findings. Topper [6] reported a case of a woman experiencing pain after repetitive microtrauma (after holding a paintbrush). The adhesion in this case was located on the radial side of the index finger where the dTML is absent. Instead the adhesion involved the MCP joint capsule, the first lumbrical and first dorsal interosseous muscle. MRI helped making the diagnosis. In the present study, three cases underwent MRI investigations with significant findings in two cases. Ultrasonography could possibly be helpful in an experienced setting, but we believe that the diagnosis primarily is made by clinical examination. MRI and ultrasonography might not be sensitive enough to set a definite diagnosis but may help to exclude other conditions and pathologies. With increasing resolution and image quality, MRI and ultrasonography will probably play a more important role in the future.

Objective findings as local pain and swelling or reduced ROM are reported in all available reports about interosseus-lumbrical adhesions. The Bunnell-test [7] may be helpful to diagnose intrinsic tightness. With the MCP joint in extension and the PIP joint passively flexed, a flexion deficit is seen in comparison to when the MCP is held in flexion. A positive Bunnell-test indicate tightness of the intrinsic muscles or a joint capsule contracture. All of our patients had compromised ROM and a positive Bunnell-test.

Our range of follow-up of 3–18 months and a mean of 8.2 month is similar to the follow-up in all the latest case reports, ranging from 3 to 12 months.

Being a rare condition, it is still uncertain whether conservative or surgical treatment is more effective. Pakeerappa et al. reported on a traumatic case with adhesions which they treated with two ultrasound-guided corticosteroid injections around the dTML and

subsequent hand therapy. On a 12-week follow-up, pain went from VAS 6 to VAS 1 and ROM improved to nearly normal. They conclude that pain relief is achieved by mechanical disruption of the adhesions by the volume of the injectate in the fascial planes [8]. Van der Veen also reported on one case treated conservatively with cortisone injections [5].

Also, as this condition is not well studied, the number of patients treated successfully with a conservative regime is unknown. If pain in the distal metacarpal area persists after a trauma or infection, other more common conditions should be excluded. At this stage an MRI might be helpful, in particular to rule out other conditions. We suggest conservative treatment, none-steroid anti-inflammatory medication and physiotherapy for at least 3–6 month. If the history and the clinical examination are unambiguous, we recommend exploration and, if needed, release of the adhesions and partial resection of the dTML. In our study, all patients received conservative treatment (hand therapy, splinting, anti-inflammatory topical or systemic drugs), but only one patient received corticosteroid injections. All patients eventually needed surgical treatment; therefore, we think that a conservative approach can be a good beginning, but we suspect that surgical treatment is the definitive treatment in these cases.

A potential risk might be injuries to the digital nerves or vessels due to altered anatomy and scarring after a trauma. Furthermore, only about one third of the dTML should be resected as over-resection might lead to instability between the metacarpal bones. Complications after this procedure are not described in the literature and have not occurred in our case series. We consider the surgery to be safe.

Conclusion

Interosseous-lumbrical adhesions may be more common than reflected by the literature. Hand surgeons should keep this condition in mind in cases with chronic inter-metacarpal pain after trauma or infection. Surgical exploration is relatively straight forward and tends to lead to gratifying results.

Ethical approval

Patients signed informed consent.

Author Contributions

David Jann wrote the first draft of the manuscript. All authors reviewed and edited the manuscript and approved the final version of the manuscript.

Disclosure statement

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

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