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A meta-analysis of injury to collateral ligaments of metacarpo-phalangeal joints other than the thumb: incidence, management and outcome

Abstract

Background: The incidence for the injury to the collateral ligament of the metacarpophalangeal joint (MCPJ) of fingers other than the thumb is unknown.

Methods: We carried out a systematic review of the literature using several search engines and several MeSH terms. A meta-analysis of the incidence, mechanism of injury, diagnosis, management, and outcome was performed.

Results: A total of 164 injuries were reported. A lot of the data was missing. The mean age was 43.32 years with no gender differences. The majority of the injuries were for the right hand, little finger and index finger. In 31.1% of the collateral ligament injuries cited in the literature, the radial collateral ligament (RCL) was the injured site. Surgical intervention was the main reported type of management and 30% of those who underwent conservative management required a surgical intervention.

Conclusion: This is the first meta-analysis of all the case reports and case series in the literature. It highlights the importance of early diagnosis and treatment and calls for standardizing the reporting of these injuries to avoid data gaps in future reviews.

Keywords: metacarpophalangeal joints, collateral ligament, hand injury

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Introduction

The incidence of injury to the collateral ligaments of the metacarpophalangeal (MCP) joints of the fingers other than the thumb is unknown throughout the literature[1] although many case reports describe it as very rare.[2–5] A prospective study undertaken by Delaere et al. in 2003 estimated that 1 in 1000 cases of hand injuries involves collateral ligaments of the MCP joints, 61% of these involving the thumb, and 39% involving the other fingers.[1] Such injuries are commonly missed in the emergency room due to the lack of knowledge of these lesions, resulting in the failure to identify them and in their misdiagnosis as contusions or sprains.[1,5,6] The common mechanism in the overwhelming majority of the MCP collateral ligament tears is trauma.[1,6,9] with sudden ulnar or radial stress resulting in radial or ulnar collateral ligament tears, respectively. These injuries can be classified into three grades with grade 1 signifying ligament sprain with no associated loss of joint stability, grade 2 signifying a partial tear with some instability, and grade 3 denoting a complete tear with marked instability.[7] In addition to these 3 grades, injury to the MCP collateral ligaments can be in the form of an avulsion fracture of the proximal phalanx or metacarpal bone as has been often found in case reports dealing with MCP collateral ligament ruptures.[1,2,4,10] Considering the paucity of information about the incidence and the proper management of these injuries we carried out a meta-analysis of all the published case reports and case series together with a review of the anatomy to the metacarpophalangeal joints and their collateral ligaments.

Anatomy

The metacarpophalangeal (MCP) joint is of paramount importance and crucial for hand function as it provides stability and mobility that allows the requested dexterity of the digits.[11] It is considered as a diarthroidal or condyloid joint that allows flexion, extension, abduction, adduction, and rotation of the proximal phalanx on the metacarpal head. The metacarpal head is narrow dorsally and wide in its volar aspect giving more contact with the base of the proximal phalanx during flexion.[12–14]

For an MCP joint to be stable, its articular structure, joint capsule and musculo-tendinous unit should be intact. The muscle and tendon forces are considered primary joint stabilizers acting to sustain pinch and grasp. On the other hand, the joint ligaments and capsule provide initial stability to instantaneous forces and provide stability during static loading conditions [11]

The MCP joint capsule extends from the metacarpal neck to the base of the proximal phalanx and it is reinforced by specialized structures on all sides. It is composed of areolar tissue dorsally and reinforced by the loose insertion of the common extensor tendon. On the volar aspect, it is the volar plate which supports the joint and it continues laterally with the deep transverse metacarpal ligament (intervolar plate).[14]

Laterally, the collateral ligaments are capsular thickenings on either side of the joint which arise from small depressions in the medial and lateral surfaces of the metacarpal head, run from the metacarpal tubercles in two parts and insert onto the volar two-thirds of the lateral margin of the phalangeal base and the lateral margin of the volar plate.[8,15] A collateral ligament (radial or ulnar) is separable into two layers, one superficial and one deep. It is eccentrically oriented such that its length changes depending on the relationship to the fixed joint axis.[13]

The ulnar and radial collateral ligaments play primary roles in stabilizing the MCP joint in all four modes of joint displacement: distal distraction, dorsopalmar dislocation, abduction-adduction rotations,

and supination-pronation rotations.[11,15] These ligaments are tauter in flexion than in extension due to the cam effect created by the non-spherical shape of the metacarpal head which is wider volarly than dorsally.[14] Given this fact and that the metacarpal head is narrower dorsally, this creates more laxity of the joint in the extended position and hence more vulnerability to radial/ulnar-stress forces.

Diagnosis

Patients with MCP collateral ligament tears present with a history of trauma, pain, swelling, and instability of the MCP joint.[1–4] The involved finger may overlap with adjacent fingers upon flexion[6] deviating towards the intact collateral ligament. Physical examination of the involved joint reveals point tenderness at the site of the torn ligament, joint swelling and instability.[1–4] A reliable testing technique for radial collateral ligament ruptures is to apply ulnar stress to the involved finger while the MCP joint is in flexion i.e. at maximum tension- complete tear of the ligament is characterized by joint instability leading to ability to excessively abduct the involved finger, sometimes with no fixed end point to abduction.[3,4,6,7] If the physical exam is limited due to pain, performing the exam under a local anesthetic blockade allows to physician to perform the exam with less distress to the patient.[4] Ligamentous tears and avulsions cannot be differentiated based on the physical exam alone.[4] On radiological examination, avulsion injuries may be obscured by the metacarpal heads, this is especially notable on AP films.[3,7] Some authors encourage the use of the Brewerton view in radiography in order to better visualize possible avulsions.[1,5,16] This view involves "the fingers lying flat on the x-ray plate, MP joints flexed to 65° and the beam angled from a point 15° to the ulnar side of the hand".[5] Arthrography is another modality to indirectly diagnose injuries to the joint capsule and collateral ligaments by demonstrating extravasation of the dye injected into the joint.[6,7] The most accurate modality for radiologic diagnosis is the MRI especially when using the high field strength magnets digital coils.[7] MRI allows visualization of a ligamental tear directly and assessment of any retractions of the torn pieces especially when combined with an MR arthrography.[7]

Material and methods

A literature search was carried out using Medline, Pubmed, Embase, and Scopus engines using the MeSH terms 'collateral ligament', 'metacarpophalangeal joint', 'finger injury' and '2nd to 5th digits' and a combination of these terms (period from 1950-2010). Both case series and case reports were selected.

Nearly 5000 articles were reviewed by the authors out of which 22 articles were found to provide relevant data about injury of the collateral ligaments of the MCP joint of fingers other than the thumb. Exclusion criteria included publications not in English and injuries to the thumb collateral ligaments. Data in 19 of these articles was used to perform a meta-analysis of the incidence, mechanism of injury, diagnosis, management, and outcome. The 3 unused studies were excluded due to the lack of individual data for the cases described that made them unsuitable for use in the statistical analysis.

The 19 articles used for this meta-analysis provided a total of 164 cases of metacarpophalangeal collateral ligament injuries in fingers other than the thumb. Data on each case was coded and entered using Microsoft Excel 2007 (Microsoft Corporation, Redmond, Washington).

These cases were analyzed for the patients' age, gender, the laterality of the injury, the finger involved, the type of management (conservative vs. surgical) and the outcome of the applied treatment with respect to stability of the joint, pain and range motion. Frequency distributions of characteristics of cases were derived. These were based on all cases that provided information on that characteristic, regardless whether data were lacking for other characteristics. Chi-square tests were used to examine associations of type of management of the injury with the outcomes of pain, stability of joints and range of motion. Fisher's Exact test was used when numbers were small. The level of significance was set at 0.05. Analysis was done with PASW Statistics 18 Release 18.0.0 (PASW Inc, Thousand Oaks, California).

Results

A total of 164 patients were analyzed from the 19 studies reviewed. For around 65% of the patients, data on age, gender and description of the site of the injury were not reported. The age of the patients ranged from 17 to 79 with a mean of 43.32years and with a higher proportion of patients being above 30years of age (Table 1). There were no differences in the gender of patients. The majority of the injuries were for the right hand (22.6%), the little finger (13.4%) and the index finger (10.4%). In 31.1% of patients the radial collateral ligament (RCL) was the injured site. Surgical intervention was the main reported type of management of cases (48.2%). There were 30.5% of patients who had a failed conservative management which was followed by a surgical intervention. Only 18.9% of patients were managed only conservatively. Buddy taping or strapping was the main type of conservative management (59.7%), followed by splinting (24.4%), 6.1% of patients treated conservatively were observed, and 9.7% received unspecified conservative treatment. Looking at the types of surgical interventions, the use of screws was the most commonly reported method (41.5%) followed by grafts (20.7%) and suture anchors (13.1%) (Table 1). The characteristics of patients who had a failed conservative management in terms of age, gender and site of injury are not different from the entire group of patients. Similarly this information is missing for the majority of cases. The main type of intervention for patients who had a failed conservative management was buddy taping or strapping (62%) followed by splinting (24%) (Table 2).

Table 1 Characteristics of the patients in the included series

Characteristics	N	%
Age (years)		
17-30	11	6.7
31-50	25	15.2
51-79	20	12.2
Unspecified	108	65.9
Mean = 43.32		
Gender		
Male	27	16.5
Female	23	14
Unspecified	114	69.5
Hand		
Right	37	22.6

Table Continued

Characteristics	N	%
Age (years)		
Left	21	12.8
Unspecified	106	64.6
Finger		
Index	17	10.4
Middle	9	5.5
Ring	9	5.5
Little	22	13.4
Unspecified	107	65.2
Side of the finger		
RCL	51	31.1
UCL	9	5.5
Unspecified	104	63.4
Management		
Conservative only	31	18.9
Surgical only	79	48.2
Conservative followed by surgical	50	30.5
No management	3	1.8
Unspecified	1	0.6
Type of conservative management (n=82)		
Splinting	20	24.4
Taping or strapping	49	59.7
Observation	5	6.1
Unspecified	8	9.7
Type of surgical management (n=130)		
Wires	13	10
Screws	54	41.5
Suture anchors	17	13.1
Sutures	15	11.5
Grafts	27	20.7
Arthrodesis	2	1.5
Pull-out suture	2	1.5

Surgical interventions are significantly more common for younger patients (below mean age of 43yrs) (p-value=0.010). No statistically significant change was found in the type of management of the injury in relation to the gender of the patient (Table 3).

Data on outcome variables is missing for 84 cases for pain, 62 cases for stability of joints and 60 cases for range of motion. Moreover, stability of joints is reported for only one patient in the group who were managed conservatively. To test the association of type of management with patient outcomes (Stability, pain and range of motion) only those with the outcomes reported were considered in the analysis.

Table 2 Characteristics of the patients with failed conservative management (n=50).

Characteristics	N	%
Age (years)		
17-30	0	0
31-50	4	8
51-79	6	12
Unspecified	40	80
Gender		
Male	5	10
Female	5	10
Unspecified	40	80
Hand		
Right	6	12
Left	4	8
Unspecified	40	80
Finger		
Index	3	6
Middle	3	6
Ring	1	2
Little	3	6
Unspecified	40	80
Side of the finger		
RCL	9	18.2
UCL	1	2
Unspecified	40	80
Type of conservative management		
Splinting	12	24
Taping or strapping	31	62
Unspecified	7	14

Table 4 shows that there are no statistical differences in patient outcomes of pain and range of motion by the type of management used for the injury.

When looking at the specific fingers involved and their management it was noted that all fingers were more likely to be treated surgically except the ring finger which was more likely to be treated conservatively. There was no difference among the different fingers as far as failing the conservative treatment is concerned (Table 5). A total of 14 index finger injuries were reported in the reviewed articles 6 (42.4 %) of which were managed conservatively. Half of the index finger injuries managed conservatively required surgery later on. For the long finger, 33.3% of the injuries reported were treated conservatively initially, however, they all required surgery later on and there were no reported successful conservative treatments for injuries in this digit. For the ring finger, only 33.3 % were treated surgically

initially. Of those treated conservatively only 11.1% required surgical treatment. For the fifth finger 54.5% of the 22 reported cases were treated initially in a conservative way. 13.6% of them required surgery later on (Table 5).

Table 3 Type of management, age and gender*

Characteristics	Type of management						p-value
	Conservative only		Surgical		Conservative followed by surgical		
n	%	n	%	n	%		
Age (years)							
<=43	10	35.7	17	60.7	1	3.6	0.01
>43	7	28	9	36	9	36	
Gender							
Male	9	36	11	44	5	20	0.967
Female	8	36.4	9	40.9	5	22.7	

*includes only patients for whom data are available.

Table 4 Type of management and outcomes of stability, range of motion and pain*

Outcomes	Type of management						p-value
	Conservative only		Surgical		Conservative followed by surgical		
	n	%	n	%	n	%	
Stable	1	1	57	56.4	43	42.6	0.514
Unstable	0	0	0	0	1	100	
Range of motion							
Full	12	12.9	54	58.1	27	29	0.855
Limited	1	9.1	6	54.5	4	36.4	
Pain							
No	10	14.1	26	36.6	35	49.3	0.979
Yes	1	16.7	2	33.3	3	50	

*includes only patients for whom data are available.

Table 5 Type of management with finger treated*

			Finger			
			Index	Middle	Ring	Small
Management	Conservative	Count	3	0	5	9
		% within management	17.6%	0.0%	29.4%	52.9%
		% within finger	21.4%	0,0%	55.6%	40.9%
		% of total	5.6%	0,0%	9.3%	16.7%
	Surgical	Count	8	6	3	10
		% within management	29.6%	22.2%	11.1%	37,0%
		% within finger	57.1%	66.7%	33.3%	45.5%
		% of total	14.8%	11.1%	5.6%	18.5%
	Failed Conservative	Count	3	3	1	3
		% within management	30.0%	30.0%	10.0%	30.0%
		% within finger	21.4%	33.30%	11.10%	13.60%
		% of total	5.6%	5.60%	1.90%	5.60%

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Table Continued

		Finger			
		Index	**Middle**	**Ring**	**Small**
Total	Count	14	9	9	22
	% within management	25.9%	16.7%	16.7%	40.7%
	% within finger	100%	100%	100%	100%
	% of total	25.9%	16.7%	16.7%	40.7%

*Indicates that information was reported only for 54 cases out of 164 cases (32.9%).

Discussion

Although the anatomical characteristics of the metacarpophalangeal joint and it's collateral ligaments are very well known, little is known about injury to those collateral ligaments[1] and their management[17] except for those of the thumb metacarpophallangeal joint. Our biggest challenge while collecting the data and performing our statistical analysis was the absence of descriptive data as far as patient's age, laterality of the injury, finger involved, mechanism of injury, outcome parameters (range of motion, pain, and stability). Nevertheless, important information can still be derived from the reported cases.

For example, the index and the little fingers were the most commonly affected digits probably because they are not as protected as the long and the ring fingers. This is in accordance with the literature where the index and little fingers are the most commonly involved.[1,10,18] The radial collateral ligament was also noted to be more affected in those cases that reported the laterality of the injury. In 1988, Ishizuki[6] reported on twenty one cases of MP joint collateral ligament injuries where only four of them occurred in ulnar collateral ligaments. According to Dennison[10] the UCL is more involved for the index finger, and the RCL is more involved in the little finger.

Among those whose age was reported, more than 80% of them were more than 30years old. Gaston et al.,[17] reported on 14 cases of collateral ligament injuries where all his patients were more than 36years of age.[17] All those who failed conservative treatment were more than 30years old. Again, in this group the radial collateral ligament was more involved. The type of conservative treatment did not differ between those who failed conservative treatment and those who did not.

When looking into the association of type of management with age, we noted that patients were significantly more likely to be younger in the surgical management group in contrast to those who failed conservative treatment who were more likely to be older. This was not shown when we analyzed the surgical management group including the failed conservative management (data not shown). This means that the association between older age and surgical treatment was likely to be secondary to those who failed conservative treatment and were thus treated surgically thereafter.

When comparing stability, range of motion and pain levels between those who were treated surgically versus those treated conservatively there was no difference between those two groups. However, those who failed conservative treatment and were surgically treated thereafter had more limited range of motion than those treated surgically or conservatively alone. This was also noted by Gaston et al. and is probably due to the delay in the definitive treatment of the injury.[17] The stability level in this group could not be assessed as only one patient was reported as unstable.

When looking at the specific fingers involved and their management it was noted that all fingers were more likely to be treated surgically except the ring finger which was more likely to be treated conservatively. There was no difference among the different fingers as far as failing the conservative treatment is concerned. It's worth noting that all reported cases for the third finger were treated either surgically initially or required surgery after a failed conservative treatment. Although the numbers are very small (total of nine cases for this finger), this figure stimulates further assessment of injuries to this finger before constructing a treatment plan in order not to delay the definitive treatment and end up with suboptimal range of motion.

The importance of this review is that it sheds light onto a subject very little is known about. It indicates that early diagnosis and treatment is important to prevent later complications. It also highlights the importance of suggesting protocols and standards for reporting these injuries to avoid gaps in information and to maximize data collection for future reviews to come up with more clinically applicable conclusions. The major limitation of this review is the large number of missing information especially about dominance, laterality and demographic characteristics of the patients.

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Conflict of interest

The author declares no conflict of interest.

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