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Routine use of ultrasound imaging to diagnose skier's thumb. Results from a first-aid orthopedic department in an Italian ski resort

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Summary

Damage to the ulnar collateral ligament (UCL) of the thumb's metacarpophalangeal joint (TMPJ) can result in severe functional impairment: correct diagnosis is critical to ensure the appropriate treatment to restore full TMPJ function. In an acute phase, clinical findings and X-rays alone are not reliable enough for a precise diagnosis: ultrasound scan (USS) may represent a fast, inexpensive and sensitive technique to improve the diagnosis of thumb trauma in emergency department. The purpose of this study is to assess if the introduction of the routine use of USS in clinical practice to evaluate thumb trauma could aid in diagnosis and treatment of this common injury. During eight winter seasons (2012-19), we dealt with 2553 injuries of the TMCJ at our emergency department. During the first period (2012-2015), the diagnosis of TMCJ injuries relied on clinical examination and X-rays; in the second study period (2016-2019) the diagnosis of all thumb traumas were based on clinical examination, radiographs, and ultrasound. Patients affected by type I and II lesions were conservatively treated by the application of a thumb spica plaster for three weeks, while in type III injuries for a period of one month. Type IV UCL lesions underwent surgery through a phalanx tunneling and anchor fixation technique followed by 5-weeks of immobilization in a thumb spica plaster cast. Both groups were followed up either clinically or as phone consultations for foreign patients. In the period 2012-2015, we classified 27% of TMPJ lesions as type I, 19% as type II, 15% as type III, and 27% as type IV lesions. The remaining 12% represented a fracture variant (type V). USS identified 30% type I, 21% type II, 18% type III, and 19% type IV lesions, the latter with a positive so called tadpole sign (14) (247 pts.); the remaining 12% of patients presented a fracture variant.

During the first study period, the diagnosis of TMPJ injuries made exclusively by clinical examination and X-ray studies, lead to a high number of false positive type IV diagnoses that were not confirmed during surgery (13%). The introduction of USS imaging during the second period led to a detection of almost all (> 98%) type IV lesions intra-operatively, thereby avoiding unnecessary surgery, possible complications, rehabilitation, and recovery. Our work demonstrates that the routine use of USS imaging in the study of thumb UCL injuries improves the diagnostic sensitivity of clinical findings in a low cost, quick and feasible manner. USS can lead to a significant decrease in the number of misdiagnoses as previously demonstrated by other studies. USS is likely to improve patient collaboration and could potentially supplant stress-test radiography which can be painful and potentially risky in some patients.

Key words: Stener lesion, thumb trauma, ski-related injury, ultrasound imaging

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Introduction

Trauma to the thumb's metacarpophalangeal joint (TMPJ) is relatively common [1] both during everyday life and sport activities – particularly in skiing – but its frequency is often underestimated in emergency departments [2]. The treatment of thumb sprains is often delayed and diagnosis incorrectly grouped with other injuries. Some authors classify the lesion according to the demographic of the trauma into acute, common in many contact and non-contact sports (eponymously known as Skier's thumb, ST) [3], or chronic injuries due to attenuation of the ligament under repeated stress (eponymously known as Gamekeeper's thumb, GK) [4,5]. Other authors simply describe the trauma as UCL lesion [6] or include it under the eponym of Stener Lesion (SL) [3,7]; the latter definition (SL) represents a detachment of the UCL from its phalanx insertion causing a tilt over the proximal adductor aponevrosis edge (Fig. 1) leading to destabilization of the metacarpophalangeal joint.

The incidence of UCL injury is 200,000/year worldwide with SL representing 14-88% of all cases [2,8].

The UCL, which consists of a main and an accessory component, stabilizes the TMPJ along with the help of the palmar plate and dorsal capsule [3,6,9]. This system interacts with dynamic structures of extrinsic and intrinsic thumb muscles and the adductor aponevrosis. The interaction between dynamic and static stabilizers of the joint is fundamental for the correct TMPJ functionality, which is essential in performing hand movements in everyday life.

The most common mechanism of injury is valgus stress to the TMPJ, leading to various grades of ligament damage which may affect thumb function. In the case of skiing accidents, the thumb is hyper-abducted at the MPJ by the ski pole which is fixed in the snow.

Figure 1. Stress test X-Rays shows a dislocation of the proximal phalanx at the Thumb's Metacarpophalangeal Joint (TMPJ).

Depending on the amount of external force applied, several different and progressively more severe clinical pictures and pathological presentations can occur [2,10].

Lesions can be classified as type I or sprain, type II or partial thickness tear, type III or full thickness tear, type IV or SL, and type V a combination of UCL lesion with fracture of the first phalanx of the ulnar base proximally dislocated.

While it is fairly straightforward to clinically diagnose the first two grades of lesions, it is more difficult to correctly detect a full thickness tear and a Stener lesion. Multiple reports [1,2,5,8,10-12] stress the importance of easy and reliable methods to study TMPJ injuries: ultrasound scan (USS) is among these.

The purpose of this study is to assess if the introduction of the routine use of USS in the clinical practice to evaluate thumb trauma could aid in the diagnosis and treatment of this common injury. The case series arise from our experience working on hand trauma in a public hospital located in the heart of one of the most popular ski resorts in Italy.

Case series

Our public hospital is located in the Dolomites (UNESCO – World Heritage Site) and attracts patients from one of the largest skiing areas in the Italian Alps. During the last eight winter seasons (2012-19) nearly 24 million skiers visited the almost 300 km of slopes. In the same period, 37,674 skiers were admitted to our emergency department. Considering TMCJ injuries constitute approximately 7.35% of winter sport injuries [11], we would expect approximately 2,770 TMCJ injuries over the eight years studied; in fact, we dealt with 2553 injuries of the TMCJ in the period of the study.

During the first four-year period (2012-2015), the diagnosis of TMCJ injuries relied on clinical examination and X-rays; in the second study period (2016-2019), the diagnosis of all thumb traumas was based on clinical examination, radiographs, and ultrasound.

Radiographs were taken as either plain X-rays or stress-test X-rays in extension and in flexion with or without local anesthesia [13,14].

In the period 2012-2015, we classified 27% of TMPJ lesions as type I, 19% as type II, 15% as type III, and 27% as type IV. The remaining 12% represented a fracture variant (type V).

We recommended surgical intervention for the 396 patients with type IV injuries and operated on 379. Intra-operatively, the diagnosis of SL was confirmed in a relatively high proportion of them (330 patients, 87%), which is in line with findings from the literature [2].

Because of the large number of patients affected by TMPJ injuries and the low correlation between clinical and surgical findings, a new collaboration between the orthopedic and radiology departments began in 2016 to investigate all thumb injuries with suspected ligament injury with the addition of USS. Pa-

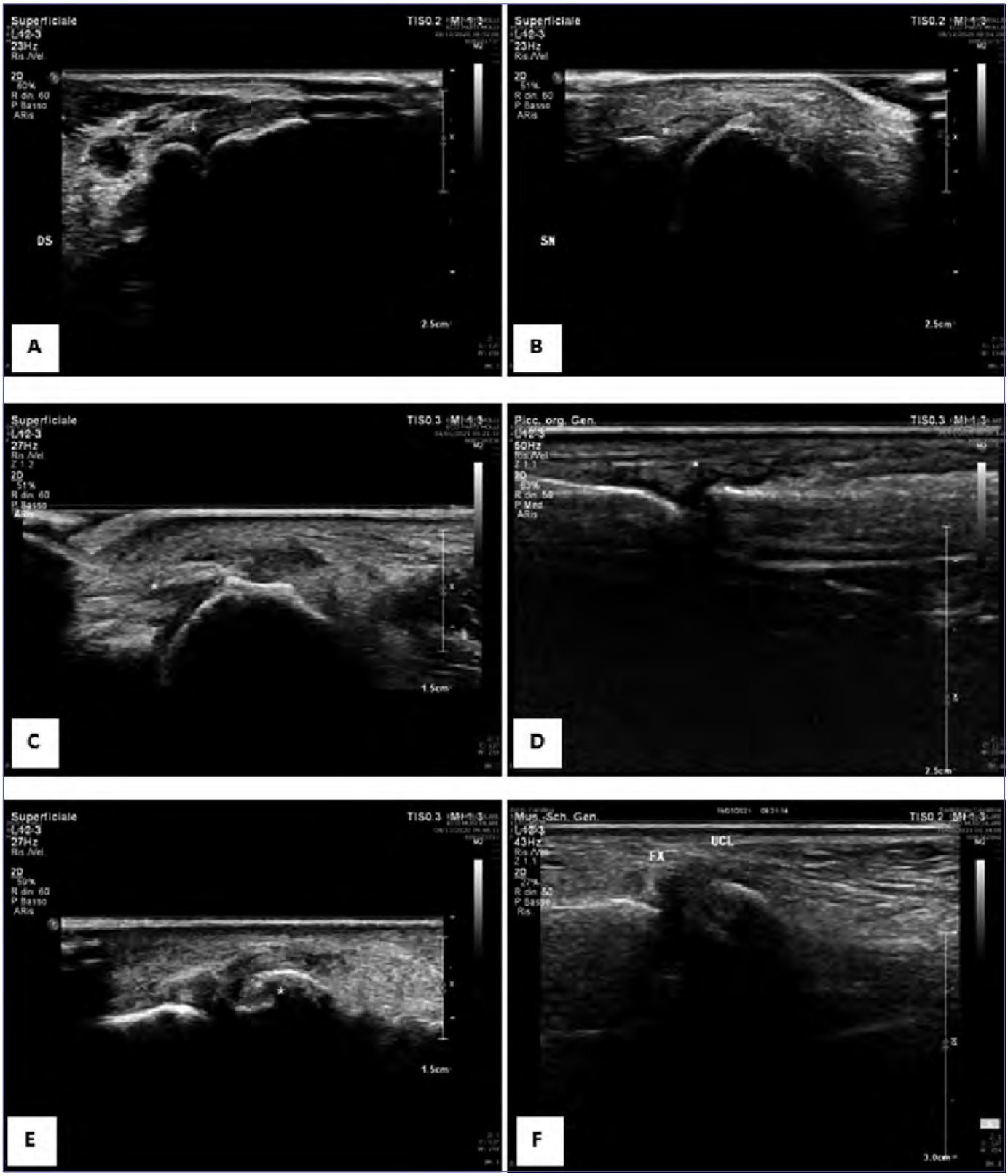

Figure 2. USS grading of thumb's UCL (ulnar collateral ligament) lesion: A) Grade 0 (Normal): the UCL (asterisk) is visible as a homogeneous and fibrillar structure; B) Grade I (Sprain): USS reveals a thickening and a hypoechogenity of the UCL (asterisk) with intact fibers; C) Grade II (Partial thickness tear): USS demonstrates a focal hypo/anechoic abnormality of the UCL that does not involve the entire ligament; D) Grade III (Complete non-displaced tear): UCL (asterisk) demonstrates an abnormality involving the entire ligament; E) Stener Lesion (complete displaced tear): USS demonstrates a lack of visualization of UCL with retraction of the ligament (asterisk) proximal to the MCPJ; F) Fracture variant: USS reveals a fracture of the ulnar side of base of the proximal phalanx (Fx) and an entire ligament (UCL).

Table I. The Table represents the percentage of patients belonging to the different grades of UCL lesion according to the USS classification in the two period of study. In the period 2016-2019, after the introduction of routine use of USS for the diagnosis of thumb trauma, there was a relative higher reduction in particular in patients classified as grade IV or Stener Lesion (SL). High sensitivity of USS led to an intra operative correlation of SL high as 98.7% thus leading to a lower number of surgical procedure in regard to the previous period (2012-2015), a more accurate indication for surgery and better results.

USS UCL lesion classification	Period of study 2012-2015	Period of study 2016-2019
Grade I	27%	30%
Grade II	19%	21%
Grade III	15%	18%
Grade IV (Stener Lesion)	27%	19%
Fracture variant	12%	12%

tients had clinical examination followed by a plain X-ray and then USS by an experienced investigator (V.P.) using a high frequency linear array machine (Phillips Affinity 70 G with a 3-10 Hz transducer) to better determine the TMPJ soft-tissue condition. Patients affected by an obvious fracture and a proximal dislocation of the ulnar base phalanx on X-ray (therefore requiring osteosynthesis surgery) were excluded from the USS study.

According to injury type, USS identified 30% type I, 21% type II, 18% type III, and 19% type IV lesions, the latter with a positive so-called tadpole sign [15] (247 patients); the remaining 12% of patients presented a fracture variant (Fig. 2). Results of the two different periods of study are summarized in Table I.

Type IV UCL lesions diagnosed both clinically and by US had 98.7% correlation with intraoperative findings (228 of 231 patients who underwent surgery among the original 247) (Fig. 3). A phalanx tunneling and anchor fixation technique (Fig. 4) followed by 5-weeks of immobilization in a thumb spica plaster cast was utilized in all patients.

Patients affected by type I and II lesions were conservatively treated by the application of a thumb spica plaster for three weeks, while in type III injuries for a period of one month. Both groups were followed up either clinically or as phone consultations for foreign patients.

During 2012-2015, the diagnosis of TMPJ injuries was made exclusively by clinical examination and X-ray studies, leading to a high number of false positive type IV diagnoses as confirmed during surgery (13%). The introduction of USS imaging during the study period 2016-2019 meant that almost all (> 98%) type IV lesions were detected, thereby avoiding unnecessary surgery, possible complications, rehabilitation, and recovery in this group of patients.

The main limitations of the present work are represented by its retrospective design, lack of statistical analysis of the data collected, and the dependence on the operator of the ultrasound examination.

Figure 3. Intra operative picture represents a confirmation of the case reported in Figure 2E: a rupture of the UCL of the thumb with an evident slippage of the torn end of the ulnar collateral ligament superficial to the adductor aponeurosis (Stener lesion).

Conclusions

Our work demonstrates that the routine use of USS in the study of thumb UCL injuries improves the diagnostic sensitivity of clinical findings in a low cost, quick, and feasible manner. USS improves the detection rate of TMPJ lesions and is therefore particularly useful in high volume hospitals with large numbers of trauma patients. USS can lead to a significant decrease in the number of misdiagnoses as previously demonstrated by other studies [2,8,10,16-18]. USS is likely to improve patient collaboration and could potentially supplant stress-test radiography which can be painful and potentially risky in some patients. We strongly recommend USS as a routine diagnostic tool in the emergency department setting for diagnosis of thumb injuries from winter sports.

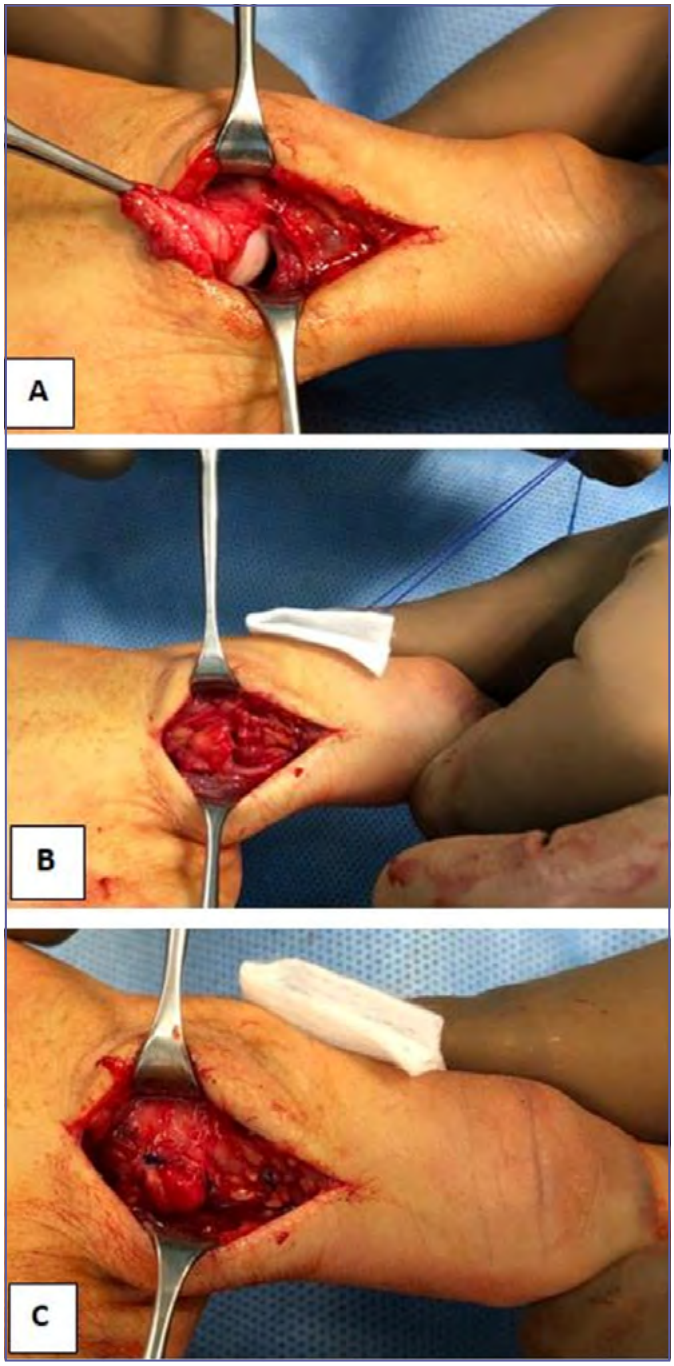

Figure 4. Exposure of the thumb's Metacarpophalangeal Joint (TMPJ) after the incision of the adductor aponeurosis (A). Trans osseous tensioning of the UCL before (B) and after (C) the suture of the aponeurosis.

Conflict of interest statement

The Authors declare no conflict of interest.

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Authors' contribution

MM, PG: contributed to the design and implementation of the research, to the analysis of the results and to the writing of the manuscript; BC, MP: performed the analysis of the data; VP: performed all the ultrasound studies.

Ethical consideration

No ethical approval was obtained because this study did not involve a prospective evaluation and only involved non-invasive procedures.

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