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ORIGINAL ARTICLE

A useful surgical landmark for the trapezio-scaphoid joint

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ABSTRACT

Aim Unintended scaphoid excision is a rare but serious complication that can occur during surgical procedures involving the trapezium, including but not limited to trapeziectomy. Although prosthetic replacement is increasingly favoured in the treatment of rhizarthrosis, trapeziectomy (with or without ligamentoplasty) remains a widely used and effective option. To reduce the risk of inadvertently removing the scaphoid, we rely on the anatomical intersection between the radial artery branch and the first dorsal compartment tendons as a landmark for identifying the scapho-trapezial joint.

Methods In our institution, Policlinico Universitario A. Gemelli IRCSS, we have been using a simple landmark to identify scapho-trapezial joint to teach residents: during surgery, after isolating the radial artery, a 16G needle is inserted at the intersection of the extensor tendons and the radial artery branch, followed by fluoroscopy to confirm needle placement in the scapho-trapezial joint. Patients were classified according to Eaton-Littler classification and the accuracy of the landmark was then assessed among groups.

Results So far we used the landmark on 212 patients. The distribution by Eaton-Littler stage was: 11 stage 1, 63 stage 2, 79 stage 3, and 33 stage 4. The reference point was accurate in 178 cases. No significant differences were found by sex or between stages 1, 2 and 3. However, accuracy in stage 4 was significantly lower ($p<0.00001$).

Conclusion Our results confirm reliability of this reference point, particularly in stages 1–3. While useful in stage 4, additional caution is required due to slightly reduced precision.

Keywords: C05 musculoskeletal diseases, E01 diagnosis, E04 surgical procedures

INTRODUCTION

Rizharthrosis, or thumb basal joint arthritis, is a pathology that involves the thumb's base joint (carpometacarpal joint; CMC joint). Rhizartrhrosis usually advances over time as the joint cartilage begins to degenerate, although some cases may stem from previous injuries or inflammatory processes (1).

The thumb basal joint is the second most frequent location of osteoarthritis (OA) in the hand after the distal interphalangeal (IP) joint of the forefinger with radiographic manifestation in almost 40% of females by age 80 (2). The female sex is a consistent risk factor for thumb CMC OA as it the likely outcome of increased ligamentous laxity (3-4). Other contributing factors are genetic, environmental, and preexisting comorbid conditions (5).

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Alterations in the clinical presentation may occur in varying degrees of severity as the disease is not always clinically evident (6). Symptoms increase in severity with activities demanding a pinching or gripping action like signing, fetching, or jar opening (7-8). Examination of the thumb shows first metacarpal adduction with accompanying metacarpophalangeal (MCP) hyperextension compensatory deformity (9).

The CMC grind test is mostly the one test performed to confirm the diagnosis (10).The diagnosis of rhizarthrosis relies mainly on clinical assessment combined with the patient's history, and, in some cases, X-rays are needed. Characterization is usually done by standard radiographs including postero-anterior (PA) view, lateral, and oblique views of the hand and wrist. CT scans are not in daily based diagnosis but can be useful for challenging pre-operative planning situations (12). Several classifications exist for describing arthritis of the thumb's basal joint using X-ray, with the most popular being Eaton-Littler's (12).

Treatment options for rhizarthrosis aim to alleviate pain, improve function, and slow down the progression of joint damage. Conservative treatments may include activity modification, splinting, pain medications and corticosteroid injections

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to reduce inflammation (13). Occupational therapy can also be beneficial for strengthening the surrounding muscles and improving thumb mobility (14).

In cases where conservative measures are ineffective, surgical intervention may be considered. Surgical options for rhizarthrosis include trapezial excision with or without ligament reconstruction, arthroplasty (joint replacement), arthroscopy, or arthrodesis (joint fusion), depending on the severity of the condition and the patient's individual needs (15).

The main procedure performed at our centre is trapeziectomy with tendon interposition. The main aim of the ligament reconstruction and tendon interposition (LRTI) is the reconstruction of anterior oblique ligament by using half of flexor carpi radialis tendon or abductor pollicis longus tendon. The key points of this surgery are the identification and protection of radial artery and the correct excision of the trapezium. In case of severe alternation of normal anatomy the joint line might not be clearly recognizable (16).

For patients undergoing surgery, complications such as infections, nerve or tendon injury, stiffness, joint instability, and reduced strength are well-recognized (17). However, among these, one particularly serious and underreported complication that deeply concerns especially young surgeons during their initial procedures is the incorrect removal of the scaphoid instead of the trapezium (18). This mistake can lead to severe functional impairment, prolonged disability, and complex revision surgeries (19).

Given the catastrophic consequences of scaphoid excision, the identification of a reliable and reproducible anatomical landmark to accurately locate the scapho-trapezial space is essential. According to Caggiano et al. (18), a clear intraoperative reference can drastically reduce this risk. In our experience, the intersection between the first extensor compartment tendons, abductor pollicis longus (APL) and extensor pollicis brevis (EPB) and the branch of the radial artery corresponding to the scapho-trapezial joint provides a highly dependable landmark. This landmark plays a critical role in guiding the surgeon, especially when progressive rhizarthrosis leads to distorted anatomy, altered bony landmarks, and extensive osteophyte formation, which can otherwise make the joint line difficult to discern (16).

By using this vascular-tendinous intersection as a reference point, surgeons can enhance the precision of trapeziectomy, avoid the devastating error of scaphoid removal, and ultimately improve surgical safety and patient outcome, as this reference is highly patient-specific beyond any geographic and environmental influence (18-19).To the best of our knowledge, there are no articles in the literature that describe a landmark meeting these requirements. The aim of this study is to define and validate a reproducible vascular–tendinous intraoperative landmark for precise identification of the scaphotrapezial (ST) joint during trapeziectomy for thumb CMC osteoarthritis, and to evaluate its reliability, accuracy, and safety in patients with basal thumb arthritis.

PATIENTS AND METHODS

Patient and study design

The landmark has been used in our institution, Policlinico Gemelli, Rome, Italy as teaching support for residents for about 3 years. Surgeries were performed on patients recruited from the hand surgery outpatient clinic on the Policlinico Gemelli Campus from 1 April 2021 to 1 April 2024.

Patients were considered eligible for landmark evaluation in case of: radiographic diagnosis of rhizarthrosis in any stage and indication to surgical treatment by trapeziectomy with or without tenoplasty. Patients younger than 45, with anatomical variations (such as trapezium dysplasia, presence of superficial dorsal branch of the radial artery, abductor pollicis longus insertion over the trapezium), history of previous hand surgeries as previous first metacarpal fractures or De Quervain syndrome surgery, vascular or nerve disorders (e.g. peripheral microvascular impairment and polyneuropathy), and history of treatment with injection therapy were not tested for the landmark.

The study complies with national ethical standards and the Declaration of Helsinki. According to institutional protocols, each patient was given informed consent for surgery and for the collection of clinical data for scientific purposes at admission and before the surgery.

Methods

The evaluation process begins with taking a thorough patient history, followed by a physical exam. Standard imaging is then performed using X-rays in both anteroposterior (AP) and lateral views, with particular focus on the trapeziometacarpal joint to check for signs of arthritis or degenerative changes. When indicated, additional X-rays of the base of the thumb are taken to get a clearer picture of joint alignment, especially in cases involving subluxation or the presence of osteophytes.

Surgeries were performed under locoregional anaesthesia with a tourniquet applied to the proximal upper arm. The classic surgical approach for performing trapeziectomy was used, with a longitudinal incision of approximately 4 cm at the base of the thumb. During the surgical approach for trapeziectomy, once the radial artery was freed, all patients had a 16G needle inserted into the capsule at the intersection between the extensor tendons of the first compartment and the branch of the radial artery (Figure 1).

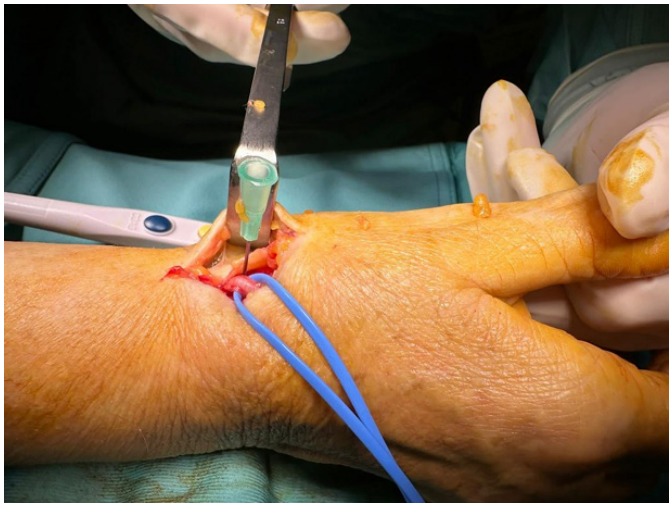

Figure 1. Image showing a 16G needle inserted at the intersection between the extensor tendons of the first compartment and the deep branch of the radial artery (property of Camillo Fulchignoni, 2024)

A fluoroscopic image (in Kapandji projections – antero-posterior and lateral) was taken to confirm that the needle was correctly placed in the scapho-trapezial joint (Figure 2).

Selected patients were divided into 4 groups according to Eaton-Littler classification, as described in Table 1 (12).

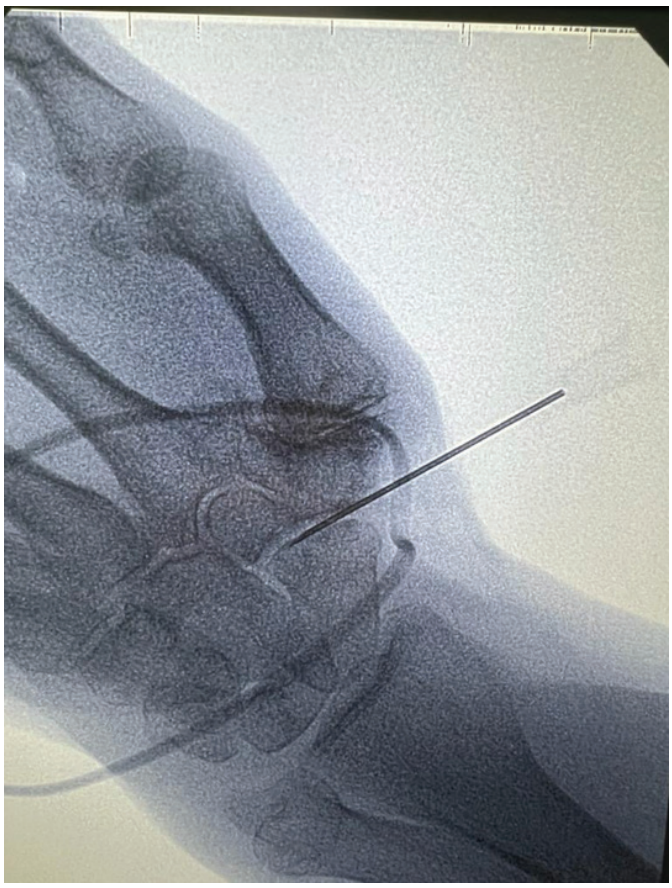

Figure 2. Fluoroscopy image showing the needle placed in the scapho-trapezial joint (property of Camillo Fulchignoni, 2024)

Table 1. Eaton-Littler classification

Eaton Littler's Grade	Definition
Grade I	Normal or slightly widened joint space (synovitis/ laxity), no osteophytes, minimal/no subluxation (<⅓ of the metacarpal base
Grade II	Mild joint-space narrowing, early subchondral sclerosis/cysts, osteophytes <2 mm, subluxation still <⅓
Grade III	Marked narrowing of the CMC joint, prominent sclerosis/cysts, osteophytes >2 mm, and subluxation >⅓ of the metacarpal base
Grade IV	Criteria of Stage III plus degenerative changes of the scaphotrapeziotrapezoid (STT) joint (pan-trapezial involvement)

Statistical analysis

The reliability of the landmark was presented as raw numbers and corresponding percentages to provide a clear overview of its consistency across observations. To evaluate the significance of changes in the distribution of bounded scores among the different groups (or stages), a two-sided $\chi 2$ test was employed, with the significance threshold set at $\alpha=0.05$. Categorical data are reported as n (%) with 95% confidence intervals (CI) for proportions (Wilson).This statistical approach was chosen due to its suitability for categorical data and its ability to detect differences in frequency distributions between independent groups. All statistical analyses, including the calculation of observed and expected frequencies, as well as p-values, were performed using Microsoft Excel 2003, which allowed for the organization, tabulation, and comparison of data in a structured format.

RESULTS

In the selected period of time, surgery was performed on 212 patients, of which 186 were tested for the landmark (Figure 3). A total of 127 patients were female (59.9%) and 59 (40.1%) male; the average age was 67.

Patients were allocated to groups according to the Eaton–Littler stage (12) determined on pre-operative radiographs. Two trained hand surgeons independently graded the images blinded to intraoperative findings and outcomes; disagreements were resolved by consensus. At the moment of selection, 11 patients presented with grade 1 tapezio-metacarpal (TM) arthrosis (six-females and five males). In all cases (100%) the intersection between the first extensor channel and the deep branch of the radial artery corresponded to the scaphotrapezial joint. The same rate was recorded for 63 patients in grade 2 (45 females and 18 males). Our landmark came up less accurately in patients belonging to grande III and IV (98.7% and 78.8%). Gender and age were not significantly associated with landmark accuracy or with disease grades I, II, and III. A significant difference between the accuracy of the landmark in the first three grades and grade IV was found ($p<0.00001$)

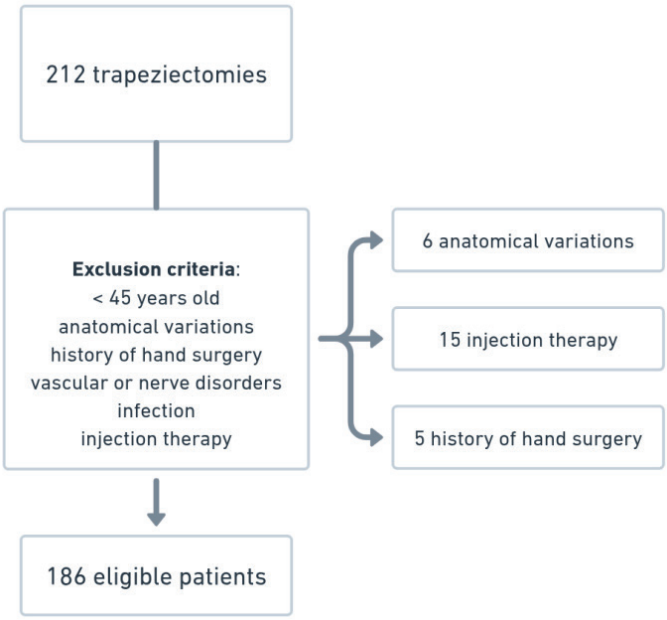

Figure 3. Flowchart showing patients selection

Table 2. demographic data and landmark accuracy

Eaton Littler's Grade	No (%) of patients	Female	Male	Accuracy (%) (CI)
Grade I	11 (5.91%)	6 (54.54%)	5 (45.45%)	100 (74.1 – 100)
Grade II	63 (33.87%)	45 (71.42%)	18 (28.57%)	100 (94.3-100)
Grade III	79 (42.47%)	56 (70.88%)	23 (29.11%)	98.7 (93.2-99.8)
Grade IV	33 (17.74%)	20 (60.60%)	13 (39.39%)	78.8 (62.2-89.3)

* Percentages by gender are calculated relative to each group's sample size (group n), not the overall cohort – CI = confidence interval

DISCUSSION

Trapeziectomy is the most performed surgery for arthritis of the trapeziometacarpal joint, both alone or followed by a suspension arthroplasty. Trapeziectomy has traditionally been the operation of choice after conservative failure, first performed in 1948 (19), and has since been modified to prevent excessive thumb shortening (20). The main complications of this technique are lesions of the dorsal branch of the radial nerve and lesions to the deep branch of the radial artery (21). The first step of this procedure is to identify these structures and protect them throughout the whole surgery. Despite appearing to be an easy and standardized procedure for expert surgeons, young surgeons and trainees might find it hard to identify the articular space, especially in cases of severe arthritis and dysplasia of the trapezium. According to Caggiano et al. (19), taking out the wrong bone in hand surgery is not so uncommon. The most commonly incorrectly excised bone is the scaphoid, with the most common reasons being inadequate visualization or inadequate localization (18-19). Our landmark could effectively solve part of this problem as it presents an easy and reproducible way to localize the articular line between scaphoid and trapezium.

From an educational standpoint, especially for junior surgeons, a consistent land-mark simplifies the process of learning trapeziectomy and builds confidence. However, it is also critical to acknowledge that anatomical landmarks can be influenced by individual variations, such as a bifurcation of the radial artery or an atypical split in the abductor pollicis longus tendon (22-23). In rare scenarios where the artery or tendon distribution is aberrant, relying solely on this landmark might lead to inaccuracies, underscoring the importance of always corroborating with visual inspection and imaging (24).

Our results confirm its reliability with an overall 95.7% accuracy that reaches 100% in grades I and II and 98.7% in grade III. These data lead us to affirm that the crossing of the first extensor channel and the deep branch of the radial artery is a true landmark for the articular space between scaphoid and trapezium. The lowest accuracy rate of 78.8% was recorded in grade IV patients, probably due to the severe dysplasia and degeneration of the trapezium, which alters the normal anatomy of the thumb. Moreover, the subluxation of the joint, the severe narrowing of the articular space, and the presence of sclerosis also at the scaphoid-trapezium joint constitute more elements disrupting the normal anatomy (11).

Despite some known anatomical landmarks that present differences between females and males (25), our landmark does not rely on gender or age.

To our knowledge, no other landmark has been described in this regard. The only study we found related to thumb anatomy discusses the anatomical course of the deep branch of the radial artery to identify and protect it during the procedure (26). Although the mean distance between the radial artery and the scaphoid-trapezium joint line is useful for predicting the artery's location and avoiding iatrogenic injury, it provides limited assistance in identifying the joint space. Another point in favour of our study is that it was conducted *in vivo*, while the study of Yildirim et al. (27) was entirely on cadavers.

An interesting observation was that, in the few cases requiring multiple needle placements, osteophytes around the trapezium were notably large or the joint surface was extensively degenerated. In such instances, small changes in needle angle improved landmark accuracy. Beyond the primary outcome of correct needle placement, we noted minimal differences in operative time among the different disease stages, though slightly longer surgeries were required in advanced cases due to the challenges posed by more deformed anatomy. No instances of inadvertent scaphoid removal were documented in this cohort, suggesting that integrating this reference point into the surgical workflow may enhance overall safety. A key contribution of our study is that the landmark we validate is patient-specific: it relies on the radial artery within the APL–EPB interval as it crosses the scaphotrapezial level—anatomical structures identified in vivo for each individual. Unlike protocol- or resource-dependent approaches (e.g., routine fluoroscopy or centre-specific navigation aids), this strategy does not depend on location, surgeon training pathway, or equipment and, by design, does not rely on patient sex, ethnicity, or age. In practical terms, a patient-specific landmark can standardize a critical step—localizing the joint line—across diverse settings, thereby reducing the scope for geography-driven or ethnicity-linked variability in technical accuracy.

In our cohort, landmark accuracy was consistently high across disease stages I–III and only declined in stage IV, where extreme deformity can obscure any bony cue; this pattern supports the notion that biologic, patient-level anatomy rather than external context primarily governs success. While broader treatment outcomes may still be influenced by access, rehabilitation, and social determinants, the intraoperative risk we target—wrong-bone excision—can be materially reduced by a patient-specific technique that is reproducible regardless of where or in whom the surgery is performed.

The principal limitations of our study include the relatively small proportion of stage IV cases, as well as the overall distribution of patients across the four Eaton-Littler grades. Additionally, our patient cohort was derived from a single institution, which might impact the generalizability of our findings. Future multicentre research involving a larger number of high-grade rhizarthrosis cases could provide a more robust validation of the landmark's accuracy. Similarly, the potential influence of anatomical variations or concurrent pathologies, such as longstanding rheumatoid arthritis, on this landmark remains an area ripe for further inquiry. Investigations combining ultrasound imaging or three-dimensional intraoperative navigation could also shed more light on the interplay between soft tissues and bony landmarks in advanced osteoarthritic conditions.

In conclusion, the intersection of the first extensor compartment tendons and the deep branch of the radial artery is a reliable intraoperative landmark for identifying the scapho-trapezial joint, particularly in early to moderate rhizarthrosis. Our results show high accuracy of the patient-specific landmark across disease stages I–III (and a measurable drop in stage IV). This supports a stage-aware operating protocol that standardizes joint-line identification while acknowledging when escalation is prudent: if the landmark is uncertain or distorted (osteophytes, gross subluxation), pause and corroborate with fluoroscopy (or ultrasound, if available). To collect further data and try to make the landmark reliable in more advanced stages, operating room feedbacks could be taken into account: (a) landmark identification rate, (b) time-to-exposure, (c) reliance on intraoperative imaging, (d) arterial/tendon injuries, (e) rate of wrong-bone excision (goal: 0 per 1,000 cases). A simple, patient-specific landmark combined with a stage-aware safety algorithm provides an immediate, scalable method to reduce technical disparities—independent of geogra-

phy, equipment, or patient ethnicity. Policy support (guidelines, training, reporting, rehab access) can amplify this effect, converting a procedural insight into the system-level improvement.

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No specific funding was received for this study.

TRANSPARENCY DECLARATION

Competing interests: None to declare

Abbreviations

The following abbreviations are used in this manuscript:

CMC	Carpometacarpal
OA	Osteoarthritis
IP	Interphalangeal
MCP	Metacarpophalangeal
PA	Postero-anterior

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