

## Current trends in the management of trapeziometacarpal arthritis

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### Abstract

The purpose of this update is to report on a variety of topics related to trapeziometacarpal arthritis that have been recently investigated. The keyword *trapeziometacarpal arthritis* was utilized to query the PubMed database of the U.S. National Library of Medicine. From the resulting list, papers published from the beginning of April 2014 through the beginning of April 2017 were reviewed. The forty-five studies identified are reviewed here and referenced.

### Introduction

The first carpometacarpal (trapeziometacarpal) joint of the thumb is crucial for hand dexterity and strength and is a frequent site of osteoarthritis in the elderly and in postmenopausal women, leading to severe disability and pain.<sup>1</sup> In the case that nonsurgical management fails, surgical treatment options, including arthroscopy, osteotomy, and arthroplasty should be considered.<sup>1</sup> A review of these surgical modalities by Hentz *et al.* found that the 60-year-old procedure of simple trapezoid resection remains the most common surgical procedure for trapeziometacarpal (TMC) joint arthritis, while newer soft tissue and prosthetic arthroplasty methods have not shown any conclusive superiority in terms of pain reduction or increased function.<sup>2</sup> This is in sharp contrast with surgical treatments for other arthritic joints, which have largely evolved from resection arthroplasty to implant arthroplasty.<sup>2</sup>

A randomized control trial by Vermulen *et al.* compared trapeziectomy with ligament reconstruction and tendon interposition (LRTI) versus arthrodesis with plates and screws in 43 female patients with stage II-III TMC arthritis, and found significantly more moderate and severe complications following arthrodesis, leading to an increase in revision surgery.<sup>3</sup> Although function and disability scores were similar in both groups, patient satisfaction was significantly lower in the arthrodesis group, and the

authors continued to recommend trapeziectomy with LRTI as the gold standard for surgical treatment.<sup>3</sup> A summary of TMC arthritis treatment by Igoe *et al.* also supports trapezium removal with LRTI as the standard of care, and although some argue that LRTI is unnecessary, the authors defend the procedure, citing that it does not increase morbidity and yields a more natural-looking thumb.

### Pathophysiology of trapeziometacarpal joint arthritis

A study of degenerative changes in the TMC joint seen by radiography identifies narrowing of the joint space on the lateral side of the joint, thinning of cartilage, and increased density of subchondral bone as common radiographic signs.<sup>4</sup> Bony changes, such as the finding of osteophytes on the trapezoid side of the joint, indicate an advanced case of TMC arthritis and are likely to cause mechanical issues and reduced function.<sup>4</sup> An anatomical study of 36 TMC joints from 18 fresh cadavers by Maes-Clavier *et al.* compared ligamentous attachments and articular surfaces for stage I-III (absent to moderate osteoarthritis) with stage IV (severe osteoarthritis), and similarly reported that the primary difference was the finding of palmar osteophytes in all cases of stage IV TMC arthritis.<sup>5</sup> The authors also identified the dorsal ligament complex, including the dorsoradial ligament and posterior oblique ligament, as the most important for stabilizing thumb opposition and preventing metacarpal subluxation, while the anterior oblique ligament was found to be less important for TMC stability.<sup>5</sup>

A review of ligament reconstruction procedures for TMC arthritis by Lin *et al.* also found the dorsoradial ligament to be the most important stabilizer of the TMC joint, and thus recommended that additional stabilization of the dorsoradial ligament would help improve grip strength, relieve pain, and strengthen the dorsal ligament complex.

Clifton *et al.* conducted a histologic study examining the potential role of relaxin, a peptide hormone which loosens ligaments before childbirth, in ligament attenuation in TMC arthritis.<sup>6</sup> The authors found positive relaxin receptor immunostaining in the dorsoradial ligament for 8 out of 15 patients undergoing surgery for TMC arthritis, as well as positive relaxin receptor staining in the synovium for 14 of the 15 patients. Chondrocytes in TMC cartilage also exhibited receptor staining, and more intense

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staining was seen in women with more severe arthritis, suggesting that the TMC joint is a potential target for relaxin, and that circulating relaxin may negatively impact joint stability.<sup>6</sup>

### Detection and diagnosis of trapeziometacarpal arthritis

Gelberman *et al.* reported that metacarpal adduction and extension tests are more sensitive than the standard grind test for detection of TMC arthritis prior to obtaining radiographic imaging.<sup>7</sup> Oheb *et al.* recommend obtaining a combination of both lateral and Robert-hyperpronation X-ray views to enhance assessment of radiographic disease severity.<sup>8</sup> Several different methods exist for the radiographic staging of TMC arthritis, and Ladd *et al.* compared the Eaton, modified Eaton, and thumb osteoarthritis (ThOA) index staging classification methods in thumb radiographs from 60 adults patients with asymptomatic to advanced disease.<sup>9</sup> They found that while all three methods yielded highly reproducible results, the ThOA index had the highest correlation with disease severity, and therefore suggested the ThOA index as a feasible alternative to Eaton staging.<sup>9</sup>

Berger *et al.* further investigated the intra- and interobserver reliability of the Eaton classification system, which is currently most widely used for TMC arthritis staging.<sup>10</sup> The authors performed a systematic review of 4 studies spanning 163 patients, and found that the Eaton classification exhibits fair to moderate intraobserver reliability and poor to fair interobserver

reliability, suggesting the need to adopt a more reliable system for classifying disease severity.<sup>10</sup>

Tools are also needed to monitor outcomes after surgical treatment, and Tandara *et al.* studied the use of EBRA™ (Ein-Bild-Röntgen-Analyse) software for the detection of TMC prosthetic implant failure.<sup>11</sup> The authors applied the EBRA software to radiographs of 76 patients with a total of 102 prostheses with an average follow-up of 14.5 months after surgery, and found that the software showed significantly different cup migration for loose and stable implants over time, and thus could serve as a reliable tool for predicting implant failure.<sup>11</sup>

### Non-surgical and minimally invasive techniques

More conservative treatment options, including NSAIDs or splinting, are often considered before surgical intervention for carpometacarpal osteoarthritis.<sup>1</sup> Options for splinting include neoprene and thermoplast hand-based thumb spica splints, although factors such as disability, pain, and satisfaction comparing different splinting options are not well-established.<sup>12</sup>

The difficulty of monitoring patients wearing splints, poor adherence to strict schedules for splint usage, and a higher drop-out rate compared to surgical treatments contribute to the lack of definitive information about the most effective splinting methods.<sup>13</sup> One example of a minimally-invasive technique is trapeziometacarpal arthroscopy, which can help visualize the joint under high-power magnification while minimizing disruption of ligament complexes.<sup>14</sup>

A review by Slutsky concluded that careful wound spread technique, fluoroscopy, and cadaver training are important for successfully arthroscopy, but it is unclear whether arthroscopy as an adjunctive technique for resection arthroplasty provides better outcomes compared to more standard open techniques.<sup>14</sup>

Finally, Frizziero *et al.* describe a minimally invasive technique involving intra-articular hyaluronic acid injections to treat pain and disability caused by carpometacarpal arthritis.<sup>15</sup> The authors reported that the injections led to a significant reduction in pain, stiffness, and intake of NSAIDs over a 6-month period, with adverse events limited to local pain during or after injections.<sup>15</sup> Loibl *et al.* also report that platelet-rich plasma (PRP) injections significantly improved VAS pain and Mayo Wrist scores in a case series of 10 patients.<sup>16</sup>

Overall, these minimally invasive injections are recommended primarily for early-stage TMC arthritis based on reported improvements in pain and function and low rates of adverse events, but their efficacy and long-term benefits in placebo-controlled trials have not yet been demonstrated.<sup>17</sup>

### Further considerations for trapeziectomy with ligament reconstruction and tendon interposition

Although trapeziectomy with LRTI is considered to be the standard for surgical care of TMC arthritis, Kirchberger *et al.* sought to compare physical outcomes in 44 women who underwent the procedure with 107 healthy age-matched controls without arthritis.<sup>18</sup> They found that while trapeziectomy with LRTI resulted in similar grip strength as controls, the surgical procedure led to a significant loss in pinch strength and significantly higher disability (DASH) scores, suggesting that even the gold standard of care may require discussion about expected reduction in pinch strength and physical functionality.<sup>18</sup>

Salem *et al.* investigated the potential for late-onset failure in 25 cases of simple trapeziectomy and 29 cases of trapeziectomy with LRTI.<sup>19</sup> The authors reported degenerative changes in 7 out of 25 cases of simple trapeziectomy and only 1 out of 29 cases of trapeziectomy with LRTI, and found that the presence of degenerative change did not adversely affect functional outcomes as measured by disability scores or pinch strength.<sup>19</sup> Thus, they suggested that although simple excision of the trapezium led to an increase in degenerative changes, these did not influence clinical outcomes, and thus both trapeziectomy alone and trapeziectomy with LRTI could be considered to have a good chance of long-term success.

Moneim *et al.* proposed an alternative to trapeziectomy with LRTI, which consists of partial trapezium resection with local capsular interposition arthroplasty.<sup>20</sup> Although the authors only present one successful case study which resulted in a stable thumb basal joint without any postoperative complications, the procedure may provide benefits by utilizing local capsular tissue as an interposition without requiring ligament reconstruction, thus eliminating the need and morbidity associated with tendon harvesting.<sup>20</sup> Spaans *et al.* studied a larger cohort of 22 thumbs treated with this partial trapeziectomy method and found good-to-excellent patient-reported outcomes in

15/22 patients at long-term follow-up (mean of 70.2 months).<sup>21</sup>

Another recently studied modification of trapeziectomy with LRTI involves the use of the entire width of the flexor carpi radialis (FCR), in contrast with the original Burton-Pellegrini technique suggesting the use of half the thickness of the FCR.<sup>22</sup> Marengi *et al.* and Werthel *et al.* propose that this approach could improve long-term stability and treat dorsal subluxation; they reported significant improvements in pain, stability, and range of motion with this modified technique, although studies comparing use of half versus full thickness FCR have not yet been conducted.<sup>22,23</sup>

It should also be noted that LRTI has been shown to be an effective salvage procedure for management of complications of TMC joint replacement, including instability and loosening.<sup>24</sup> Finally, Sadhu *et al.* conducted a case-controlled study comparing outcomes following primary LRTI versus revision LRTI. They reported worsened outcomes for revision patients, including more functional impairment, greater pain, and less improvement after surgery, and recommended that patients considering revision LRTI be advised that improvement of symptoms can be unpredictable compared to primary LRTI.<sup>25</sup>

### Osteotomy, arthrodesis, and fusion techniques

Thumb metacarpal extension osteotomy is an effective biomechanical alternative to ligament reconstruction, and Chou *et al.* followed 13 patients over a long-term period of 10 years following their metacarpal extension osteotomy procedures.<sup>26</sup> The authors found high satisfaction rates and low pain levels, as well as similar pinch strength and thumb radial abduction compared to nonoperative thumbs, and thus recommended metacarpal extension osteotomy as a reasonable alternative to ligament reconstruction.<sup>26</sup>

For patients with high physical demands, arthrodesis (or fusion) can provide another alternative to better stabilize the thumb, and Vanderzanden *et al.* examined clinical outcomes in 17 patients who underwent metacarpophalangeal (MCP) arthrodesis with a fixed intermedullary compression device.<sup>27</sup> All 17 patients exhibited clinical and radiographic signs of fusion at an average of 8 weeks after surgery, and there were no infections, complications, or need for hardware removal, suggesting that the technique can promote rapid union and provide joint stability without requiring long-term

immobilization.<sup>27</sup> Interestingly, Hattori *et al.* found that arthrodesis was equally effective for improving DASH scores and grip strength in an elderly cohort (>65) and a younger cohort (<55), with the exception of improved pinch strength in younger patients.<sup>28</sup>

Fontaine *et al.* further studied the use of arthrodesis with an iliac crest graft and fixation with intermedullary pins in 6 patients with mutilans rheumatoid arthritis and major wrist destruction, and found restoration of carpal height, improvement in hand function, and complete fusion in 5 of 6 cases with no major complications.<sup>29</sup>

Harston *et al.* investigated a new method involving TMC arthrodesis with V-shaped osteotomy at the base of the first metacarpal to provide a more stable fusion site in a 2-year follow-up of 21 patients.<sup>30</sup> The authors reported similar range of motion and strength between operated and non-operated thumbs, an 83% complete fusion rate, and a significant improvement in disability scores with no infections or reoperations, suggesting that the procedure is successful, reproducible, and restores strength and function.<sup>30</sup>

Kazmers *et al.* also studied a modified method of arthrodesis involving a locking cage plate construct, which was hypothesized to allow rigid fixation in order to promote bony union while reducing complications.<sup>31</sup> When comparing 14 patients treated with modified arthrodesis versus 22 LRTI patients, Kazmers *et al.* reported 25% greater pinch strength for arthrodesis, as well as similar range of motion and a low nonunion rate for arthrodesis (7%).<sup>31</sup>

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## Considerations for arthrodesis and fusion techniques

Smeraglia *et al.* called into question the necessity of bone union for positive outcomes, and conducted a retrospective study of 107 cases of thumb carpometacarpal joint arthrodesis, comparing patients who attained bone union versus those who did not.<sup>32</sup> The authors found no clinical difference in disability scores, Kapandji test for thumb opposition, and grip and pinch strength, and reported fewer cases of scaphotrapeziotrapezoid arthritis in patients without bone union, and thus concluded that bone union is not necessary for good outcomes.<sup>32</sup>

An alternative method involves volar capsulodesis of the thumb MCP joint, which Qadir *et al.* studied in conjunction with basal joint arthroplasty.<sup>33</sup> The procedure, involving suture anchors and joint

pinning for 6 weeks to promote healing of the volar plate, improved thumb extension and range in all 14 studied patients, and although there was one case of infection and one case of pain, the authors proposed volar capsulodesis as an alternative, straightforward procedure with good results.<sup>33</sup>

Another newer alternative to a common arthrodesis technique involving Kirschner wire fixation is suspensionplasty with the dual Mini TightRope™.<sup>34</sup> Parry *et al.* conducted a retrospective study in 11 patients with the dual Mini TightRope™, and found reduced pain levels, improved range of motion, and increased pinch and grip strength.<sup>34</sup> However, there is little long-term data on the use of suspensionplasty or its comparison with traditional trapeziectomy with LRTI, and there is a potential risk for complications, as Chan *et al.* reported on a patient who experienced post-suspensionplasty heterotopic ossification which caused pain and mechanical impingement and required resection of the heterotopic bone.<sup>35</sup>

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## Prostheses and implant arthroplasty

A prospective study by Martinez-Martinez *et al.* comparing LRTI with implant arthroplasty, the two most frequently used techniques currently, demonstrated no significant differences in VAS, DASH, and pinch grip strength at 12-month follow-up.<sup>36</sup> Although new prostheses and implant arthroplasties have not shown better outcomes over simple resection arthroplasty, they may provide theoretical benefits and merit further investigation. Chug *et al.* studied outcomes of uncemented TMC total joint replacement prostheses in 14 patients with a mean follow-up period of 26 months.<sup>37</sup> They found that the prostheses led to reduced pain levels and improved hand function scores following treatment, although one patient suffered from trapezium fracture, and the authors could not make conclusions about long-term results.<sup>37</sup> However, high complication rates pose a concern for the use of implant arthroplasty, and long-term studies will be needed to determine which specific implants have unacceptable complication rates. For example, Thillemann *et al.* reported an unacceptably high 2-year revision rate of 42% for the metal-on-metal Motec™ prosthesis and advised careful monitoring with use of this implant.<sup>38</sup>

Taleb *et al.* followed 7 patients who received polyvinyl alcohol hydrogel implants, and although thumb mobility and

grip strength improved after treatment, 3 of the 7 patients suffered from persistent moderate pain, and thus the authors were unable to make conclusions about the long-term use of the implants.<sup>39</sup> Similarly, Mattila *et al.* reported a 30% rate of foreign body reactions to poly-L/D-lactide scaffold arthroplasty and recommended discontinued use of this implant.<sup>40</sup> Goubau *et al.* described the high incidence of one short-term complication in 96 patients who received the Ivory™ total ball-and-socket prosthesis, as they reported postoperative de Quervian tenosynovitis 1 year after surgery in 17% of patients.<sup>41</sup>

There have also been several studies describing long-term outcomes of prosthetic implants for TMC arthritis. Barrera-Ochoa *et al.* conducted a retrospective minimum 5-year follow-up of 19 patients who received a pyrocarbon interposition (PyroDisk™) TMC joint implant.<sup>42</sup> Patient satisfaction was high, and the 5-year survival rate of the prosthesis was 90%.<sup>42</sup> Although mobility, grip strength, and function were improved, the authors reported no superiority over previously published outcome data for simple trapeziectomy with or without LRTI.<sup>42</sup> Martin-Ferrero *et al.* studied the 10-year long-term results of the cementless hydroxyapatite-coated ARPE™ implant in 64 patients, and found that the implant had a 10-year survival rate of 94% with high patient satisfaction.<sup>43</sup> The authors therefore suggested the ARPE™ implant as a reliable, long-term treatment alternative for carpometacarpal joint arthritis. However, Semere *et al.* looked at the long-term outcomes of 64 Roseland™ hydroxyapatite-coated prostheses over an average of 12.5-year follow-up, and found a 91% survival rate with little pain but a concerning 25% complication rate and abnormal radiographic findings in 70% of cases.<sup>44</sup>

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## Conclusions

In summary, TMC arthritis is a common and disabling pathology, with the demand for surgical treatment growing as patients with TMC arthritis become increasingly younger.<sup>45</sup> Recent advancements in non-surgical treatment options include the use of hyaluronic acid and PRP injections, but these have primarily been studied only in early-stage arthritis. In the majority of cases, patients present with more advanced arthritis, for which trapeziectomy with LRTI continues to be the gold standard, both as a primary treatment and as a salvage procedure following complications of other surgical interventions. The use of implant arthroplasty is becoming more frequent, but

providers and patients should be advised of the potential high complication rates as well as the current absence of evidence of improved outcomes for implant arthroplasty compared to trapeziectomy with LRTI.

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