Trapeziometacarpal osteoarthritis – a stepwise therapeutic approach

Nuessle Nils C., Vögelin Esther, Hirserg Stefanie
Department of Hand and Peripheral Nerve Surgery, Inselspital University Hospital Bern, Switzerland

Summary
Osteoarthritis of the trapeziometacarpal joint, also called rhizarthrosis, is a common finding in the second half of life. It has a higher prevalence in females and is of growing importance in ageing societies. A variety of conservative and surgical treatment options are known, including conservative treatment up to joint replacement. Without treatment, rhizarthrosis can lead to disabling pain and loss of hand function. The goal of this overview of treatment options is to present a stepwise approach that can be initiated by any physician.

Treatment of trapeziometacarpal osteoarthritis should be started early with conservative measures such as splinting and physical therapy, which can be supplemented by oral and topical analgesics and local infiltrations subsequently. If all of these interventions do not provide sufficient relief, referral to a hand surgeon should be considered.

Surgical strategies vary from arthroscopic debridement over trapeziectomy, with or without tendon interposition and ligament reconstruction, to interposition implants and total joint replacements. The planned intervention should be based on clinical and subjective functional limitations and associated degenerative changes, as well as the patient's expectations and needs.

The goal of this paper is to develop a treatment algorithm, leading to higher levels of patient functionality and satisfaction. Below we discuss the current literature and point out key treatment options used in our department.

Introduction
Osteoarthritis of the trapeziometacarpal joint (TMO) is a common disease, especially in postmenopausal women [1, 2]. Radiological prevalence ranges from 13.4% above 70 years of age up to 35.8% above 55 years [3]. However, radiographic findings do not always correlate with clinical symptoms [4]. The prevalence of symptomatic TMO is notably lower than radiological changes, which are often incidental [5]. Symptomatic TMO has been found to peak at 5.3% in women aged 70–74 and at 1.7% in men aged 80–84 [6]. On the other hand, there is often no or little evidence of TMO on conventional radiographs in early stages, whereas functional limitations and pain can be very prominent [5]. Symptoms of TMO usually include pain in the trapeziometacarpal (TMC) joint, reduced hand strength and decreased mobility of the thumb [7]. Pain can vary from episodic to pain related to a specific activity, sometimes accompanied by a background ache [7, 8]. Grasping and pinching is often limited [9]. As the thumb is needed for countless daily activities and represents approximately 40% of overall hand function, limitation of its function can be very disabling [9–11]. Known risk factors include obesity [5], heavy manual labour [12], female gender and hormonal changes, such as menopause [1]. Trauma, rheumatoid arthritis and hyperlaxity diseases (Marfan/Ehlers-Danlos) are risk factors for secondary osteoarthritis of the TMC joint [13, 14]. Because of our ageing societies, TMO is a growing medical challenge and economic burden [15]. Patients who are referred to our hand surgical consultation are mostly aware of their diagnosis, but have not yet received the full array of conservative treatments and often hesitate to consider surgical treatment. This review aims to give an overview of current and evidence-based treatment options and to formulate a stepwise approach for optimal patient care.

Imaging and classification
Conventional radiographs
In 1987, Eaton and Littler proposed a radiological classification of trapeziometacarpal osteoarthritis, which is still the most widely used for staging. This classification system consists of four different stages (fig. 1) [16, 17]. Even though other imaging techniques and classification systems exist, X-rays of the thumb in two planes remain the gold standard and should be ordered early in suspected TMO [16, 17]. It is, however, important to evaluate the neighbouring joints such as the scaphotrapezial and scaphotrapezoidal (STT) joints for treatment.

Additional imaging
Multilayer imaging can help to evaluate the trapeziometacarpal joint and the neighbouring joints in more detail. To evaluate bone stock and cartilage surfaces, and especially if planning prosthetic implants, computed tomography (CT) enhanced by intra-articular contrast injection can be useful [18]. Magnetic resonance imaging (MRI) allows ligament and soft tissue evaluation. Recent...
developments of specific sequences can quantitatively analyse cartilage or define alterations in its composition [19]. Single-photon emission computed tomography combined with conventional CT (SPECT/CT) can be used to discriminate between pain arising from the TMC or the STT joint [20]. In patients with persistent postoperative pain SPECT is a good adjunct, as other forms of imaging can be difficult to evaluate owing to residual changes from the intervention [21]. Arthroscopic evaluation may allow earlier and more detailed evaluation of degenerative changes [22].

The treatment ladder

Treatment of TMO should not only be based on the radiological classification, but also focus on the patient’s symptoms, subjective loss of function and the evolution over time. Conservative options are at the bottom and ultimately surgery is the last step of the treatment ladder (fig. 2). The treatment ladder is based on current literature, as well as experience in our centre.

Step 1: Multimodal conservative treatment

In every stage of TMO, conservative treatment is the first step of the treatment ladder. All therapeutic modalities described below should be used in combination to optimise the treatment effect.

Figure 1: Eaton/Littler classification of trapeziometacarpal osteoarthritis. Stage I: slight widening of the joint space and normal contours. Stage II: slight narrowing of the TMC and sclerosis, osteophytes <2mm, up to 1/3 subluxation of the joint. Stage III: marked joint space narrowing, osteophytes >2mm, >1/3 subluxation. Stage IV: Pantrapezial arthritis, major subluxation, cystic and sclerotic subchondral bone changes, significant erosion of the scaphotrapezial joint.

Figure 2: Treatment ladder for basal thumb osteoarthritis. A structured approach for all caregivers recommended by the department of hand surgery at Inselspital Bern, Switzerland. Different steps should be combined to ensure optimal treatment. If results are unsatisfactory for the patient, the treatment can be escalated to the next step.
**Splinting**

In a recent meta-analysis, splinting caused a moderate to large reduction in pain in the medium term (3–12 months) and an improvement of function, and can avoid surgical treatment in some patients [23, 24].

In our experience, neoprene bandages provide a high level of comfort for the patients with low risk of developing pressure points, at low cost. Additionally, they serve as an insulation layer, which may help to reduce cold-related worsening of symptoms (fig. 3a). For some patients, taping may present a good alternative (fig. 3b) [25]. For those more comfortable with a rigid support, a thermomoulded splint can be an option (fig. 3c).

**Physical therapy**

Physical therapy by specialised hand therapists leads to a significant improvement in pain and hand function [26]. Specific hand exercises help to increase grip strength and function, reduce pain and improve the range of movement of the thumb [27]. Some investigators focus primarily on increasing the range of movement and strengthening intrinsic and extrinsic muscles by providing a set of exercises that are based on biomechanical findings in cadaver studies [28]. Others prefer the so-called dynamic stability modelled approach, including a variety of hand exercises that focus on restoration of the thumb web space, re-education of thumb muscles, joint mobilisation and muscle strengthening, which has been able to show significant reduction in pain and disability [29].

We therefore recommend initiating physical therapy, together with splinting, as one of the first steps in treating TMO [30].

**Step 2: Pharmacological therapy**

The American College of Rheumatology in 2012 and the European League against Rheumatism recommended the use of one or more of the following drugs for patients suffering from hand osteoarthritis [31, 32]:

- Topical capsaicin
- Topical nonsteroidal anti-inflammatory drugs (NSAIDs)
- Oral NSAIDs, including cyclo-oxygenase-2 (COX2)-selective inhibitors
- Oral chondroitin sulphate

In patients older than 75 years, topical use of NSAIDs is preferred, as side effects might outweigh the benefits of systemic application, especially when used over a longer period of time [31–33]. There is no evidence on superiority of one specific anti-inflammatory treatment over another in TMO [31, 32]. In addition, topical capsaicin has been described as an option to reduce tenderness and pain [34, 35]. Oral chondroitin sulphate has shown effectiveness in relieving symptoms of hand osteoarthritis [36]. As side effects are rare and benign, we recommend its use.

Paracetamol is regularly prescribed for patients suffering from hand osteoarthritis with contraindications for NSAID use [31]. However, in three small trials, paracetamol showed no superiority over placebo or an active comparator [31, 37–39].

Therefore, as an add-on therapy to step 1, we recommend analgesics for short-term use, if applied orally. If all conservative treatments fail, treatment can be escalated to more invasive approaches.

**Step 3: Infiltration therapy**

Corticosteroid injections into the TMC joint can provide short-term benefits, with pain relief and improved function [40]. Unfortunately, the effect usually does not last longer than 1–3 months [40–42]. Nevertheless, in early stages of TMO or when inflammation is predominant corticos
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should be considered in these situations.

to exacerbate pre-existing positional abnormalities and de-

if pain relief is provided effectively by the first steroid in-
jection, we recommend up to three injections with a delay
of 3 months before escalating to a surgical intervention.

Step 4: Surgical interventions

Several surgical interventions exist for the treatment of
TMO, but none has shown to be ultimately superior
[46]. We will shortly describe the different options and
their indications hereafter.

Trapeziectomy with or without ligament reconstruction and interposition

Resection arthroplasty consists of surgical removal of the
trapeziun bone and can be combined with ligament recon-
struction and interposition (LRTI).

The latter adds suspension with a tendon strip in order
to support the first metacarpal bone, as well as filling
the trapezial space with the partially resected local tendon
(fig. 4) [47]. Both interventions show equal long-term out-
comes, nevertheless simple trapeziectomy is a shorter pro-
cedure with slightly lower complication rates [48–51].

Nevertheless, most hand surgeons prefer LRTI to simple
trapeziectomy [52] and it thus represents the most common
surgical therapy for patients suffering from advanced
stages of TMO [6]. A possible explanation could be that
the ligament reconstruction allows initial suspension and
early functional rehabilitation. Ligament reconstruction
and interposition using artificial material or allografts have
fallen out of favour due to significantly higher complica-
tion rates [53].

Shortcomings of both techniques are the risk of subsidence
of the first ray and decreased strength and mobility [54].
Although studies show no correlation between success of
LRTI and radiologic subsidence [55–57], a conflict be-
tween the scaphoid and the base of the metacarpal I can be
a reason for persistence or recurrent pain. Especially in ad-
vanced TMO, when the scaphotrapeziotrapezoidal (STT) joint is involved, partial trapezial excision has been shown
to exacerbate pre-existing positional abnormalities and de-
genervative changes of the carpus [52, 58]. Other options
should be considered in these situations.

Joint replacement surgery

Alternatives consist of a wide variety of interpositional
prosthetic implants, whose use has been increasing in the
last decades [59]. In the early days, loosening presented
the main complication of the different subtypes, with rates
ranging from 3% up to 53% [60–62]. Most prosthetic im-
plants changed continuously over time, so that long-term
outcomes mainly exist for models not being used anymore
because of high complication rates. On the other hand,
some studies report better postoperative pinch strength,
greater range in metacarpophalangeal (MCP) joint hy-
perextension and faster recovery for patients treated with a
prosthesis [63–65]. Non-cemented prostheses provide bet-
ter results in mid-term follow-up [66, 67], high rates of pa-
tient satisfaction and 71–92% survival rates in a 10-year
follow-up [68, 69]. There is a lack of prospective studies
directly comparing trapeziectomy with the different pros-
theses [59], but at present overall prosthetic implants seem
to have a higher complication rate and inferior long-term
outcomes compared with resection arthroplasty [69, 70].

There are several other treatment options, but for an
overview we focus on the procedures and techniques used
in the department of hand surgery at Inselspital (Bern,
Switzerland). Thus, one model representative of a total
joint replacement prosthesis (Touch®), one surface replace-
ment implant (Pyrocardan®) and the surgical technique
of arthrodesis are described below.

Total joint replacement prosthesis

The Touch® prosthesis (KeriMedical, Geneva, Switzer-
land) has been introduced onto the market as a dual mobili-
ty trapeziometacarpal prosthesis. A first case series of 132
patients showed a reduction of luxations and a longer lifes-
span compared with older prosthesis [71]. Because of faster

Figure 4: Left thumb after trapeziectomy with ligament reconstruction and tendon interposition. Lateral view (left) and anterior-pole-
rior view (right). After complete resection of the trapezial bone, the
height of the thumb is preserved by filling the trapezial space with
the partially resected flexor carpi radialis tendon. This resection-
tendon-interposition and suspension arthroplasty is used by many
hand surgeons.
review the benefits and costs of different surgical options. However, as long-term data for this prosthesis are not yet available, the pros and cons should be discussed in detail with the patient. At this point, there is a need for high-quality randomized studies to investigate whether it is able to deliver superior long-term results [72].

Spacer
Pyrocarbon has a module of elasticity similar to that of cortical bone and is therefore well suited for interposition arthroplasties [73]. There are several implant models for different joints. The Pyrocardan® spacer is a hyperbolic paraboloid disk, which is inserted into the joint after partial resection of the first metacarpal and the trapezium bone (fig. 5). Five-year survival rates of 90% were reported [74]. In several studies, the Pyrocardan® spacer had similar outcomes to conventional arthroplasties, but shorter postoperative rehabilitation until relief of symptoms [75, 76]. Revision rates in several studies vary from 3.2% after 60 months of follow up to 25% after 26 months [75, 77].

The main benefit of using an interposition arthroplasty is the maintenance of length of the first ray. Furthermore, it can easily be revised by a trapeziectomy with or without LRTI in the case of failure [78, 79]. Pyrocardan® implants can also be used as a double arthroplasty in the TMC and STT joints in patients with stage IV osteoarthritis, or as an interposition spacer after failed trapeziectomy with subsidence [80]. As for the other prosthetic implants, no prospective long-term data proving its superiority to simple interposition are available and thus the potential advantages have to be outweighed with the complication rate and higher cost.

Arthrodesis
Lastly, arthrodesis may be a primary or a salvage option for TMO [81]. Arthrodesis as a treatment option for TMO is reserved for a limited subgroup of patients, as it fixes the position of the thumb in physiological antepulsion. However, the length of the first ray is better preserved with more force due to the proximal stability on the cost of motion. Arthrodesis has been shown to have relatively high rates of non-union, especially with earlier bone fixation techniques and it may lead to further progression of STT arthrosis [82–84]. In one study, an increased grip strength following arthrodesis as compared with trapeziectomy with LRTI has been described [50]. In our opinion, arthrodesis is therefore only indicated in exceptional cases such as young manual workers or complex revision cases.

Overview
In our ageing society, osteoarthritis of the trapeziometacarpal joint represents a common disease of growing importance. The challenge to enable good access to optimised treatment options requires a stepwise approach. The growing number of patients suffering from TMO demands standardised treatment schemes applicable not only by hand surgeons.

Following clinical examination and conventional x-rays, to ensure the right diagnosis, we therefore recommend the subsequent stepwise approach for all caregivers involved in the patient’s care:

Step 1: Multimodal conservative treatment, including education, physical therapy and splinting. Specific hand therapy may apply physical anti-inflammatory and analgesic treatments, as well as instruct correct use of the weakened thumb.

Step 2: Pharmacological therapy, which involves chondroitin sulphate, topical capsaicin, short-term treatment with oral NSAIDs. For all pharmacological treatments, the individual patient’s risk factors need to be respected to ensure the right risk-benefit-ratio. In addition, oral chondroitin sulphate has been investigated and might present an alternative in the future.

Step 3: Infiltration therapy of the TMC joint, using steroids, hyaluronic acid, dextrose or saline showed contradictory results in the latest studies. They might offer a treatment option, as the rate of adverse effects is very low. Also, infiltration therapy showed a potential to postpone surgery. We recommend only cortisone infiltration, as it is the only product accepted by insurance companies.

Step 4: Surgical interventions are indicated, if all conservative treatment options fail and symptoms lead to unacceptably diminished function for the patient. Many different surgical options exist. Currently, simple trapeziectomy or trapeziectomy with LRTI present comparable options with no significant differences in long-term results. Newer therapies, such as total joint or surface replacement using implants were able to show faster rehabilitation time, but often less convincing long-term results. For many newer types of prosthesis, long-term follow-up data are still lacking. Therefore, they should only be discussed with caution in young patients with high demands. In the case of an unfavourable outcome, secondary trapeziectomy presents a surgical option.

Figure 5: Implantation of a Pyrocardan® spacer in the left thumb. Before (left) and after (right) implantation of Pyrocardan®. After partial resection of the trapezial and first metacarpal bone, the spacer of pyrocarbon is interposed in the joint.
Step 1–3 can easily be taken by general practitioners, rheumatologists, orthopaedic surgeons and other colleagues caring for TMO patients and do not require immediate consultation of a hand surgeon. These steps have been shown to avoid or postpone more invasive treatments, while reducing the patient's symptoms.

If these measures fail over a period of at least 3 months, we recommend discussing referral to a hand surgeon to evaluate the patient’s needs and will for surgery.

This review of current state-of-the-art therapies aims to emphasize that coordinated and combined use of different treatment options has a higher chance to lead to long-term patient satisfaction and might postpone or prevent surgery.

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