

Clinical Study

Arthrodesis of the Trapeziometacarpal Joint Using a Chevron Osteotomy and Plate Fixation

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Introduction. Trapeziometacarpal (TM) osteoarthritis is common. Despite the availability of numerous surgical options, none has been definitively proven to be superior. This study aims to determine the union rate and key strength following arthrodesis using a chevron osteotomy and plate fixation. **Methods.** 32 consecutive cases of TM joint arthrodesis performed between 2001 and 2006 were retrospectively identified. A chevron osteotomy was used to resect joint surfaces and fixation obtained using an AO mini T-plate. The patients were followed up for a mean of 65 months. Outcomes included visual analogue pain score, patient satisfaction, pinch strength, radiographic union, radiographic signs of scaphotrapezoidal arthritis, and complications. **Results.** The 32 cases included 16 females and 8 males with an average age of 56 years. Overall there was a 90% patient satisfaction rate. Average key pinch strength was 8.4 kg and pain score was 2.5. The union rate was 94%, and the two patients with nonunion underwent successful revision surgery. Only one case of radiographic progression of scaphotrapezoidal arthritis was identified during followup. **Conclusion.** TM joint arthrodesis using a chevron osteotomy and plate fixation has high patient satisfaction and low nonunion rates. The authors endorse this technique in the management of TM joint osteoarthritis.

1. Introduction

Osteoarthritis of the thumb is common affecting 16% to 25% of postmenopausal women [1]. Typically it presents with pain, weakness, and deformity and can result in significant disability. The severity of the disease can be described using the Eaton et al. classification shown in Table 1 [2, 3]. The majority of the disease in the early stages can be managed with nonoperative treatments such as activity modification, hand therapy with splinting, analgesia, and the use of corticosteroid injections. When symptoms are refractory to nonoperative measures, surgery may be required. Patients commonly request surgery when everyday tasks become impossible, by which time the trapeziometacarpal (TM) joint is usually stiff and deformed. The primary goal of surgery is pain relief whilst providing stability, strength, and mobility of the thumb.

Uncertainty is present regarding the best choice of surgical procedure for osteoarthritis of the TM joint [4, 5]. The surgical treatment options include reconstruction of the volar

beak ligament [6], metacarpal osteotomy [7], arthroscopy [8], partial trapeziectomy [9], and excision of the trapezium alone [10], with interposed tendon [11], plus ligament reconstruction [12, 13], arthrodesis [14–17], silicone arthroplasty [18], and joint replacement [19]. Systematic and Cochrane reviews have concluded that the available evidence is insufficient to conclude that any treatment is superior [20–22].

Arthrodesis has been reported to provide good pain relief, functional improvement, and high satisfaction rate [14, 17, 23, 24]. The technique has been proposed to improve grip [25] resulting in its use in young patients with posttraumatic osteoarthritis. Arthrodesis is contraindicated in pantrapezoidal arthritis [26, 27] and hence its use is limited to patients with stage II and III osteoarthritis [28, 29]. Comparative studies of arthrodesis have shown no difference between treatments in terms of pain, function, and patient satisfaction with trapeziectomy [28], silicon arthroplasty [29], resection arthroplasty [28], joint arthroplasty [30], and ligament reconstruction and tendon interposition [25, 29, 31]. Critics of arthrodesis cite limited function, reduced movement,

TABLE 1: Eaton and Littler classification of trapeziometacarpal arthritis.

Stage	Description
I	Slight joint space widening (due to effusion)
II	Slight narrowing of joint with sclerosis and small osteophytes < 2 mm
III	Marked narrowing of joint with osteophytes > 2 mm
IV	Pantrapezial arthritis with involvement of scaphotrapezial joint

and subsequent development of adjacent joint arthrosis as disadvantages of the technique. However, reports have shown that function and movement are not significantly affected [14, 15, 17] and that subsequent osteoarthritis does not have a significant impact on pain or patient satisfaction [25].

Nonunion is a common complication after TM joint arthrodesis with the rate reported between 8% and 21% [25, 28, 29]. Arthrodesis must be performed by decorticating the eburnated cartilage surfaces, via a variety of bony cuts and end-to-end fixation. Flat surfaces or a cup and cone formation has been used but these configurations are difficult to hold in the optimal position. The chevron osteotomy was first described by Omer Jr. in 1969 [32] and the potential advantages of this configuration are the inherent stability and large contact area for union. The union rate following this procedure is reported at 83% for TM arthritis [33] and 100% for all digits of the hand [34]. Fixation options include multiple Kirschner wires, a tension band wire, power staples, compression screw(s), or a T-plate with multiple screws. The nonunion rate following arthrodesis with plate fixation has been reported to be lower (6%) than after all techniques combined (16%) [25]. The aim of this study is to determine the union rate and key strength following TM joint arthrodesis using a chevron osteotomy and plate fixation.

2. Methods

Consecutive cases of TM joint arthrodesis procedures performed at our centre by the senior author (A. Jarvis) between 2001 and 2006 were retrospectively collected. This procedure was offered to all patients regardless of age, sex, hand dominance, or occupation if nonoperative treatments had failed and stage II or III radiographic changes were present. The arthrodesis was the first surgical procedure in all cases. No other base of thumb operations were performed by the senior surgeon during this period for stage II or III disease.

The patients were positioned supine under general anesthesia, with the use of an arm table and a tourniquet. A dorsoradial three-leg zigzag incision was made, starting over the TM joint with care taken to avoid the superficial branches of the radial nerve. The TM joint was exposed through incising the joint capsule, respecting the superficial soft tissue structures. The joint surfaces were decorticated using chevron bone cuts with irrigation to prevent thermal bone necrosis. The apex of the chevron pointed proximally with the aim of achieving a 120-degree angle (see Figure 1). The apex of the distal cut was made perpendicular to the metacarpal

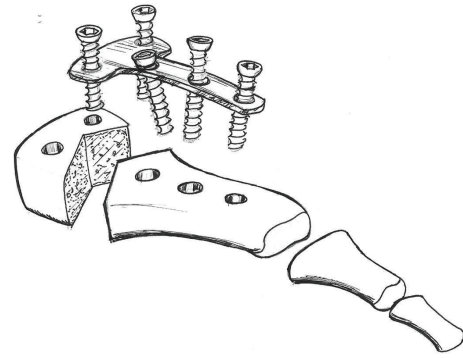


FIGURE 1: Chevron cuts and application of AO mini T-plate.

but the proximal cut was altered to facilitate optimal flexion at the arthrodesis site. AlloMatrix was used until 2004 in 30% of cases, and after this the senior author introduced a low morbidity technique to take bone graft locally from the ipsilateral radial metaphysis. Thus several bone cores are obtained with an AO tap guide (see Figure 2) being used as a trephine via a small volar incision over the distal radius and these bone cores are impacted into the TM joint cavity. The metacarpal is reduced onto the trapezium and the position was checked clinically. The final position of the thumb must be truly functional, so that the thumb tip can reach the little finger tip. Once the position is trialed and accepted, it can be held with one or more 1.6 mm K-wires passed from the first metacarpal into the trapezium. This allows the surgeon to concentrate on plate application rather than reduction of the arthrodesis. The K-wire can be positioned through the wound but should not obstruct placement of the plate which is held by five screws. The wound is closed and a plaster incorporating the thumb is used to immobilise the thumb. Postoperatively, patients were usually discharged on the day of surgery, with followup arranged at two weeks for removal of sutures and change of the plaster slab. At the five-week visit, the plaster slab was removed, radiographs were taken (see Figure 3), and patients were provided with a removal thumb splint for further four weeks.

The patients were all called for review by the senior author, with mean followup of 64 months (range 36 to 84 months). There was no loss to followup. Patients were asked to score their pain according to the visual analogue score, one relating to no pain and 10 relating to severe pain. Pinch strength was measured using a pinch gauge dynamometer. Patients rated their overall satisfaction with the procedure as excellent, good, fair, or poor. Patients were also asked whether they felt their pain and function had improved and whether they could perform their activities of daily living following surgery.

Plain radiographs were assessed for union, defined as trabecular bridging on all views. The radiographs were also reviewed for the presence of arthrosis in the scaphotrapezial joint. Any complications postoperatively were also recorded.



FIGURE 2: AO tap guide.



FIGURE 3: Postoperative plain radiographs of arthrodesis site.

3. Results

32 TM joint arthrodesis procedures were performed during the study period, 16 unilateral and 8 bilateral. Demographics included 20 females and 12 males, with an average age of 56 years (range: 42–70).

The average key pinch strength was 8.4 kg and the average visual analogue pain score was 2.5. All patients reported a subjective improvement in pain levels, hand function, and ability to perform activities of daily living. Overall there was a 90% satisfaction rate with the procedure, 60% rated excellent, 15% good, 15% fair, and 10% poor results.

The union rate of radiographs was 94%. Two patients required reoperation for clinical and radiographic nonunion involving further harvest of bone graft from the radial metaphysis and fixation with T-plate. Both patients reported a good result following the second procedure and went on to union. Only one case of radiographic progression of scaphotrapezial arthritis was identified at followup but the patient was asymptomatic.

Two patients reported transient radial nerve paraesthesia with symptoms settling in both patients at final followup. Six patients required removal of metalwork for local discomfort after union (19%).

4. Discussion

Recent systematic and Cochrane reviews have revealed that insufficient evidence is available to demonstrate superiority of any treatment option for TM joint osteoarthritis [20–22].

The results from this study show a 90% patient satisfaction rate and 94% union rate following Chevron osteotomies and T-plate fixation supporting this as an effective treatment method.

Previous studies have demonstrated similar satisfaction levels following various arthrodesis procedures [14, 17, 23, 24]. The average postoperative pinch strength of 8.4 kg is higher than the 5.9 kg reported in a previous study [23]. However, as preoperative measures were not available, it is not possible to comment on the improvement in pinch strength and this makes comparison between studies difficult. Previous studies have shown that key and chuck pinch grip are significantly better following arthrodesis than ligament reconstruction and tendon interposition [25] and the pinch strength achieved following arthrodesis in this study would support this.

The 6% nonunion rate is lower than previously reported in the literature where rates range from 8% to 21% [23–25, 28, 29]. This finding is supported by a retrospective review performed by Hartigan et al. who report a 16% nonunion rate following all types of arthrodesis but a lower rate of nonunion (6%) in cases where plate fixation was used [25]. The authors hypothesize two reasons for their low nonunion rate: the chevron configuration increases the contact area at the osteotomy site and the biomechanics of T-plate fixation improve chances of union. The senior author first started using the chevron bone cuts for TM joint arthrodesis in 1996. A variety of fixation techniques were used from Kirschner wires to single and double lag screws. Unfortunately there was a high failure rate and this contributed to a change in our practice to T-plate fixation from 2001.

It is widely believed that a fused TM joint accelerates arthritis in the adjacent joints, especially the scaphotrapezoid joint. Our experience has been quite different with only one case of radiographic scaphotrapezoid arthritis identified during followup, leading us to conclude that TM joint arthrodesis does not accelerate arthritis in the adjacent thumb joints.

The authors recognise several limitations in the study design. The study involved a retrospective case series without a comparative group. The measurement of pinch strength and pain score was only performed postoperatively, and the addition of a preoperative measurement would highlight the amount of improvement seen following arthrodesis and facilitate comparisons to other studies. Subjective measures of outcome and satisfaction were obtained but the use of a validated outcome instrument would have the advantage of quantifying any improvement and again allow comparison with other studies.

5. Conclusion

Arthrodesis using a chevron osteotomy and plate fixation can give high patient satisfaction and union rates. This technique is safe and effective and is endorsed by the authors for the management of TM joint osteoarthritis.

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

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