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SYMPOSIUM: THUMB CARPOMETACARPAL ARTHRITIS

Degenerative Change at the Pseudarthrosis After Trapeziectomy at 6-year Followup

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Abstract

Background Simple trapeziectomy has a well-documented history of success for the management of osteoarthritis at the trapeziometacarpal joint. There is concern, however, that late-onset failure can occur as a result of the development of degenerative disease at the scaphoid-metacarpal pseudarthrosis.

Questions/purposes The purpose of this study was to determine whether (1) radiographic changes of degenerative joint disease progressed; (2) the pseudarthrosis height diminished between 1 year and 6 years after either simple trapeziectomy or trapeziectomy with ligament reconstruction and tendon interposition (LRTI); and 3) the presence of degenerative changes were associated with inferior scores on standardized outcomes instruments.

Methods Using cases from an earlier randomized trial, the 1-year and 6-year stress radiographs of the pseudarthrosis between the distal pole of the scaphoid and the base of the thumb metacarpal were assessed for degenerative change in 25 thumbs that had undergone simple excision of the trapezium and 29 that had undergone trapeziectomy + LRTI for painful trapeziometacarpal joint osteoarthritis. Degenerative change was graded according to a Kellgren and Lawrence system, and clinical results were assessed using the Patient Evaluation Measure (PEM), Disabilities of the Arm, Shoulder and Hand (DASH) questionnaires, and thumb key pinch strength.

Results One of the 29 thumbs treated with trapeziectomy + LRTI and seven of the 25 thumbs treated by simple excision of the trapezium exhibited increased degenerative change at their final followup. A pseudarthrosis space was preserved in 22 of the 25 simple trapeziectomies and 28 of the 29 trapeziectomies + LRTI. The presence of degenerative change did not adversely affect the outcome as measured by the PEM, the DASH, or thumb key pinch strength.

Conclusions Increased degenerate-like changes were observed after simple excision of the trapezium but these did not influence the clinical outcome.

Level of Evidence Level II, therapeutic study. See Guidelines for Authors for a complete description of levels of evidence.

Introduction

Recent research suggests construction of a suspensory ligament may not improve the outcome of trapeziectomy at 1 year [7, 8, 12, 23] or 5 or more years [13, 21] followup. However, there is still concern that, at longer followup, recurrent thumb pain and loss of function may occur after trapeziectomy without ligament reconstruction or tendon interposition as a result of the development of degenerative osteoarthritis at the articulation between the thumb

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The original randomized controlled study from which these data were collected had ethical committee approval from Nottingham Research Ethics Committee 2 (Ref. OR020101).

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metacarpal base and the distal pole of the scaphoid. This is because these surfaces are not congruent and, in the absence of a suspensory ligament, they may articulate with each other [5].

This study has a 6-year followup and investigates (1) whether progressive degenerative-like changes occur at the thumb metacarpal base and the distal pole of the scaphoid after either trapeziectomy alone or trapeziectomy with ligament reconstruction and tendon interposition (LRTI); (2) whether the height of the pseudarthrosis between the distal pole of the scaphoid and the thumb metacarpal base diminishes after either trapeziectomy alone or trapeziectomy + LRTI; and (3) whether progressive degenerative changes are associated with inferior outcomes scores and thumb strength.

Patients and Methods

This study used men and women recruited during 2002 to 2005 to a randomized controlled study [8, 21], which compared the 1- and 6-year outcomes of excision of the trapezium alone (without temporary Kirschner wire support) and excision of the trapezium with LRTI using 50% of the flexor carpi radialis tendon and temporary Kirschner wire support [4] for trapeziometacarpal joint osteoarthritis [8, 21]. That study had ethical committee approval from Nottingham Research Ethics Committee 2 (Ref. OR020101). The entry criteria were painful trapeziometacarpal joint osteoarthritis, which had not responded to nonoperative treatment. The operative techniques and postoperative rehabilitation used in this study have previously been described [8]. Ninety-nine patients recruited into this study (114 thumbs) had undergone stress radiographs of the thumb at both their 1-year and 6-year (median, 6 years; range, 5–8 years) postoperative assessments. However, many of the 1-year stress views had been destroyed and these were only available for 54 thumbs. Demographic data for the original group of thumbs and those whose 1-year radiographs were available for followup did not show any obvious differences in age at surgery (mean, 60 years for original group versus 59 years for study group), male:female ratio (17:97 versus 9:45), and length of followup (median, 6 years for both groups).

The 1-year stress views were lateral views obtained with the patient pinching the thumb tip against the index finger tip [2]. The 6-year stress views were also lateral views but were obtained with the patient forcibly extending both thumbs against each other [20]. The 1-year stress radiographs were hard-copy films and the 6-year radiographs were digital images and were viewed on a PACS system (Agfa-Gevaert, Mortsel, Belgium).

The 1- and 6-year radiographs were reviewed separately by one of us (HS) in a blinded manner with the radiograph at the other time point unavailable for comparison and without knowledge of (1) whether the radiograph was taken at 1- or 6- year followup; (2) the result of the assessment of the other radiograph (if already performed); and (3) whether the case had been treated with trapeziectomy alone or with trapeziectomy + LRTI. However, evidence of a drill hole passing obliquely across the thumb metacarpal base meant that it was often possible to determine if a ligament reconstruction had been performed. Two assessments were made on each radiograph: (1) the severity of any osteoarthritic changes on the distal pole of the scaphoid and the base of the thumb metacarpal; and (2) the height of the pseudoarthrosis between the distal pole of the scaphoid and the base of the first metacarpal. Because the surgery had been performed for trapeziometacarpal joint osteoarthritis, degenerative change that preexisted the excision of the trapezium was expected at the base of the thumb metacarpal and also at the distal pole of the scaphoid in those who had concomitant osteoarthritis of the scaphotrapezial joint. Thus, the 1-year radiographs were used as the baseline with which to compare the 6-year radiographs to detect changes that had developed postoperatively. The severity of osteoarthritis on both of the articular surfaces of the scaphometacarpal pseudarthrosis was assessed using Kellgren and Lawrence's technique [17]. This assesses the presence and extent of osteophytes, periarticular ossicles, narrowing of joint cartilage associated with sclerosis of subchondral bone, pseudocystic areas with sclerotic walls situated in the subchondral bone, and altered shape of the bone ends. In our assessment, the third criteria (narrowing of joint cartilage associated with sclerosis of subchondral bone) was modified to an assessment of sclerosis of the subchondral bone because the original criteria might have biased the simple trapeziectomy versus trapeziectomy + LRTI comparisons. This is because collapse of the thumb metacarpal onto the distal pole of the scaphoid might occur frequently in the long term after simple excision of the trapezium, although studies suggest a pseudarthrosis space is preserved in the short term [1, 3, 10]. In contrast, the LRTI may have prevented such collapse and narrowing of the pseudarthrosis. Using this scheme, the thumb metacarpal base and distal pole of the scaphoid were individually graded for degenerative change (0 = none, 1 = doubtful, 2 = minimal, 3 = moderate, 4 = severe). This was necessary because the pseudarthrosis had one joint surface from the trapeziometacarpal joint and one from the scaphotrapezial joint, and these usually exhibited different degrees of degenerate change (which had preexisted the trapeziectomy). The scores for the two joint surfaces of each thumb at each of the two time points

were added together to give a single score (possible range 0–8) for each pseudarthrosis. It was decided that an increase in the degeneration score of 2 or more would indicate increased degeneration.

The height of the pseudarthrosis between the distal pole of the scaphoid and the base of the thumb metacarpal was measured in millimeters using a previously described and validated technique, which has 95% limits of agreement of −1 to +1 mm and −2 to +1 mm for intraobserver and interobserver differences, respectively [10].

In the original study, the clinical outcomes at 1 and 6 years were assessed [8, 21]. Three of these assessment methods were the Patient Evaluation Measure (PEM) score [19], the Disabilities of the Arm, Shoulder and Hand (DASH) score [16], and thumb key pinch strength, and these data were used in the present study. The change in each clinical outcome (PEM, DASH, and key pinch) between Year 1 and Year 6 of the thumbs with increased degenerative change at Year 6 was compared with the changes in the thumbs without increased degenerative at Year 6.

Comparisons were made using SPSS 14.0 for Windows statistical program (SPSS Inc, Chicago, IL, USA). Statistical significance was set at the $p < 0.05$ level. The chi-square test was used to compare the degenerative changes occurring after simple trapeziectomy and trapeziectomy + LRTI. The Mann-Whitney U test was used to compare the changes in the PEM and DASH scores between Year 1 and Year 6 between the group in which degenerative change progressed and that in which it did not progress. The unpaired t-test was used to compare the changes that occurred in key pinch strength in the same two groups and the pseudarthrosis heights of the simple trapeziectomies and trapeziectomies + LRTI.

Twenty-five of the 54 thumbs had been treated by simple trapeziectomy and 29 by trapeziectomy + LRTI. The mean age at the time of surgery was 60 years (SD, 8.8 for simple trapeziectomy; 8.0 for trapeziectomy + LRTI) for both procedures.

Results

Radiographic degeneration between the 1- and 6-year followup intervals was more pronounced in the trapeziectomy group than in the trapeziectomy + LRTI group. Eight of the 54 pseudarthroses demonstrated an increase of 2 or more in the degeneration score during the 5-year followup period (Table 1). Seven of these had been treated by simple excision of the trapezium and one by trapeziectomy + LRTI ($p < 0.02$, chi square test). Fourteen thumbs demonstrated a decrease (improvement) of 2 or more in the degeneration score during the 5-year followup. Three of these had been treated by simple excision of the trapezium and 11 by trapeziectomy + LRTI ($p < 0.01$, chi-square test; Table 1).

Table 1. The observed changes between Year 1 and Year 6 in the radiographic degeneration score [17], which was measured on the stress radiographs

Change in degeneration score	Trapeziectomy alone	Trapeziectomy with LRTI
+4	2	0
+3	2	0
+2	3	1
+1	5	6
0	5	8
−1	5	3
−2	2	5
−3	1	4
−4	0	1
−5	0	1

A positive value indicates increased radiographic degenerative change, whereas a negative value indicates a decrease in the degenerative change; LRTI = ligament reconstruction and tendon interposition.

The median pseudarthrosis height between the thumb metacarpal base and the distal pole of the scaphoid on the 6-year stress views was 4.4 mm (range, 0–7 mm) in the 29 thumbs that had been treated with trapeziectomy and LRTI and 3.4 mm (0–7 mm) in the 25 treated with simple excision of the trapezium. This difference is not statistically significant ($p = 0.14$, unpaired t-test). There was no pseudarthrosis gap (0 mm), indicating the base of the thumb metacarpal was touching the distal pole of the scaphoid bone when the thumb was stressed in three of the 25 simple trapeziectomies and one trapeziectomy + LRTI. Comparison of this height on the 1-year and 6-year radiographs revealed little change with time either after simple excision of the trapezium (mean, +0.1; SD, 2.3 mm) or trapeziectomy with LRTI (mean, +0.2 mm; SD, 1.7). In the eight thumbs with increased degenerative change, the median height was 3.5 mm (range, 0–7 mm) at Year 6 and all but one had a preserved pseudarthrosis gap. However, the pseudarthrosis height had reduced by 0.7 mm (range, −4.0 mm to +0.8 mm) in the interval between the 1-year and 6-year radiographs.

Because there was only one case of increased degenerative change within the trapeziectomy + LRTI group, analysis of the outcomes according to the presence or absence of increased degenerative change was performed for the whole study group (simple trapeziectomy + trapeziectomy + LRTI) and not for the two procedures separately. Radiographic signs of degenerative change occurring between the 1-year and 6-year assessments did not influence

Table 2. Changes in the PEM outcome score and thumb key pinch strength observed between the 1-year follow-up and the 6-year final assessment

Outcome measure	Increased degeneration	No increased degeneration	p Value
PEM: median (minimum-maximum)	−1.1 (−11 to +3)	−0.6 (−64 to +42)	0.58
DASH: median (minimum-maximum)	−1.7 (−9 to +11)	+4.3 (−48 to +62)	0.23
Key pinch (kg): mean (SD)	−0.6 (0.8)	−0.8 (1.2)	0.56

No significant differences observed; PEM = Patient Evaluation Measure; DASH = Disabilities of the Arm, Shoulder and Hand.

the changes in the PEM score ($p = 0.58$, Mann-Whitney U test), the DASH score ($p = 0.23$, Mann-Whitney U test), or key pinch strength ($p = 0.56$, unpaired t-test) (Table 2).

Discussion

This study investigated (1) whether progressive degenerative-like changes occur at the thumb metacarpal base and the distal pole of the scaphoid after either trapeziectomy alone or trapeziectomy with LRTI; (2) whether the height of the pseudarthrosis between the distal pole of the scaphoid and the thumb metacarpal base diminishes after either trapeziectomy alone or trapeziectomy with LRTI; and (3) whether progressive degenerative changes are associated with inferior outcomes scores and thumb strength. Increased degenerative change was found, particularly after excision of the trapezium without ligament reconstruction, but a pseudarthrosis space was preserved in 50 of the 54 thumbs. The clinical outcomes were not influenced by the development of degenerate change.

This study has several limitations, particularly regarding the assessment of the pseudarthrosis formed by excision of the trapezium. Although Kellgren and Lawrence reported that assessments of degenerative change at the thumb trapeziometacarpal joint using the same radiographs has good interobserver ($r = 0.78$) and intraobserver ($r = 0.81$) correlation [17], the assessment of progression of degenerative change by comparison of serial radiographs of the same joint is open to greater error. This is because of slight differences in the projections and exposures of the different radiographs. Additionally, the 6-year radiographs in our study could be modified on the digital PACS system to obtain ideal contrast and brightness of the images, whereas this could not be done with the 1-year radiographs. Thus, inconsistent assessments by the observer and differences in the quality of the radiographs could explain the 2 or more point deteriorations and improvements in the osteoarthritis staging of the pseudarthrosis between Year 1 and Year 6. However, such factors could not explain the differences in the numbers of the two procedures (simple trapeziectomy and trapeziectomy + LRTI), which appeared to deteriorate and improve. We had considered using Eaton and Glickel's classification of trapeziometacarpal joint osteoarthritis [11], which has moderate intraobserver reliability [9, 15, 18], but believed Kellgren and Lawrence's system was more appropriate for evaluating degenerate change after excision of the trapezium.

The technique of measurement of the height of the pseuadarthrosis created by excision of the trapezium may also be criticized because magnification produced by the divergent x-ray beam was not considered. This could have been addressed by also measuring the length of the thumb proximal phalanx and calculating the trapezial space ratio [10]. However the distances between the x-ray source and the thumb base and the thumb base and the x-ray plate were standardized for all the radiographs so that any increase in the pseudarthrosis height resulting from magnification was consistent throughout the study. Also, because the distance between the x-ray source and the thumb base is long, and that between the thumb base and the x-ray plate is small, it is unlikely that the magnification markedly increased the true pseudarthrosis height. Finally, the important finding is that a pseudarthrosis space was still maintained when the thumb was stressed in 50 of the 54 thumbs. This might indicate that there was no direct contact between the incongruous articular surfaces of the distal pole of the scaphoid and the base of the thumb metacarpal during hand use and explain why progressive degenerative change was not seen in most thumbs.

The changes observed in the severity of degenerative change were not marked. Four of the eight cases of advancement had an increase in their degeneration score of 2, which is equivalent to a single grade worsening of the degenerate change on either side of the pseuadarthrosis (distal pole of scaphoid and base of thumb metacarpal). This would be equivalent to a single grade change of the trapeziometacarpal joint within Eaton and Glickel's system [11]. We are unaware of any other studies that have investigated whether radiological degenerative changes develop at the scaphotrapezial pseudarthrosis after either simple excision of the trapezium or trapeziectomy with ligament reconstruction and tendon interposition. Superficially it appears logical to attribute the excess of progressive degenerative change seen after simple excision of the trapezium to the absence of a suspensory ligament, which would have prevented the already degenerate articular surface of the thumb metacarpal migrating down onto, and articulating with, the incongruous articular surface of the distal pole of the scaphoid. However, this explanation is not supported by the assessments of the pseudarthrosis

height. The pseudarthrosis height assessments suggest that the thumb metacarpal base did not migrate down onto, and articulate directly with, the distal pole of the scaphoid in seven of the eight pseudarthroses with a 2 or more point increase in the degenerative score. Furthermore, 22 of the 25 simple trapeziectomies still had a pseudarthrosis gap at 6-year followup. It is already known that a pseudarthrosis gap between the thumb metacarpal base and distal pole of the scaphoid is present up to 1 year after simple excision of the trapezium [6, 10, 12] and at 9-year followup after trapeziectomy with ligament reconstruction and tendon interposition [22]. However, we are not aware of any studies that have assessed the pseudarthrois gap at longer followup after simple excision of the trapezium. Previous longer-term followup studies of this procedure have exclusively assessed the clinical outcome [13, 14, 21]. Our finding is particularly interesting because a Kirschner wire was not inserted during the simple trapeziectomy to hold the thumb metacarpal base away from the distal pole of the scaphoid during the immediate postoperative period. The gap was presumably preserved as a result of either fibrous tissue formation in the trapezial void (pseuadarthrosis) in the weeks after surgery or preservation of capsular structures running between the thumb and index metacarpal bases. The development of degenerative change may result in recurrent pain and loss of thumb function. However, it did not appear to worsen the patient's perception of thumb function as assessed with the PEM [19] or DASH [16] scores or thumb key pinch strength at 6-year followup. The senior author (TRCD) in his 20 years of practice has seen two patients with late-onset recurrent pain after a simple excision of the trapezium, both occurring over 18 years after surgery. Thus, longer followup is required to ascertain if this occurs sufficiently frequently to contraindicate simple excision of the trapezium in younger patients.

In summary, our results suggest that progressive degenerative change occurs more frequently at the pseudarthrosis created by excision of the trapezium if a suspensory ligament is not created. However, this does not appear to be the result of direct bone-on-bone contact of the incongruous surfaces of the thumb metacarpal base and the distal pole of the scaphoid and does not appear to affect the clinical outcome at 6-year followup. Thus, although this study has demonstrated a radiological concern regarding the use of simple excision of the trapezium (without ligament reconstruction) for the treatment of osteoarthritis of the trapeziometacarpal joint, it has failed to show that this radiological phenomenon affects the clinical outcome at 6-year followup. Simple excision of the trapezium remains an acceptable treatment for osteoarthritis of the trapeziometacarpal joint.

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