

Surgical Management and Outcome of Primary Osteoarthritis at the Base of the Thumb

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Abstract:

Background: Hand Osteoarthritis (OA) is after knee and hip OA the most common presentation of OA in the human body. In the hand one of the most affected joint is the first carpometacarpal (CMC) joint. Surgical treatment of OA at first CMC joint is very common and a variety of surgical techniques have been described. However, there is lack of high-level studies comparing these techniques. Therefore, we planned this thesis in sequential stages that will systematically review the literature first and depending on these results randomised clinical trials (RCT) were planned and executed to determine the best modality of treatment for CMC joint OA.

Method: In the first stage a brief introduction and outline of the thesis was described (The aims of the thesis). The second stage performed a systematic review reviewing literature up to December 2009. Third stage was a prospective study of patients with primary thumb carpometacarpal osteoarthritis treated with Weilby interposition tendoplasty (20 thumbs). Fourth to sixth stage were RCTs comparing trapeziometacarpal arthrodesis with trapeziectomy with ligament reconstruction (fourth stage), trapeziectomy with total joint arthroplasty (fifth stage), Burton-Pellegrini technique (arthroplasty with a bone tunnel at the base of the first metacarpal) with the Weilby technique (sixth stage). The patients were assessed using clinical criteria's and functional scores appropriate to each study design. The Disabilities of the Arm, Shoulder, and Hand (DASH) outcome data collection instrument and the Patient Rated Wrist/Hand Evaluation (PRWHE) questionnaire were used as the most important outcome measures for pain and physical function.

Result: The first and second stage (introduction and systematic review) did not establish superiority of one technique over the other. However based on good results of some techniques we postulated that there could be differences between the various surgical procedures. Further prospective studies and RCTs were planned based on the results of this systematic review. Stage 3 prospective study found good results for most clinical parameters and DASH score for patients undergoing Weilby interposition tendonoplasty. In the fourth stage more complications and a higher revision rate was found in the arthrodesis group compared to trapeziectomy with LRTI and this RCT had to be prematurely terminated due to this reason. In both groups however, PRWHE and DASH significantly improved over time, but comparing both groups results were highly similar. In the fifth stage patients after total joint arthroplasty showed a statistically significant greater improvement on DASH and key-pinch force compared to the trapeziectomy group at one year follow up. In stage six the Burton-Pellegrini group showed a faster recovery of pain and function at three months compared to the Weilby group, however both group had similar results at the end of 1 year.

Conclusion: General discussion (stage 7): Updated systematic review with literature up to December 2012 combined with the results of the 3 RCTs (stage 4, 5, and 6): Based on the present evidence, patients with symptomatic OA only at the first CMC joint are best treated with trapeziectomy. If patients have clinical symptoms at both the first CMC and STT joint, we postulate that trapeziectomy with an additional LRTI (Burton Pellegrini technique) is the best treatment option.

Keywords: First carpometacarpal osteoarthritis, trapeziectomy, Trapeziometacarpal arthrodesis, Weilby interposition tendonoplasty,

Trapeziectomy with total joint arthroplasty.

Thesis Question: The thesis had two main questions

1. Which surgical techniques (trapeziectomy, trapeziectomy with LRTI, CMC arthrodesis, total joint prosthesis) are preferred in the treatment of the different stages of primary OA at the base of the thumb?
2. Which suspensor ligament reconstruction (LRTI techniques) is most useful?

Thesis Answer: 1. First question is answered by the following recommendation: Based on the present evidence, patients with symptomatic OA only at the first CMC joint are best treated with trapeziectomy. CMC arthrodesis of the thumb should not be routinely used because of the high complication rate. Additionally, total joint prosthesis should only be performed in a trial setting. If patients have clinical symptoms at both the first CMC and STT joint, we postulate that trapeziectomy with an additional LRTI (Burton Pellegrini technique) is the best treatment option.

2. Answering the second research question, we conclude that different types of suspensory ligament reconstruction (LRTI techniques) have more or less the same objective outcomes at 1-year follow-up. However, if a LRTI technique is used we recommend the Burton Pellegrini technique (arthroplasty with a bone tunnel at the base of the first metacarpal) over the Weilby technique (arthroplasty that preserves the structural integrity of the base of the first metacarpal), because of the faster recovery at 3 months.

THESIS SUMMARY

Introduction

Hand osteoarthritis (OA) is one of the most common OA phenotypes, after knee OA and hip OA. OA at the base of the thumb is, after distal interphalangeal joint OA, the most common affected joint in the hand and can cause severe pain, weakness and deformity, which can result in significant disabilities. Surgical treatment of OA at the base of the thumb is reserved for symptomatic patients not responding to conservative treatment and suffering from interference with occupational or recreational activities. Conservative treatment consists of splinting, exercises, physical therapy, NSAIDs, or intra-articular injections with steroids or hyaluronacid. During the last decades, a variety of surgical techniques has been described to restore function of the thumb, with pain relief, stability, mobility, and strength as the main goals of treatment. The purpose of this thesis is to better understand which surgical techniques are preferred in the treatment of the different stages of primary OA at the base of the thumb.

Aims

- To investigate which surgical technique (trapeziectomy, trapeziectomy with LRTI, CMC arthrodesis, total joint prosthesis) is preferred in the treatment of the different stages of primary OA at the base of the thumb.
- To evaluate whether different types of suspensory ligament reconstruction (LRTI techniques) lead to different subjective and objective outcomes.
- To develop new treatment recommendations for patients with different stages of OA at the base of the thumb.

Materials And Methods

We performed this research in seven stages.

First stage: The introduction and outline of the thesis showed that the 8 most commonly used surgical procedures presented in literature to treat OA at the base of the thumb are: 1. volar ligament reconstruction, 2.

metacarpal osteotomy, 3. CMC arthrodesis, 4. joint replacement, 5. trapeziectomy, 6. trapeziectomy with TI, 7. Trapeziectomy with LR, and 8. trapeziectomy with LRTI. Furthermore, the aims of the thesis were described.

The second stage was a systematic review of surgical techniques that were successful in treating primary OA at the base of the thumb. 35 articles were evaluated including articles on trapeziectomy or trapeziectomy with tendon interposition, trapeziectomy with ligament reconstruction or trapeziectomy with ligament reconstruction and tendon interposition, thumb carpometacarpal (CMC) arthrodesis and CMC total joint prostheses.

In third stage we describe the results of a prospective single-arm study of a trapeziectomy with LRTI procedure, i.e., the Weilby arthroplasty and compare it with other existing techniques. Nineteen patients (20 thumbs) with primary thumb carpometacarpal osteoarthritis were treated with Weilby interposition tendoplasty. For subjective assessment, the Disabilities of the Arm, Shoulder, and Hand (DASH) outcome data collection instrument was used to evaluate preoperative and postoperative outcomes at 0, 3, 6, and 12 months. A personal questionnaire and other relevant objective parameters were also assessed.

Fourth stage: A randomised controlled trial was performed to compare the results of trapeziometacarpal arthrodesis with trapeziectomy with ligament reconstruction in primary trapeziometacarpal osteoarthritis. Women aged 40 years or older were randomized to either trapeziectomy with LRTI or arthrodesis with plate and screws. Patients were evaluated preoperatively and postoperatively at 3 and 12 months by assessing pain, function (PRWHE and DASH questionnaires), ROM, strength, complication rate, and patients were asked if they would have the same surgery again under the same circumstances.

Fifth Stage: A randomised controlled trial was performed to compare trapeziectomy and total joint arthroplasty in primary thumb carpometacarpal osteoarthritis. Primary outcome measure was the

Patient Rated Wrist/Hand Evaluation questionnaire (PRWHE). Secondary outcome measures were the Disabilities of the Arm, Shoulder and Hand questionnaire (DASH), patient satisfaction, grip and pinch force, active range of motion and complications. Patients were evaluated preoperatively and postoperatively at 3 and 12 months.

Stage 6: We conducted a randomised controlled trial comparing the Burton-Pellegrini technique (arthroplasty with a bone tunnel at the base of the first metacarpal) with the Weilby technique (arthroplasty that preserves the structural integrity of the base of the first metacarpal). Women aged 40 years or older with stage IV osteoarthritis were randomized to either of both treatments. Patients were evaluated preoperatively and postoperatively at 3 and 12 months by assessing pain, function (PRWHE and DASH questionnaires), ROM, strength, duration to return to work or activities, satisfaction with the results, and complication rate.

Results

Stage 1-. A brief introduction and outline of the thesis was described (The aims of the thesis).

Stage 2- Findings in the previous published systematic reviews showed no evidence of superiority of any of the surgical procedures to treat OA at the base of the thumb. Nine new articles were added (literature up to December 2009), but still none of the procedures showed superiority over another. However, based on good results of CMC arthrodesis and total joint prostheses, we postulate that there could be differences between the various surgical procedures. Therefore randomized clinical trials of CMC arthrodesis and total joint prostheses compared to trapeziectomy with long follow-up (>1 y) are warranted.

Stage 3: The DASH score was significantly improved, and 17 of 19 patients were satisfied with the procedure. The interphalangeal joint flexion/extension, metacarpophalangeal joint flexion/extension, and carpometacarpal joint extension did not significantly change. Carpometacarpal joint palmar abduction and opposition were significantly improved at 12 months. The 3-point pinch and overall grip strengths were significantly improved at 12 months.

Stage 4: Forty-three patients were enrolled in this study. The study was prematurely terminated to significantly more complication and higher revision rate in the arthrodesis group as compared to trapeziectomy with LRTI (71% vs 29%, $p = .016$). In both groups, PRWHE and DASH scores significantly improved over time, but comparing both groups results were highly similar.

Stage 5: Fifty-five patients were enrolled in this study. Twenty-six patients underwent trapeziectomy and 29 patients total joint arthroplasty. Although in both groups the PRWHE scores significantly improved over time, there was no significant difference between both groups. Three month after surgery the total joint arthroplasty group was significantly more improved with respect to key- and three-point pinch, and IP extension compared to the trapeziectomy group. One year after surgery the total joint arthroplasty group showed a statistically significant greater improvement on DASH and key-pinch force compared to the trapeziectomy group. Furthermore, no significant

difference in complications between both groups was observed.

Stage 6: Seventy-nine patients were enrolled in this study. Our main findings were that at 3 months PRWHE pain and PRWHE total were significantly more improved in the Burton-Pellegrini group compared to the Weilby group. At 12 months, however, no significant differences were found for all PRWHE and DASH scores between both groups. In addition, we observed no significant differences between groups in strength, duration to return to work or activities, patient satisfaction, and complication rates

General Discussion (Stage 7)

Because OA at the base of the thumb can result in significant disability, selecting the optimal surgical procedure is highly relevant. Patients should only be operated on when not responding to conservative treatment and when suffering from interference with occupational or recreational activities.

Patients with symptomatic OA only at the first CMC joint: Based on the best available evidence in literature and the results of this thesis we conclude that patients with symptomatic OA only at the first CMC joint are best treated with trapeziectomy. It has less complications reported by various authors. Additional value of an interposition after trapeziectomy is questionable and if planned only autologous T1 tissue should be used. Routine use of CMC arthrodesis in these patients is not recommended, because too many complications occur due to delayed union and non-union (regardless of the use of bone grafting). The results of total joint prosthesis are only slightly better in the short-term and because costs are inevitably higher, it should only be used in a trial setting.

Patients with symptomatic OA at both the first CMC and scaphotrapeziotrapezoid (STT) joint: the available evidence says that there is no evidence for superiority of trapeziectomy with additional LR or LRTI, not even in the long-term. Since stage IV OA is characterized by more cartilage and soft-tissue damage (ligament wear) than stage II en III, we postulate that the thumb has an increased tendency to collapse in the palm, resulting in a typical zigzag deformity of the thumb. Therefore, we believe that an additional ligament reconstruction after trapeziectomy could still be a valuable treatment option in patients with stage IV OA (patients with symptomatic OA at the first CMC and STT joint). Performing additional LRTI in these patients is debatable, however based on our study we can say that if a LRTI technique is performed the Burton Pellegrini is preferable, because of the faster recovery. A recent meta-analysis reports that a higher probability of complications after an additional LRTI is due to the more comprehensive technique, but whether these complications are all clinically relevant is questionable, because present literature does not report the clinical relevance of the complications. Therefore, further research is warranted.

Conclusion

Based on the present evidence, patients with symptomatic OA only at the first CMC joint are best treated with trapeziectomy, because

trapeziectomy has less complications compared to a trapeziectomy with LRTI or trapeziectomy with a nonautologous interposition. CMC arthrodesis of the thumb should not be routinely used because of the high complication rate caused by delayed and non-union, regardless the use of a bone graft. Additionally, total joint prosthesis should only be performed in a trial setting. If patients have clinical symptoms at both the first CMC and STT joint, we postulate that trapeziectomy with an additional LRTI (Burton Pellegrini technique) is the best treatment option.

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