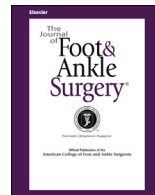




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Review Article

Incidence of Nonunion of the Hallux Interphalangeal Joint Arthrodesis: A Systematic Review

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ABSTRACT

Hallux interphalangeal joint arthrodesis is an effective procedure to treat pain and provide stability and is often performed for intrinsic pain to the hallux interphalangeal joint. Additionally, this procedure is typically used in concert with the Jones tenosuspension. Although this as an accepted technique, the available data are scant, and questions remain regarding nonunion rates and contributory factors to poor healing. A systematic review of the reported data were undertaken to determine the rate of nonunion for hallux interphalangeal joint arthrodesis. Seven studies involving 313 hallux interphalangeal joint arthrodeses met the inclusion criteria. The nonunion rate was 28.3% at a weighted mean follow-up period of 8.4 months. The overall complication rate was 33.0%. Considering the increased rate of complications and nonunion rate for this commonly used procedure, additional prospective comparative analyses are needed regarding this topic to identify important patient demographic data and determine superior fixation constructs.

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Arthrodesis of the hallux interphalangeal joint (HIPJ) is a surgical procedure indicated for a variety of disorders and conditions (1–4). Some of the described indications include arthritis, progressive neuromuscular disorders, structural malposition (including hallux valgus, hallux malleus, pes cavus, and associated claw hallux in conjunction with the Jones procedure), posttraumatic osteoarthritis, inflammatory arthritis, and a dislocated interphalangeal joint (1–5).

Multiple methods of fixation have been described for HIPJ arthrodesis, with no clear recommendations for a superior fixation construct limiting the incidence of nonunion (1,4–10). Nonunion can result in pain, edema, undesirable motion, failure of fixation, continued disability, and the requirement for revision surgery. To date, the incidence of nonunion has varied in the reported data (1–10). One study reported the nonunion rate was upward of 44% (5). More recently, Thorud et al (10) found a clinical nonunion rate of ≥17.8% and a radiographic nonunion rate of ≥13.8% in a multicenter retrospective study. Therefore, a systematic review of electronic databases was performed to identify the rate of nonunion after HIPJ arthrodesis.

Materials and Methods

We performed a systematic review of electronic databases and relevant peer-reviewed sources, including Embase® (Excerpta Medica Database; available at: <http://www.embase.com/>; last accessed June 10, 2017), Cochrane Database of Systematic Reviews (available at: <http://www.cochrane.org/reviews/>; last accessed June 1, 2017), PubMed (available at: <http://www.ncbi.nlm.nih.gov/pubmed/>; last accessed June 20, 2017), and OvidSP Medline® (available at: <http://ovidsp.tx.ovid.com/>; last accessed June 7, 2017). We searched each identified study for pertinent references. Only those that had involved HIPJ arthrodesis were included.

The 4 electronic databases were searched in June 2017. No restrictions were placed on data or language. We performed the present systematic review using an inclusive text word query “hallux interphalangeal” OR “hallux IPJ” OR “great toe” AND “arthrodesis” OR “fusion” AND “nonunion” OR “union” OR “complication” OR “outcome” (the capitalized words represent the Boolean operators). Each of us reviewed all reports, with a unanimous decision determining final inclusion. The references from the identified studies were then manually searched for additional potentially pertinent published reports, which were then secured for review.

To acquire the highest quality and most relevant studies available, the studies were eligible for inclusion only if they had involved patients undergoing HIPJ arthrodesis. Additionally, the studies were required to have a mean follow-up period of ≥6 weeks and the inclusion of appropriate details regarding complications, nonunion rates, and patient demographic data. If a reference could not be obtained through purchase, library assistance, or electronic mail contact with the author, it was excluded. If the reference was not written in English, it was translated by the primary author (M.A.P.) from its native language of German or Spanish to English using an Internet-based translator (Google Translate; available at: <http://translate.google.com/>; last accessed June 25, 2017).

Statistical analysis of the pooled data included the incidence of nonunion, weighted mean follow-up duration, and patient age. The data were weighted as follows: for each sample size, the numeric results were summed and then divided by the total sample size for all included studies (i.e., the weighted mean age was determined by taking the

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mean age for all patients in 1 study and multiplying it by the number of patients in the study and then repeating this for each study; the total number was then divided by the total number of patients, which resulted in the weighted mean age). A statistical description of the pooled data was then compiled and has been provided in the present report.

A complication was defined as dehiscence, infection, hardware complications, deep venous thrombosis, pulmonary embolus, recurrence, malunion, or nonunion. A reoperation was defined as an unplanned operation subsequent to the initial arthrodesis that was performed to address a complication. A revision was defined as a reattempt at arthrodesis.

The guidelines from the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) were used to design our review of the reported data. PRISMA is a 27-item checklist that is intended to improve review quality (11). This was supplemented by generating review quality scores. The methodologic quality of the included studies was assessed using the Coleman score (12). A score of 100 indicates the most high-quality study with no confounding factors or other biases. Two independent reviewers (E.S., M.D.W.) assessed the methodologic quality of the included studies. Conflicting scores for the various items were discussed until consensus was reached.

Results

The search for potentially eligible information for inclusion in the systematic review yielded a total of 442 studies. All references identified were obtained and reviewed by each of us in June 2017. After considering all the potentially eligible references, 7 (1.6%) met our inclusion criteria, 2 retrospective comparative studies, 2 retrospective case series, and 3 case studies (Fig.). A total of 291 patients with a weighted mean age of 48.9 years were included (Table 1). Of the studies that reported gender, 47 patients were male (47 of 152; 31.0%) and 105 were female (105 of 152; 69.0%; Table 1). The most common underlying comorbidities were neuromuscular conditions (103 of 286; 36.0%), followed by peripheral neuropathy (48 of 152; 31.6%; Table 2). Tobacco history was recorded in 1 study (10). Of the 151 patients, 25 (17.8%) were active smokers, 46 (30.9%) were former smokers, and 78 (52.4%) were never smokers. The most common indication for HIPJ arthrodesis was neuropathic-induced deformity (27 of 101; 26.7%; Table 2).

Nonunion was confirmed radiographically in 77 of 272 feet (28.3%). The revision rate of nonunion was 27.3% (21 of 77; Table 1) (4–8,10). In 1 report, with 44 cases of pseudoarthrosis with Kirschner wire fixation, 14 patients developed clinically significant symptoms an average of 41 months after the initial surgery (5). Of the 13 patients who underwent revision attempts for whom follow-up data were available, 2 eventually required amputation (5). Another study reported amputation was required in 5 of 152 patients (10). All studies specified the exact follow-up duration, which was a weighted mean of 8.4 months (Table 1) (1,4–8,10). Of 312 procedures, 103 complications were reported, for a complication rate of 33.0% (Table 1). For the studies that included the complication type, the most common were hardware-related complications, which occurred in 35 of 175 patients (20%) (4–6,10). The incidence of unplanned surgical removal of hardware occurred in 10.9% of all cases (Table 3). The overall incidence of

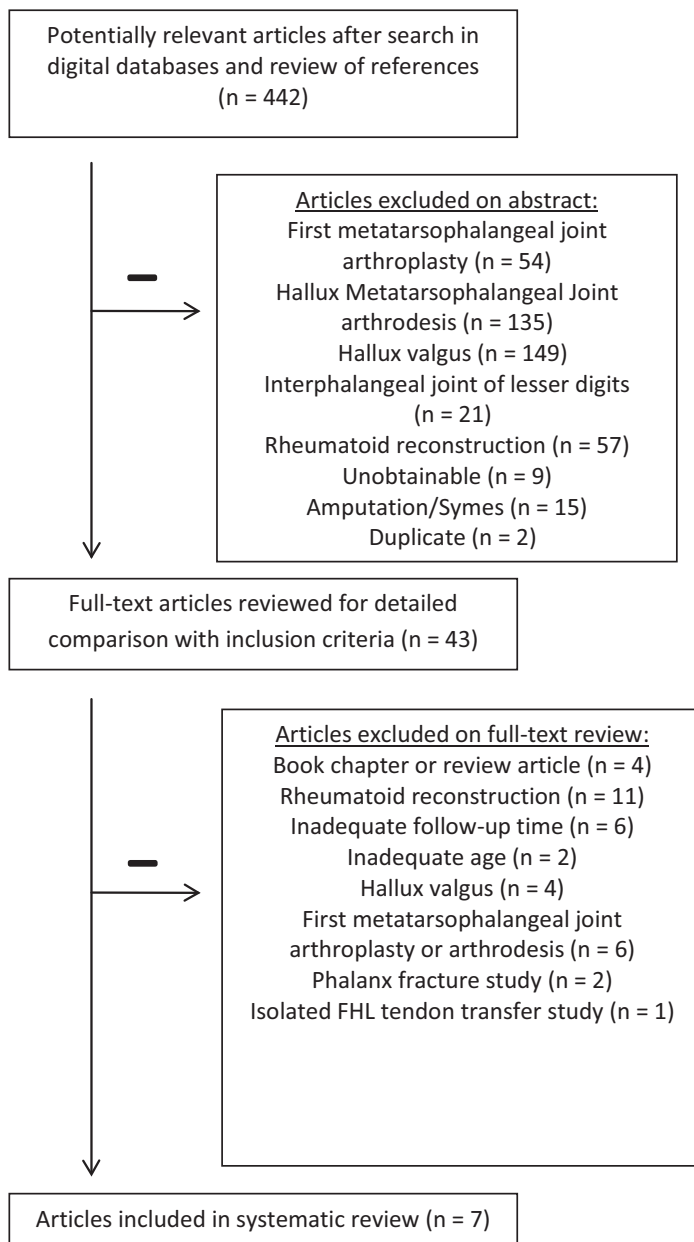


Fig. Flowchart of identified reports during the selection process.

Table 1
Demographic data included in the systematic review

Investigator (EBM)	Total Patients (n)	Feet (n)	Mean Age (y)	Fixation	Follow-up (mo)	Nonunion Rate (%)	Complications (%)	Revisions (%)
Shives et al (5), 1980 (IV)	85	101	NA	K-wire	6	43.6	13.9	29.5
	18	20	33.5	Screw	11.5 (2 to 36)	10	35	0
de Palma et al (1), 1997 (IV)	21	24	26.3 (15 to 51)	K-wire	48 (24 to 84)	4.2	20.8	NR
Faraj (8), 1997 (V)	12	12	24.5 (18 to 32)	K-wire	32 (24 to 36)	0	0	0
Hatori et al (4), 2006 (V)	1	1	58	Screw	48	0	0	0
Cansu (7), 2009 (V)	1	1	20	K-wire	15	0	NR	0
Babazadeh et al (6), 2011 (V)	1	2	74	Screw	36	0	0	0
Thorud et al (10), 2016 (III)	152	152	55.7	Multiple	1.5	27	49.3	26.6
Total	291	313	48.9		8.4	28.3	33.0	27.3

Data in parentheses are ranges. Abbreviations: EBM, evidence-based medicine; K-wire, Kirschner wire; NA, not available; NR, not reported.

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