

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

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## INTRODUCTION:

Arthrodesis of the hallux interphalangeal joint (HIPJ) is a surgical procedure indicated for treatment of various arthritic conditions, neuromuscular disorders, and deformities of structural malposition. (1-5) Although multiple methods of fixation exist, nonunion remains a recognized complication. Nonunion can result in pain, edema, undesirable motion, failure of fixation, continued disability, and need for surgical revision. Incidence of nonunion varies in the reported literature. (1-10) To further explore nonunion rates for HIPJ arthrodesis using different forms of fixation, a systematic review of electronic databases was performed.

## MATERIALS AND METHODS:

A systematic review of electronic databases containing articles involving HIPJ arthrodesis was performed. Four electronic databases (EMBASE, Cochrane, Pubmed, OvidSP Medline) were searched in June 2017. The systematic review was performed using the inclusive text word query “hallux interphalangeal” OR “hallux IPJ” OR “great toe” AND “arthrodesis” OR “fusion” AND “nonunion” OR “union” OR “complication” OR “outcome”, where the uppercase words represent Boolean operators. The was no restriction placed on date or language. All manuscripts were reviewed and manuscripts were included with unanimous agreement amongst investigators. Inclusion criteria required studies including patient undergoing HIPJ arthrodesis with a mean follow-up of six weeks and published detail regarding complications, nonunion rates, and patient demographics.

Fixation Type	N	Nonunions	Nonunion Rate by Fixation (%)
K-wire	158	51	32.3
Single screw	121	19	15.7
Crossing screw	17	3	17.6
Other	14	4	28.6

Table 2- Nonunion rate according to fixation type

Author (year) [EBM]	Total Patients	Feet (N)	Mean Age (yr)	Fixation	Follow-up (mo) [range]	Non-union Rate (%)	Complications (%)	Revisions (%)
Shives (1980) [IV]	85	101	NA	K-wire	6	43.6	13.9	29.5
	18	20	33.5	Screw	11.5 [2-36]	10	35	0
De Palma (1997) [IV]	21	24	26.3 [15-51]	K-wire	48 [24-84]	4.2	20.8	NR
Faraj (1997) [V]	12	12	24.5 [18-32]	K-wire	32 [24-36]	0	0	0
Hartori (2006) [V]	1	1	58	Screw	48	0	0	0
Cansu (2009) [V]	1	1	20	K-wire	15	0	NR	0
Babazadeh (2011) [V]	1	2	74	Screw	36	0	0	0
Thorud (2016) [III]	152	152	55.7	Multiple	1.5	27	49.3	26.6
<b>Total</b>	<b>291</b>	<b>313</b>	<b>48.9</b>		<b>8.4</b>	<b>28.3</b>	<b>33.0</b>	<b>27.3</b>

Table 1- Demographic Data included in Systematic Review

## RESULTS:

The search of databases for manuscripts potentially eligible for inclusion in the systematic review yielded a total of 442 manuscripts. All references identified were obtained and reviewed by each investigator in June 2017. After considering all the potentially eligible references, seven (1.6%) were found to meet our inclusion criteria. Specifically, there were two level III studies, two level IV studies and three level V studies that meet inclusion criteria (Table 1). There was heterogeneity in study type, fixation technique, indications for surgery, and study size among the included studies (Table 1). A total of 291 patients with a weighted mean age of 48.9 were included (Table 1). All studies specified follow-up, with a weighted mean of 8.4 months (Table 1). (3-9)

Out of the seven included articles, radiographically confirmed nonunion occurred in 77/272 (28.3%) feet (Table 2). For the studies that included it, the revision rate of nonunion was 27.3% (21 out of 77) (Table 1). (4-9) In one report, that involved 44 instances of pseudoarthrosis with K wire fixation, 14 patients developed clinically significant symptoms at an average of 41 months after initial surgery. (5) This led to 13 revision attempts with two eventually requiring amputation. (5) Another study required amputation in five patients. (9) There were 103 reported complications out of the reported 312 procedures, which yielded a complication rate of 33.0%, (Table 1).

For the studies that included it, the most common complication were hardware-related complications, which occurred in 35 out of 175 patients (20%). (4,5,8,9) The incidence of unplanned surgical removal of hardware occurred in 10.9% of all cases (Table 3). The overall incidence of dehiscence was 12.3% and incidence of infection was 14.9%. When breaking down incidence of nonunion according to form of fixation, K-wire fixation was most common at 32.3%, then crossing screw at 17.6%, then single screw fixation at 15.7% (Table 2)

Author (year) [EBM]	Feet (N)	Dehiscence (%)	Infection (%)	Hardware Complications (%)	DVT /PE (%)	Recurrence (%)	Malunion (%)	Reoperation Rate (%)	Hardware removal rate (%)
Shives (1980) [IV]	101	NR	NR	NR	NR	NR	NR	0	0
	20	NR	5.0	40.0	NR	NR	NR	50.0	7.0
De Palma (1997) [IV]	24	NR	NR	NR	NR	12.5	8.3	0	0
Faraj (1997) [V]	12	NR	NR	NR	NR	16.7	NR	0	0
Hartori (2006) [V]	1	0	0	0	0	0	0	0	0
Cansu (2009) [V]	1	NR	NR	NR	NR	NR	NR	0	0
Babazadeh (2011) [V]	2	0	0	0	0	0	0	0	0
Thorud (2016) [III]	152	12.5	16.4	17.8	2.6	NR	NR	23.0	27.0
<b>Total</b>	<b>291</b>	<b>12.3</b>	<b>14.9</b>	<b>20.0</b>	<b>2.6</b>	<b>12.8</b>	<b>7.4</b>	<b>14.3</b>	<b>10.9</b>

Table 3- Complication and Reoperation Rate

## DISCUSSION:

The purpose of the present systematic review was to evaluate the incidence of nonunion after HIPJ arthrodesis. A review of the presented data allows for some generalized statements regarding arthrodesis of the HIPJ. Although subgroup analysis was not attainable, our findings suggest the identified nonunion rate is 28.3% at weighted mean follow-up of 8.4 months for HIPJ arthrodesis. The revision rate for nonunion was 27.3%. The radiographically apparent nonunion incidence was lowest for single screw fixation. The improved union rate is likely due to the screw’s ability to achieve compression. The most common cause for reoperation was hardware removal. With a relatively high nonunion rate determined in the present systematic review, additional studies should be undertaken to validate our findings. Only then can a critical comparison be undertaken to define which operative technique and osteosynthesis method minimizes the risk of nonunion development. There is a need to standardize the reporting of patient outcomes and satisfaction. Further research is warranted, including methodologically sound, appropriately powered prospective cohort studies focusing on long-term outcomes comparing joint preparation techniques and fixation constructs.

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