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 deformities of structural malposition. (1-5) 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 is most suitable. 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.

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.

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 281 patients with a weighted mean age of 48.9 years (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 undertaken to validate our findings. Only then can a critical comparison be undertaken to define which operative technique and osteosynthesis method is most suitable. 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.

<table>
<thead>
<tr>
<th>Author/year [(EBM)]</th>
<th>Total Patients</th>
<th>Feet (%)</th>
<th>Mean Age (yr)</th>
<th>Fixation</th>
<th>Follow-up (mo)</th>
<th>Non-union Rate (%)</th>
<th>Complications (%)</th>
<th>Revisions (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shives (1980) [IV]</td>
<td>85</td>
<td>101</td>
<td>NA</td>
<td>K-wire</td>
<td>6</td>
<td>43.6</td>
<td>13.9</td>
<td>29.5</td>
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<tr>
<td>De Palma (1997) [IV]</td>
<td>18</td>
<td>20</td>
<td>33.5</td>
<td>Screw</td>
<td>11.5 [2-36]</td>
<td>10</td>
<td>35</td>
<td>0</td>
</tr>
<tr>
<td>Cansu (2009) [V]</td>
<td>1</td>
<td>1</td>
<td>58</td>
<td>Screw</td>
<td>48</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Babazadeh (2013) [V]</td>
<td>1</td>
<td>2</td>
<td>74</td>
<td>Screw</td>
<td>36</td>
<td>0</td>
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<td>0</td>
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<tr>
<td>Thorud (2016) [III]</td>
<td>152</td>
<td>152</td>
<td>55.7</td>
<td>Multiple</td>
<td>1.5</td>
<td>27</td>
<td>49.3</td>
<td>26.6</td>
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<tr>
<td>Total</td>
<td>291</td>
<td>313</td>
<td>48.9</td>
<td></td>
<td>8.4</td>
<td>28.3</td>
<td>33.0</td>
<td>27.3</td>
</tr>
</tbody>
</table>

Table 1: Demographic Data included in Systematic Review

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 is most suitable. 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.

REFERENCES:

Table 2: Nonunion rate according to fixation type

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