Risk Factors for Failure of Hemiepiphysiodesis in Blount Disease: Systematic Review

LLRS Annual Meeting 2016

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History of Treatment in Blount

- Bracing
- Osteotomy
- Permanent Hemiepiphysiodesis
  - Drill Hemiepiphysiodesis
  - Phemister
- Temporary Hemiepiphysiodesis
  - Blount Staple
  - Non-locking extra-periosteal plate

Schoenecker et al. CH28. Lovell & Winter Pediatric Orthopedics 2006, 6th e, Lippincott Williams Wilkins, Phil
Question

1. What is the prevalence of unplanned reoperation following lateral hemiepiphysiodesis using implants?

2. Is there a difference in clinical outcome and complications based on age at surgery and type of implant?
Methods

• Systematic Review
• PRISMA Guidelines

Preferred Reporting Items for Systematic reviews and Meta-Analyses

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<table>
<thead>
<tr>
<th>Section/Topic</th>
<th>Item #</th>
<th>Checklist Item</th>
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<tbody>
<tr>
<td>TITLE</td>
<td>1</td>
<td>Identify the report as a systematic review, meta-analysis, or both.</td>
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<tr>
<td>ABSTRACT</td>
<td>2</td>
<td>Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria; participants; and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.</td>
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<tr>
<td>INTRODUCTION</td>
<td></td>
<td>Describe the rationale for the review in the context of what is already known. Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).</td>
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<tr>
<td>METHODS</td>
<td>3-16</td>
<td>Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number. Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale. Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched. Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated. State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis). Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators. Define and name all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made. Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis. Describe the principal summary measures (e.g., risk ratio, difference in means). Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I²) for each meta-analysis. Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies). Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression). If done, indicating which were pre-specified. Describe numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram. Study characteristics: For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations. Risk of bias within studies: Present data on risk of bias of each study and, if available, any outcome-level assessment (see Item 12). Results of individual studies: For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group and (b) effect estimates and confidence intervals, ideally with a forest plot. Synthesis of results: Present results of each meta-analysis done, including confidence intervals and measures of consistency. Risk of bias across studies: Present results of any assessment of risk of bias across studies (see Item 15). Additional analysis: Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression) (see Item 16). DISCUSSION</td>
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Eligibility Criteria

PICOS

• Patient/Problem
  – Blount disease (late and early onset)

• Intervention
  – Temporary hemiepiphysiodesis

• Comparison
  – Expected outcome vs. unplanned reoperation

• Outcome
  – Expected outcome: “neutral” mechanical axis
  – Unplanned reoperation (implant failure, infection, under-correction, over-correction, other)
Information Sources

- Pubmed
- CINAHL
- OVID
- Web of Science
- SCOPUS
Inclusion and Exclusion Criteria

**Inclusion**
- Itemized patient data
- Blount disease
  - Early onset
  - Late onset
- Use of temporary hemiepiphysiodesis
  - Lateral proximal tibia
  - Lateral distal femur

**Exclusion**
- No Itemized patient data
- Other causes of angular deformity
Search and Study Selection

FIGURE 1. Detail databases searching and adapted PRISMA flow diagram for study inclusion.
Search terms: (blount OR blouts OR tibia vara OR bow legged) AND (guided growth OR hemiepiphyseodesis OR osteotomy OR staples OR Phemister)

Database Search

Ovid Medline (1965 to Aug 31, 2015) Records, n=178
Scopus (1965 to Aug 31, 2015) Records identified, n=0
Web of Science (1965 to Aug 31, 2015) Records, n=176
CINAHL (1965 to Aug 31, 2015) Records, n=16

Records identified through database searching, n=690
Records screened, n=106 (Abstracts reviewed)

Records excluded, n=81

Full-text articles assessed for eligibility, n=25

Records excluded, n=17
- Review article/Technique Guide:
- Letter to Editor:
- Not enough data:
- Duplicate patients:
- Not relevant:

Studies included in qualitative analysis, n=8
Data Items

- **Demographics**
  - Age @ surgery, early vs. late onset Blount, operated segment (femur/tibia)

- **Method of Treatment**
  - Lateral hemiepiphysiodesis
    - Staples
    - Extraperiosteal plate

- **Mode of Failure**
  - Implant break/backing out, infection, under-correction, over-correction, other

- **Outcome**
  - Expected Outcome – “Neutral” mechanical axis
  - Unplanned surgery
    - Osteotomy,
    - Removal of broken hardware,
    - I&D,
    - Revision
Results

- 53 patients (63 limbs)
  - 18 early onset Blount
  - 9 late onset Blount
  - 36 unspecified

- Laterality of surgery
  - 17 left side
  - 10 right side
  - 36 unreported

- Location of Surgery
  - 54 tibias
  - 8 femur + tibia
  - 1 femur only
Results

< 9 yo @ surgery

- N = 27 limbs
- Age @ surgery = 4.7 yo
- Length F/U = 19 month
- 17/27 (63%) expected outcome
- 10/27 (37%) unplanned reoperation

≥ 9 yo @ surgery

- N = 36 limbs
- Age @ surgery = 12 yo
- Length F/U = 23 month
- 16/36 (44%) expected outcome
- 20/36 (56%) unplanned reoperation
Results

**Staples**
- N = 16 limbs
- Age @ OR = 6.9 yo
- Length F/U = 24 month
- 6/16 (37%) expected outcome
- 10/16 (63%) unplanned reoperation

**Plates**
- N = 47 limbs
- Age @ OR = 11 yo
- Length F/U = 20 month
- 25/47 (53%) expected outcome
- 22/47 (47%) unplanned reoperation
16 staples as index surgery

Loose staple (N=2)

Osteotomy

Expected outcome (N=6)

Osteotomy for under correction (N=2)

Over correction (N=1)

Epiphysiodesis for LLD (N=2)

Expected outcome (N=2)

Revision to plate (N=5)

Infection

Screw break

Osteotomy

6/16
37%
Discussion

• Data is limited
  – Published articles do not itemize data

• Unplanned subsequent procedures and complications are commonly reported

• *Older age and use of Staples more frequently had unplanned surgeries*
Bias

- **Selection Bias**
  - Patients selected from studies that looked at failure

- **Publication Bias**
  - Studies with statistically significant results more likely to be published

- **History Bias**
  - After 2007 most published research on plates and not staples
Conclusion

- Published studies contain heterogeneous data
- High prevalence (51%) of unplanned subsequent procedures and complications published in literature
- **Older age and use of Staples more frequently had unplanned surgeries**
References

BMI

- Westberry 2004
  - Retrospective; 33 limbs (Blount pts); staples and plates; **BMI not significant for subsequent surgery**
- Bushnell 2009
  - Retrospective; 67 limbs (late onset Blount pts); staples; body weight was not significant for amount of correction
- McIntosh 2009
  - Retrospective; 64 limbs (adolescent Blount), permanent hemiepiphysiodysis; **BMI > 45 significant for clinical failure**
- Schroerlucke 2009
  - 18 limbs (adolescent Blount); plates; **failure in increasing heavier population but not statistically significant**
- Funk 2016
  - 38 limbs (late onset Blount); staples and plates; **BMI significant for surgical failure (BMI 42)**
Preop Deformity

• Westberry 2004
  – Preop MA significant for subsequent surgery after staples

• Bushnell 2009
  – Less deformity an independent predictor for greater correction in staples

• McIntosh 2009
  – A smaller mPTA associated with clinical failure in permanent hemiepiphysiodesis

• Funk 2016
  – Greater deformity results in higher surgical failure in staples and plates
Age

• Raab 2001 – higher rate of staple loosening in girls > 9yo and boys >11 yo
• Westberry 2004 – not significant for subsequent surgery
• Park 2005 – stapling better when started younger
• Bushnell 2009 – younger age is an independent predictor for greater deformity correction
• McIntosh 2009 – older age a risk for clinical failure in permanent hemiepiphysidesis
• Schroerlucke 2009 – age NOT significant for screw break
• Funk 2016 – younger age significant for implant failure