The Birmingham Interlocking Pelvic Osteotomy (BIPO) for Acetabular Dysplasia: 13 to 21 Year Survival Outcomes

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Introduction

- Acetabular dysplasia is characterized by deficient superior and anterior coverage of the femoral head associated with reduced acetabular depth and lateralization of the femoral head.
- Arthroplasty in young, active patients is likely to require at least one revision during the patient’s lifetime.
- Whereas each arthroplasty revision is accompanied by increasing risks and deteriorating outcomes, a successful reorientation osteotomy has been shown to reduce pain, improve joint stability, and delay the development of osteoarthritis.
Purpose

- To identify mid- to long-term clinical and functional outcomes in a consecutive series of the first 100 patients undergoing treatment with a Birmingham Interlocking Pelvic Osteotomy (BIPO), covering the developing surgeon’s learning curve.
Methods

- Retrospective analysis of prospectively collected data
- Consecutive cohort of the first 100 patients treated by BIPO for symptomatic acetabular dysplasia
- Patients treated between January 1992 and June 2000
Methods

• Inclusion criteria for operation:
  – Hip pain for minimum 6 months AND
  – Failed conservative management AND
  – Hip ROM sufficient to allow rotation of the acetabulum to produce a congruent joint without impingement AND
  – Lateral center edge (LCE) angle < 25º OR
  – Sourcil angle > 10º OR
  – Interruption of the Shenton line

• Exclusion criteria:
  – Radiographic evidence of osteoarthritis (Tönnis grade > 2)
  – BMI > 40
  – Previous hip surgery
Methods

Surgical technique

• Two-stage procedure as described by Kumar et al (J Pediatr Orthop 2002)
• Ischial osteotomy is performed through a mini-incision posterior approach from the greater sciatic notch to the obturator foramen
• In the second stage, an anterior incision is made to access the ilium and pubis
• Superior pubic ramus is cut just medial to the quadrilateral plate
Methods

• Three interconnected iliac osteotomies are made, forming two equal interstitial angles that determine the extent of lateral coverage to be gained.
Methods

- Two external fixator pins are applied to the central acetabular fragment (CAF), offset in the transverse axial and mid-coronal planes by the degree of desired axial and coronal correction, respectively.
- When the CAF is subsequently rotated to the desired position, the external fixator pins become aligned with the axial and coronal planes, providing visual confirmation of successful positioning.
- Once realigned, the three interconnected iliac osteotomies create an interlocking construct with good bony apposition and improved fragment stability, allowing for immediate unrestricted weight bearing.
Methods

- Outcomes assessed at follow-up included:
  - Conversion rate to hip arthroplasty
  - Oxford Hip Score (OHS) (Dawson et al, 1996)
  - University of California Los Angeles (UCLA) score (Amstutz et al, 1984)
  - Harris Hip Score (Harris, 1969)
  - LCE angle
  - Sourcil angle
  - Tönnis grade of osteoarthritis
Results

- 116 BIPO procedures performed in 100 patients
- 88 procedures in females, 28 in males
- Mean follow-up was 17.5 years (range, 13-21 years)
- Three hips (2.5%) lost to follow-up
- For 66 patients with surviving radiographs, preoperative OA grade is shown below:

<table>
<thead>
<tr>
<th>Preoperative Tönnis grade</th>
<th>N (% of total)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>44 (67%)</td>
</tr>
<tr>
<td>1</td>
<td>21 (32%)</td>
</tr>
<tr>
<td>2</td>
<td>1 (2%)</td>
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</tbody>
</table>
Results

- Changes in LCE and Sourcil angle are shown below
- There was no significant difference between the postoperative LCE angle in surviving versus failed BIPOs (49.8º vs 51.3º, p = 0.72)
- Median OHS at follow-up was 41 (inter-quartile range [IQR] 23.5 to 46.0)
- Median UCLA score at follow-up was 5 (IQR 3 to 6.5)
- Harris Hip Score increased from preoperative median 52 (range, 44-72) to postoperative median 90.5 (range, 59-100)

<table>
<thead>
<tr>
<th></th>
<th>Preoperative Mean (SD)</th>
<th>Postoperative Mean (SD)</th>
<th>Mean difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sourcil angle</td>
<td>23 (12)</td>
<td>2 (9)</td>
<td>21</td>
</tr>
<tr>
<td>LCE angle</td>
<td>19 (14)</td>
<td>50 (17)</td>
<td>32</td>
</tr>
</tbody>
</table>
Results

• At latest clinical follow-up, 38 of 116 hips (33%) had undergone hip arthroplasty (34 resurfacing, 4 total hip arthroplasty)
• Mean survival at 12.5 years and 17.5 years was 76.0% (95% CI 67.5-84.3%) and 54.0% (95% CI 34.1-67.9%), respectively
• Increasing age at time of surgery was a significant predictor of treatment failure: Hazard ratio of 1.03 per every year increase in age (p = 0.024, 95% CI 1.00-1.06)
• The following were NOT found to be associated with surgery failure:
  – Preoperative Tönnis OA grade (0 and 1 only) (p = 0.78)
  – Preoperative (p = 0.23) or postoperative (p = 0.93) Sourcil angle
  – Preoperative (p = 0.54) or postoperative (p = 0.54) LCE angle
Results

Postoperative complications included:
- 1 pulmonary embolism at 36 hrs postoperatively from a contralateral 12 day old deep venous thrombosis (DVT)
- 2 DVTs
- 3 non-unions (2 pubis, 1 ischium)
- 1 transient sciatic nerve palsy
- 2 permanent lateral femoral cutaneous nerve injuries
- 1 iatrogenic pincer-type femoroacetabular impingement
- 1 infection
Discussion

• The BIPO was developed to address shortcomings of the Tönnis and Bernese osteotomies
• The use of a posterior mini-incision enables the surgeon to make the ischial cut under direct visualization with the sciatic nerve retracted away from the field
• The BIPO also has a lower risk of intra-articular osteotomy or unintentional propagation or fracture into the acetabulum
• The overall rate of complications associated with the BIPO technique in our study was 10.4%, significantly lower than that described by Biedermann et al [Int Orthop 2008] for the Bernese PAO (minor complications 41%, major complications 37%)
• Another important advantage of the BIPO technique over other pelvic realignment procedures is its inherent stability, allowing patients to weight bear immediately after surgery
Conclusions

- The Birmingham Interlocking Pelvic Osteotomy (BIPO) allows accurate and stable positioning and fixation of the central acetabular fragment permitting immediate postoperative weight bearing and rapid rehabilitation.
- As with other operations, there was an increasing failure rate with increasing patient age and hip arthritis grade.
- The BIPO survival rates are comparable to the Bernese PAO, even during the surgeon’s learning curve.
References


References