

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



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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



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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 $< 25^{\circ}$ OR
 - Sourcil angle $> 10^{\circ}$ OR
 - Interruption of the Shenton line
- Exclusion criteria:
 - Radiographic evidence of osteoarthritis (Tönnis grade > 2)
 - BMI > 40
 - Previous hip surgery



Methods

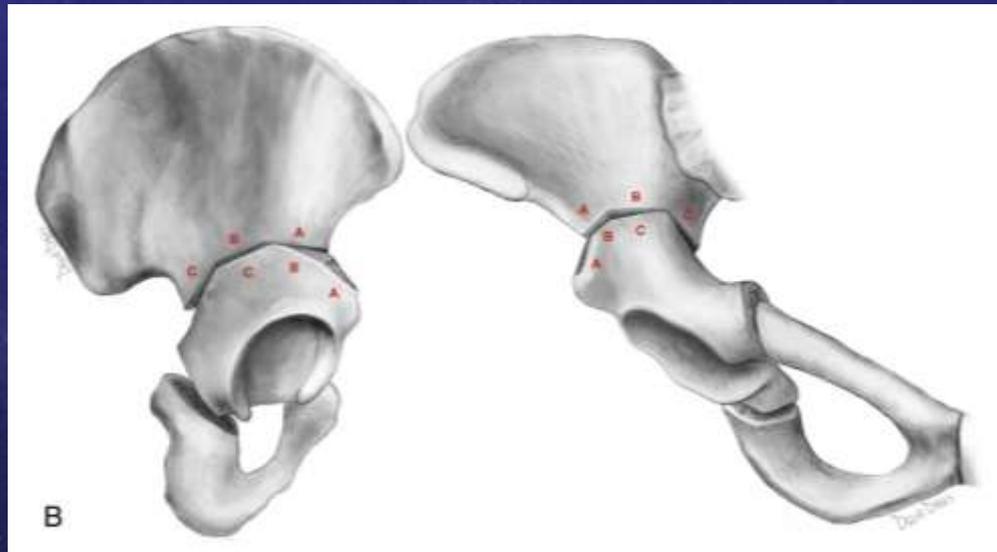
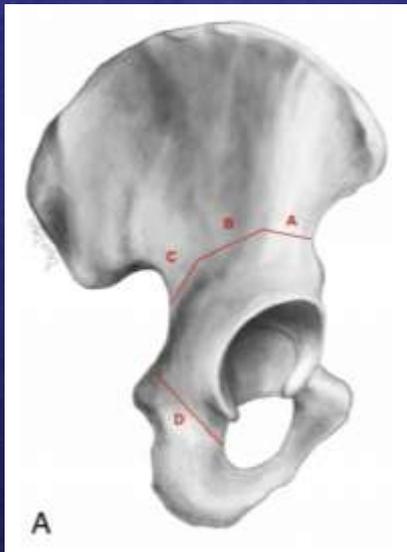
Surgical technique

- 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



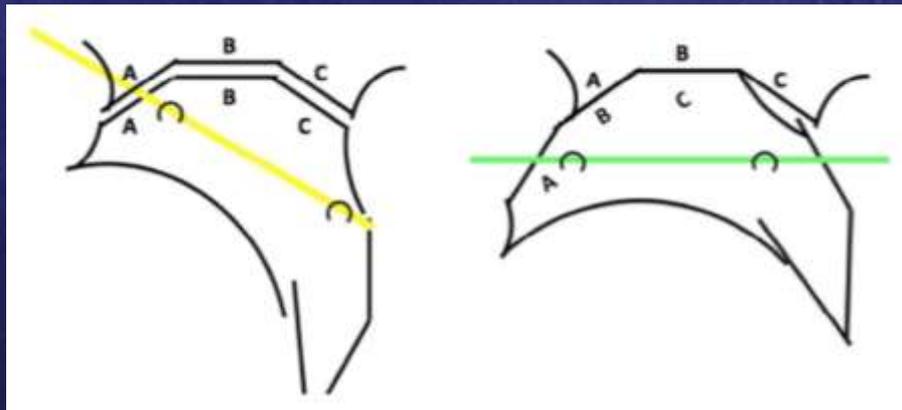
Methods

- 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



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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:

Preoperative Tönnis grade	N (% of total)
0	44 (67%)
1	21 (32%)
2	1 (2%)



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 (49.8° vs 51.3°, $p = 0.72$)
- 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)

	Preoperative Mean (SD)	Postoperative Mean (SD)	Mean difference
Sourcil angle	23 (12)	2 (9)	21
LCE angle	19 (14)	50 (17)	32



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



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