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Total Hip Arthroplasty in Patients With Severe Chronic Pubic Diastasis

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ABSTRACT

Background: Total hip arthroplasty (THA) in patients with severe chronic pubic diastasis from either congenital or acquired causes presents an exceptionally difficult challenge that has rarely been addressed in the arthroplasty literature. The purpose of this paper is to present a series of THAs in patients with severe chronic pubic diastasis, asking the following research questions: (1) What is the survivorship and clinical outcomes after THA in patients with severe chronic pubic diastasis? And (2) What is the rate of complications after THA surgery in this challenging patient population? We additionally describe our algorithm for preoperative planning and rationale for surgical technique and implant position.

Material and methods: We retrospectively queried the prospective arthroplasty database of 2 high-volume referral centers, yielding 6 THA in 4 patients with severe chronic pubic diastasis (minimum 8 cm) with a mean follow-up of 2.7 years. We recorded baseline demographic and intraoperative variables, as well as survivorship, patient-reported outcomes (Hip disability and Osteoarthritis Outcome Score for Joint Replacement score), and incidence of complications.

Results: There were no failures reported (100% survivorship) at a mean follow-up of 2.7 years. Mean Hip disability and Osteoarthritis Outcome Score for Joint Replacement scores improved from 36.0 preoperatively to 82.8 postoperatively. There were no infections, dislocations, fractures, or any major complications in the postoperative period.

Conclusion: THA for patients with severe chronic pubic diastasis remains a rare but challenging reconstructive procedure. Excellent outcomes can be achieved with adequate preparation, particularly regarding the acetabular component position. Understanding the nature of the hemipelvis deformity and meticulous templating using “normalized” views of the hip are important components to a successful preoperative plan.

Introduction

Total hip arthroplasty (THA) is a highly successful intervention for degenerative conditions of the hip [1]. However, congenital or acquired deformities of the hip or pelvis add to the complexity of the surgery and continue to pose a reconstructive challenge. For example, in developmental dysplasia of the hip or Legg-Calve-Perthes disease, anatomic challenges exist on both the acetabular and femoral sides, particularly if the patient has previously undergone a corrective surgery [2-6]. While they remain technically demanding, these hip deformities have been studied extensively in the arthroplasty literature, and their surgical solutions are well described [2-7].

However, THA in patients with severe chronic pubic diastasis from either congenital (such as congenital exstrophy of the bladder) or acquired (such as post-traumatic) causes presents an exceptionally difficult challenge that has rarely been addressed in the arthroplasty literature. This lack of discussion is partly due to the low incidence of congenital bladder exstrophy, which is

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estimated to be identified in 2.15 out of 100,000 live newborns [8]. Post-traumatic cases of pubic diastasis are rarely encountered in the late reconstructive setting, as these are typically life-threatening emergencies that, in the modern era, are addressed with early reduction and operative fixation [9]. For those patients with severe chronic pubic diastasis, whether congenital or post-traumatic, little is known about the clinical outcomes after THA.

Thus, the purpose of this paper is to present a series of THAs in patients with severe chronic pubic diastasis and ask the following research questions: (1) What is the survivorship and clinical outcomes after THA in patients with severe chronic pubic diastasis? And (2) What is the rate of complications after THA surgery in this challenging patient population? In addition, we describe our algorithm for preoperative planning and rationale for surgical technique and implant position.

Material and methods

Study design

The present study is a retrospective review of a prospectively collected series of patients from 2 high-volume orthopedic referral centers. Approval for the study was obtained by the individual institutional review board of the participating centers prior to its commencement. We queried the respective institutional arthroplasty databases and included all patients undergoing elective, primary unilateral THA with a diagnosis of severe chronic pubic diastasis and osteoarthritis between March 2015 and December 2020. This yielded a total of 6 THAs in 4 patients with a mean follow-up of 2.7 years (range 1.0-5.7 years). The size of the pubic diastasis was assessed radiographically by measuring the gap (in millimeters) between the 2 separated ends of the pubic symphysis, and we considered any diastasis greater than 80 mm to be “severe” and were thus included for analysis. Specific demographic and radiographic variables were collected for each patient. We also collected intraoperative data including implant type, head size, bearing, and surgical approach.

Preoperative planning and surgical technique

Prior to THA, all patients underwent digital templating using a commercially available computer software program. In specific cases, a preoperative computed tomography scan may be indicated to determine areas of bone deficiency or better understand the nature of the pelvic deformity. THA was performed in this series using 1 of 3 approaches, depending on the preference of the surgeon: direct anterior (DA), anterolateral, or posterior. In cases where the DA approach was used, surgery was performed in the supine position on a traction table using a peroneal post.

The pubic diastasis deformity results in a native acetabular position that is excessively vertical and retroverted (Fig. 1). Thus, for preoperative planning films, the patient is internally rotated 20°-30° with respect to the radiographic beam to obtain a “normalized” anteroposterior (AP) view of the operative hip and hemipelvis (Fig. 2). This “normalized” view of the hip and hemipelvis is then used for preoperative templating. If intraoperative fluoroscopy is used, this view is re-created during surgery to ensure accurate acetabular component positioning (Fig. 3). Cup preparation and impaction then proceed according to the preference of the surgeon (Fig. 4). Reaming is typically performed to the anatomic hip center, although the cup position may be lateralized a few millimeters if needed to achieve the appropriate offset. The cup is then impacted, aiming for 40° of inclination and 20° of anteversion with respect to the “normalized” hemipelvis. The “normalized” view can be compared with a standard AP view of the affected hip in Figure 5. A high-speed burr may be used to take down excess anterior wall bone to avoid anterior impingement in cases of excess anterior wall osteophyte (Fig. 1).

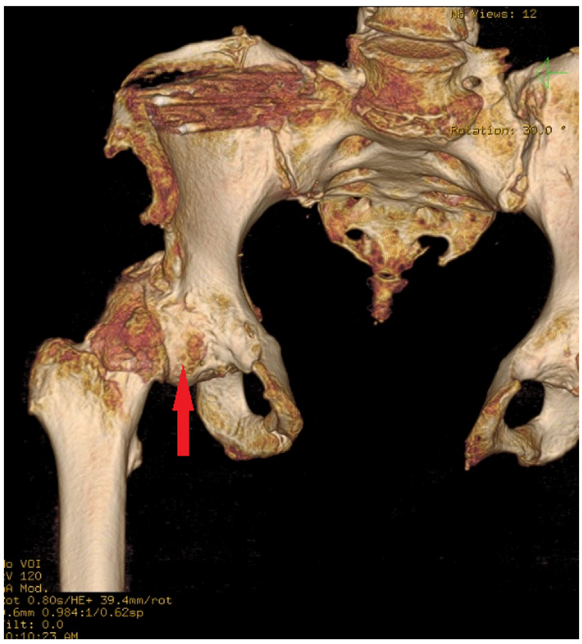

Figure 1. Patient with chronic post-traumatic pubic diastasis. The deformity of the hemipelvis positions the acetabulum in an excessively vertical and retroverted position. The red arrow demonstrates the excess anterior wall osteophyte.

On a typical AP pelvic radiograph, the final cup anteversion may appear neutral or even slightly retroverted. However, this is due to the excessive external rotation deformity of the hemipelvis rather than malposition of the cup itself (Fig. 4). The femoral

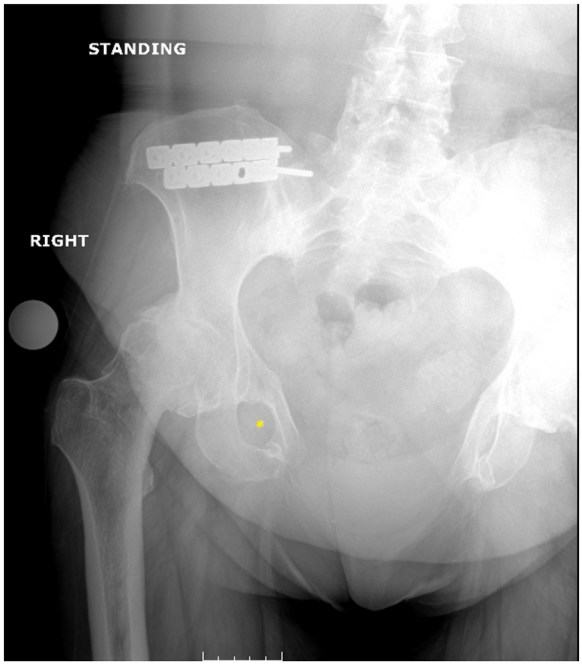

Figure 2. For preoperative planning, a standing anteroposterior radiograph is taken with the patient's pelvis internally rotated 20°-30° to obtain a “normalized” view of the hemipelvis, with more normal-appearing morphology of the obturator foramen (asterisk).

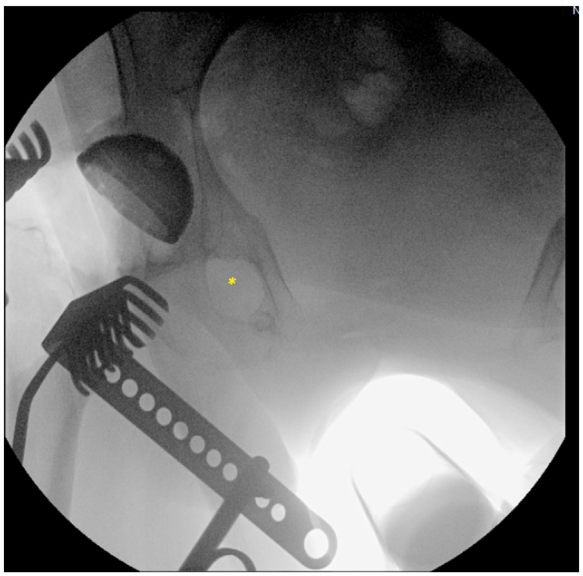

Figure 3. Intraoperatively, the "normalized" view of the standing hemipelvis is re-created using fluoroscopy to navigate the cup position. Note the more normal-appearing morphology of the obturator foramen. In this case, the cup position was reamed under fluoroscopy and lateralized several millimeters to maintain the patient's native hip offset. Asterisk (*) denotes the position of the obturator foramen.

reconstruction proceeds according to the surgeon's usual protocol; we do not specifically adjust the femoral version for patients with pubic diastasis. The final bearing choice is left to the surgeon's discretion although larger head sizes or dual mobility (DM) bearings may be considered to maximize stability in these challenging patients.

Study outcomes

The primary outcome was revision-free survivorship of the implant, defined as the time elapsed from the date for surgery. We also determined patient-reported outcomes (Hip disability and Osteoarthritis Outcome Score for Joint Replacement) for each patient, as secondary.

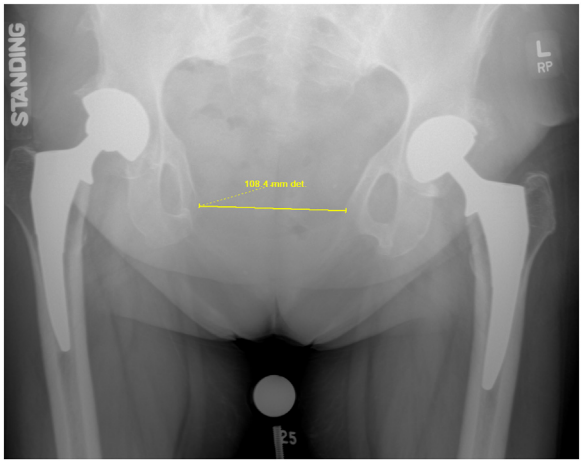

Figure 4. The cup appearance on postoperative anteroposterior pelvis film may appear neutral or even slightly retroverted due to the external rotation deformity of the hemipelvis. Note the slightly lateralized position of the right acetabular component to reconstruct the patient's high offset. A line between the 2 separated ends of the pubic symphysis demonstrates a pubic diastasis of 108 mm.

Results

A total of 6 THAs were performed in 4 patients with pubic diastasis: 4 THAs in patients with congenital exstrophy of the bladder and 2 THAs (staged bilateral) in a patient with a chronic post-traumatic open-book pelvis. Demographic and intraoperative variables are reported in Table 1. Anterior-based approaches were preferred (4 DA, 1 anterolateral, 1 posterior), and larger head sizes were used (36-mm and 40-mm heads). Two THAs received a DM bearing.

There were no failures in the cohort (100% survivorship) at the time of final follow-up, with a mean follow-up of 2.7 years (range 1.0-5.7 years). Four hips had clinical outcome scores available for review; the average Hip disability and Osteoarthritis Outcome Score for Joint Replacement score improved from 36.0 preoperatively to 82.8 postoperatively. There were no infections, dislocations, fractures, or any major complications in the postoperative period.

Discussion

In patients with severe chronic pubic diastasis, THA is a rarely encountered reconstructive challenge. However, these patients still benefit significantly from THA, and appropriate pre-operative planning may still achieve a successful outcome. In the present study evaluating a small cohort of THA patients with chronic pubic diastasis, we found 100% survivorship at mean a follow-up of 2.7 years, with patient-reported outcomes comparable to standard THA and no major complications.

Our study has multiple potential limitations. First, because THA in patients with pubic diastasis is such a rare event, we have a relatively small patient population presented in this case series, limiting our results' general applicability. Another limitation of this study is the variability introduced from different implants and surgical approaches utilized in our case series, which again may limit the applicability of our patients to those treated at other centers. However, we feel the strength of this study is that it is to date the largest known series of THAs in patients with pubic diastasis, and we report our recommended preoperative planning, surgical technique, clinical outcomes, and survivorship at a mean follow-up of 2.7 years (minimum 1 year).

Previous authors have rarely reported on THA in patients with congenital pubic diastasis secondary to bladder exstrophy, and these reports do highlight the challenging reconstructive nature of such cases. Camera et al. described a 39-year-old female with a stiff, painful right hip and congenital pubic diastasis due to bladder exstrophy [10]. The authors used a press-fit porous tantalum acetabular component, a press-fit splined tapered titanium femoral stem, and a 28-mm modular head with a monopolar bearing; follow-up at 14 months demonstrated good clinical and radiographic outcomes [10].

Drobniewski et al. reported on 2 patients with congenital pubic diastasis secondary to bladder exstrophy [11]. The first was a 53-year-old female with severe right hip pain. The authors used an anterolateral approach with a porous-ingrowth titanium acetabular component, a short broach-only curved press-fit stem with a proximal-bilateral conical shape and reduced distal geometry, and a 32-mm head with a monopolar bearing. Unfortunately, on post-operative day 7, the patient acutely displaced the acetabular component. She subsequently underwent a cup revision with a larger acetabular component and multiple screws; follow-up at 33 months demonstrated good clinical and radiographic outcomes. The second case reported by the authors was a 57-year-old female with right hip pain. The authors utilized an anterolateral approach and implanted a porous-ingrowth acetabular component, an

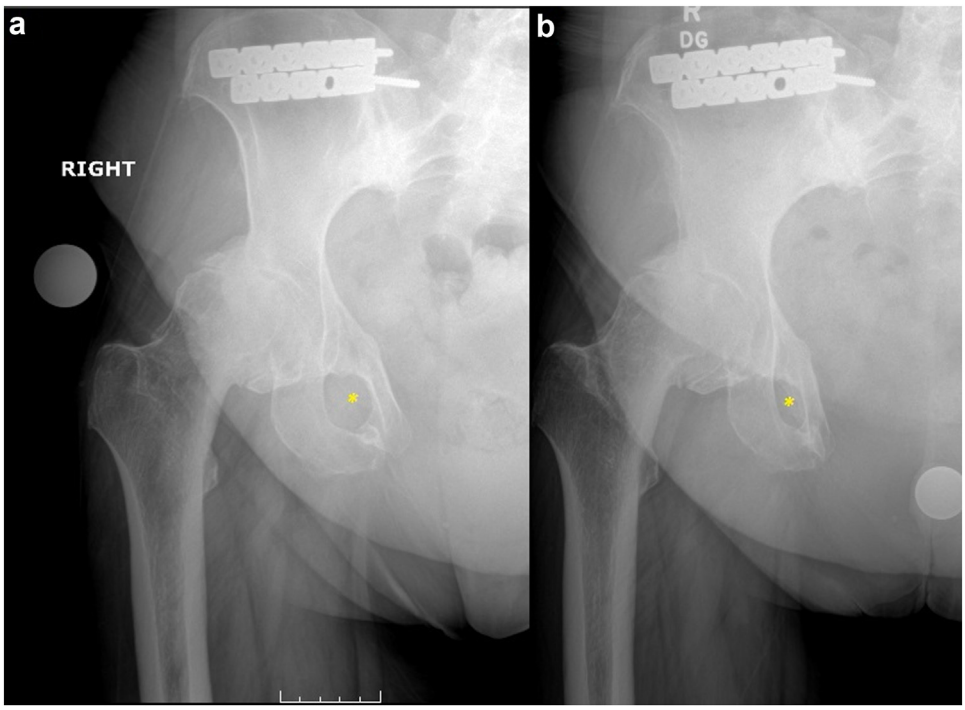

Figure 5. The "normalized" view of the hip (a) is obtained by internally rotating the patient 20-30° to offset the external rotation deformity of the hemipelvis. Note the difference in morphology of the obturator foramen compared with the standard AP view (b). Asterisk (*) denotes the position of the obturator foramen.

anatomic (side-specific) broach-only tapered-wedge femoral component with hydroxyapatite coating, and a 32-mm head with a monopolar bearing. Follow-up at 33 months demonstrated good clinical and radiographic outcomes [11].

Table 1
Patient pre-operative and intra-operative variables

Variable	THA in pubic diastasis N = 6
Age (mean)	59 y (range 45-78)
Gender	
Male	4 (67%)
Female	2 (33%)
BMI (mean)	32.5 kg/m^2 (range 25.6-35.6)
Side	
Left	3 (50%)
Right	3 (50%)
Diagnosis	
Bladder exstrophy	4 (67%)
Post-traumatic	2 (33%)
Size of pubic diastasis (mean)	98 mm (range 83-107)
Approach	
Direct anterior	4 (67%)
Anterolateral	1 (17%)
Posterior	1 (17%)
Cup size	
48 mm	1 (17%)
50 mm	1 (17%)
52 mm	2 (33%)
54 mm	2 (33%)
Head size	
36 mm	5 (83%)
40 mm	1 (17%)
Bearing	
Ceramic-on-polyethylene	4 (67%)
Dual mobility	2 (33%)
Stem	
Cemented (collared I-beam)	1 (17%)
Dual-tapered, HA-coated	3 (50%)
Triple-tapered, HA-coated	2 (33%)
Follow-up (y)	2.7 (range 1.0-5.7)

HA, hydroxyapatite.

While there are rare case reports of THA in patients with chronic pubic diastasis, there is a relative dearth of literature describing the specific anatomic challenges inherent to these patients and the strategies for ensuring a successful result. The major reconstructive dilemma in these patients is typically cup position. With no functioning pubic symphysis, the hemipelvis is situated in an excessively vertical and externally rotated position, resulting in relative retroversion of the native acetabulum. Thus, if one were to implant the acetabular component relative solely with reference to the coronal plane of the sacrum/greater pelvis, there would be a significant risk of creating excessive unilateral hip anteversion, potentially resulting in posterior prosthetic impingement and anterior instability. Thus, we recommend obtaining a standing 20-30° internally rotated view of the operative hemipelvis to obtain a "normalized" view of the hip and hemipelvis; cup position can then be planned based on this image (Fig. 2).

Generally, the femoral anatomy is unaffected by the pattern of deformity seen in pubic diastasis. In the present study, all femora were reconstructed using primary, nonmodular components. However, we recommend having a modular stem, Wagner-type stem, cemented stem, or other reconstructive options available in case femoral anteversion needs to be modified to enhance intraoperative stability. Larger head sizes, as well as the use of DM bearings, should also be considered to improve prosthetic range of motion prior to impingement. Indeed, DM constructs were used in 2 of the 6 hips in our series. A variety of surgical approaches were utilized in the present study, and we did not find any effect of the approach on postoperative stability, survivorship, or clinical outcome. However, regardless of approach, the surgeon should be prepared to make an incision in a more lateral position on the limb than would be typically encountered due to the excessive external rotation of the hemipelvis.

For patients with severe chronic pubic diastasis, THA remains a rare but challenging reconstructive procedure. Although definitive conclusions regarding patient outcomes are limited by the small cohort size and relatively short duration of follow-up in this study,

we believe that excellent outcomes can be achieved with adequate preoperative preparation, particularly regarding the acetabular component placement. Understanding the nature of the hemipelvis deformity and meticulous templating using “normalized” views of the hip are important components to a successful preoperative plan.

Conflicts of interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: B. P. Gladnick is a paid consultant for and receives research support as a principal investigator from DePuy Synthes and is an AAHKS committee member. J. M. Gililland receives royalties from MiCare Path and OrthoGrid; is a paid consultant for DJ Orthopaedics, Medacta, OrthoGrid, Smith and Nephew, and Stryker; has stock or stock options in CoNextions and OrthoGrid; receives research support as a principal investigator from Biomet, Stryker, and Zimmer-Biomet; and is a committee member of AAOS, AAHKS, and *Journal of Arthroplasty*. L. A. Anderson is a paid consultant for Medacta; has stock or stock options in OrthoGrid; and receives research support as a principal investigator from Stryker and Zimmer-Biomet. J. L. Masonis receives royalties from and is a paid consultant for Medacta, Smith and Nephew, and Zimmer-Biomet; has stock or stock options in OrthoGrid; receives research support as a principal investigator from DePuy Synthes, Smith and Nephew, and Zimmer-Biomet; and is a committee member in Anterior Hip Foundation. P. C. Peters receives royalties and research support as a principal investigator from DePuy Synthes.

The authors declare that there are no conflicts of interest.

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