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Safety of modified Stoppa approach for Ganz periacetabular osteotomy: A preliminary cadaveric study

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ABSTRACT

Objective: The aim of this cadaveric study was to investigate the efficacy of the modified Stoppa approach in Ganz periacetabular osteotomy (PAO).
Methods: The Ganz PAO was performed on 10 hemipelvises with normal hips, from 5 cadavers using the modified Stoppa approach through the Pfannenstiel incision. All of the osteotomies were performed under fluoroscopic control and direct visualizing the osteotomy site from the same incision. After the osteotomy, the acetabulum was medialized and redirected anterolaterally, and fixed with 2 screws. The neurovascular structures and the joints were examined by dissecting the soft tissues after fixation of the osteotomies. Outcome parameters were center-edge (CE) angle, the distances between the osteotomy and anterior superior iliac spine (ASIS), and between the osteotomy and the sciatic notch, neurovascular and joint penetrations.
Results: After the osteotomy, the mean CE angle was improved from 19.8° to 25.2°, mean distance between the osteotomy and ASIS was 3.1 cm, and the mean distance between the osteotomy and the sciatic notch was 10.2 mm. The neurovascular structures and the joints were examined by dissecting the soft tissues after fixation of the osteotomies. No damage to the joint, surrounding arteries, veins or nerves was detected in any of the cadavers.
Conclusions: Bilateral dysplastic hips can be treated with a 10 cm, cosmetically more acceptable incision in the same session using this approach. Quadrilateral surface of the acetabulum can be directly seen using this approach and the osteotomy can be safely performed.

Introduction

Periacetabular osteotomy is a restorative surgery for patients with hip dysplasia. There is consensus in the literature that untreated hip dysplasia progressively advances to arthritis.[1,2] Patients with acetabular dysplasia should be treated immediately after diagnosis rather than after symptoms appear or become more severe.[3,4] Surgical treatment attempts to convert the pathological shear force to a normal compressive force and prevent focal damage to the cartilage. As the weight-bearing area of the acetabulum decreases and the joint surface is lateralized, joint contact pressure increases, creating a condition which causes early osteoarthritis.[2,5,6]

Several osteotomies for the treatment of dysplastic hips have been described in the literature.[1,3–5,7–12] The Ganz periacetabular osteotomy (PAO) involves extensive exposure and careful cutting of the pelvic bones, as well as offers the advantages of a single incision, making higher amounts of corrections and pelvic continuity due to intact posterior colon.[12] However, during this process, major complications may develop.[1,5,13,14] The most frequently encountered complication during the surgery is penetration of the osteotome into the joint; some authors have reported a 2.7% rate for this complication, which arises as a result of the inability to visualize the quadrilateral surface.[15]

There are reports in the literature documenting the use of different approaches that aim to reduce complications and decrease the duration of surgery and hospitalization, comparing the results with those of the standard approach.[16–18] Some authors

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have focused on better visualization of the osteotomy site to achieve this aim.[19] Similarly, it was hypothesized in the present study that Ganz PAO with modified Stoppa incision would be easier and safer than the standard approach. The modified Stoppa surgical approach was first described in 1993 by Cole et al for the treatment of acetabular anterior colon fractures.[20] With this technique, the acetabular fracture is indirectly reduced, and fixation is possible. No previous studies have attempted to perform PAO using this approach.

PAO surgery involving a more minimally invasive method has positive effects on postoperative patient satisfaction. It was hypothesized in the present study that a medial colon osteotomy could be performed more easily using the modified Stoppa approach. The aim of this cadaveric study was to investigate the applicability of Ganz PAO surgery with the modified Stoppa surgical technique, the possible complications that may affect critical neurovascular structures, and the avoidance of penetration into the joint by osteotome or screw.

Materials and methods

This study was approved by the Board for Experimental Research in Forensic Medicine. PAO with modified Stoppa approach was performed on 10 hemipelvises of 5 fresh cadavers: 3 females and 2 male, aged 25, 31, 33, 37, and 40 years. Mean height of the cadavers was 172 cm (range: 160–178 cm), and mean weight was 84 kg (range: 56–98 kg). Hips with advanced osteoarthritis were not included in the study, and because there were no cadavers with dysplastic hips, the osteotomies were performed on hips with normal acetabulums.

The same surgical technique was performed for each cadaver by the senior author. The technique described by Cole et al was utilized to provide effective acetabular surgery.[20] Before the osteotomy procedure, anteroposterior pelvic radiographs were obtained, and center-edge (CE) angles were measured.

PAO was performed as originally described; however, the exposure involved a modified Stoppa incision. The cadavers were laid supine on a radiolucent operating table, and a 10-cm transverse incision was made 2 cm above the symphysis pubis (Fig. 1). The rectus sheath was carefully incised at the inferior border of the rectus abdominis muscle. After incision of the fascia transversalis, the abdominal muscles were bluntly dissected, and the peritoneum was retracted craniomedially with a blunt retractor. The psoas and iliac veins lying on the linea pectinealis were dissected bluntly and retracted carefully. The corona mortis was dissected carefully (Fig. 2). The periosteum was raised above the iliopectineal line, and a blunt retractor was inserted into the greater sciatic notch. At this stage, the obturator nerve was visualized in all cases and carefully preserved (Fig. 3).

Prior to conducting the osteotomies, the greater sciatic notch, supraacetabular region, pubic rami, and quadrilateral surface were exposed, and the distances were measured as described by Shiramizu et al.[15] The first osteotomy was performed on the supraacetabular region and the iliac wing, from the pectineal line and aiming 1–2 cm distal to the medial of the anterior superior iliac spine (ASIS) (Fig. 4). The second osteotomy was performed on the posterior colon of the acetabulum, under fluoroscopic guidance with a 45° oblique view of the iliac. This osteotomy was from the pectineal line to the inferior ischium with an angle of 130° to the first osteotomy, leaving approximately 1 cm of bone posterior to the osteotomy line to preserve the posterior colon, as described in previously conducted anatomical studies (Fig. 5).[15] The third osteotomy was performed on the pubic arm near to the acetabulum (Figs. 6 and 7). And the last osteotomy was performed on the distal ischium, parallel to the inferior acetabular rim (Fig. 8). Each stage of the operation was conducted under fluoroscopic control to ensure that the osteotome did not penetrate the joint. By twisting the osteotome under fluoroscopic guidance, it was ensured that the fragment was completely free. After completing the osteotomies, the acetabular fragment was medialized and rotated anterolaterally using a spike-tipped pusher. An anterolateral repositioning of approximately 20° was achieved under fluoroscopy. After the correction, the osteotomy was fixed with 2 or 3 3.5-mm screws (DePuy Synthes, Bettlach, Switzerland), which were inserted percutaneously from the iliac crest to the supraacetabular area, using 0.5- to 1-cm skin incisions.

The operation was considered successful if direct visualization and fluoroscopic examination confirmed that the osteotome and screws had not penetrated the joint. At this stage, the applicability

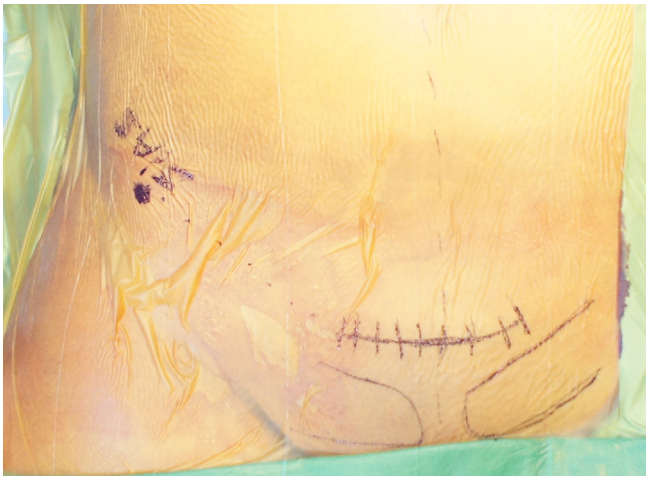

Fig. 1. Incision. Pfannenstiel incision approximately 10 cm for modified Stoppa approach.

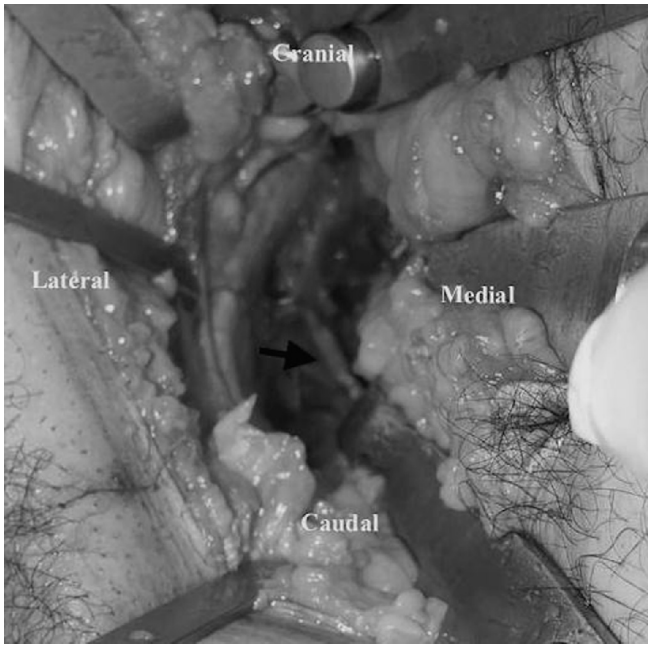

Fig. 2. The corona mortis. Dissection and ligation of the corona mortis is important to prevent bleeding (**black arrow**). It was dissected in all the cadavers to simulate real surgery.