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# Pelvic osteotomies: anatomic pitfalls at the pubic bone

## A cadaver study

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**Abstract** Pelvic osteotomies for acetabular dysplasia include an osteotomy of the pubic bone. The anatomical consequences of two different approaches to the pubic bone were assessed by performing a triple osteotomy on a series of 12 fresh cadaver hemipelvises. The medial approach through a separate incision over the pubic symphysis was compared with the lateral approach through the incision used for the innominate osteotomy. Although the medial approach appears technically easy, there are several anatomical structures at risk, such as the femoral vein and the corona mortis. The lateral approach is safer, and it is easier to make the osteotomy close to the hip joint. The closer the osteotomy is to the hip joint, the smaller the chance of developing a non-union.

## Introduction

Developmental dysplasia of the hip is characterised by malposition of the proximal femur and a deficient acetabular coverage of the femoral head. In adolescents and young adults it can be treated by acetabular re-orientation procedures to provide more lateral and anterior coverage of the femoral head. Many osteotomies have been designed to achieve this goal, such as triple osteotomies through the innominate, pubic and ischial bones [6, 7] and the Bernese peri-acetabular osteotomy comprising four cuts and a controlled fracture close around the acetabulum [2]. All these procedures require an osteotomy of the pubic bone. This can be performed through a separate incision medial over the pubic bone [7], or laterally using the incision also used for the innominate osteotomy [2, 6].

The aim of this study was to perform an anatomical evaluation of both approaches to the pubic bone, and to describe the clinical advantages and disadvantages of each.

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## Materials and methods

Twelve fresh cadaver hips were studied. A triple osteotomy was performed each time. Six times a separate medial incision was used [7]. Over the palpable pubic bone, just lateral to the symphysis, a transverse incision is made. Subperiosteally and under the pectineus muscle, the pubic bone is exposed. It is osteotomised with an osteotome as far laterally as possible, close to the hip joint.

Six times the pubic bone was approached laterally. A bikini incision is used [5], and after elevating the muscles off the inside of iliac wing, it is possible subperiosteally to approach the pubic bone medially. Medial to the iliopectineal eminence a Hohman retractor is placed to elevate the iliopsoas muscle, and then the bone is cut with an osteotome.

In all cases, after the operation an intrapelvic dissection was performed followed by an anterior and posterior dissection of the hip.

## Results

The most important anatomical structures are schematically illustrated in Fig. 1. The femoral vein lies close to

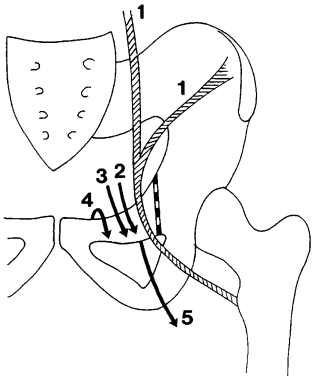


**Fig. 1** Schematic representation of the neurovascular structures around the pubic bone: *1* iliopsoas muscle, *2* femoral vein, *3* femoral artery, *4* corona mortis, *5* obturator nerve

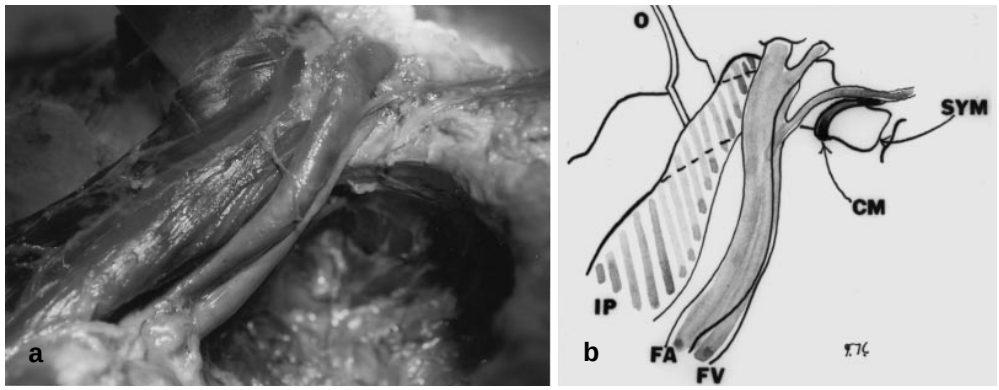


**Fig. 2** **a, b** Anatomical dissection, with corresponding schematic representation of the left hemipelvis. Intrapelvic view looking laterally and distally. The osteotome is placed in the pubic bone, lateral to the iliopsoas muscle. *O* Osteotome, *IP* iliopsoas muscle, *FA* femoral artery, *FV* femoral vein, *CM* corona mortis, *SYM* symphysis pubis

the pubic bone and is therefore prone to damage. It runs medial to the iliopectineal eminence and the iliopsoas muscle. During the lateral approach – but not during the medial approach – the vein is protected by the muscle. The common femoral artery lies on top of the vein, and is much less in danger during subperiosteal exposure from either the medial or lateral approach (Fig. 2).

Six hemipelvises had a corona mortis. This is an anastemotic branch of the external iliac or epigastric vessels to the obturator vessels in the obturator canal. It runs tightly over and around the pubic bone (Fig. 2) medial to the femoral vein. It is only encountered during the medial approach.

The obturator nerve runs caudal to the pubic bone to innervate the hip adductors. It passes through the obturator canal about 1 cm medial to the most lateral corner of the obturator foramen.

Performing the osteotomy from a medial approach, it is more difficult to come as close to the hip joint as during the lateral approach because the femoral vein and corona mortis limit the exposure.

## Discussion

Pelvic osteotomies for acetabular dysplasia reduce symptoms and probably also the onset of degenerative osteoarthritis [3]. However, an anatomical examination has seldom been made before, despite the fact that there are different types of osteotomies which all attempt to re-orient the acetabulum. In this study neurovascular structures at risk when performing different pubic osteotomies as part of a pelvic osteotomy are reported. Benson [1] described the anatomy of the sciatic nerve after a Chiari osteotomy, but we could find no other comparable studies.

The medial approach to the pubic bone appears technically easier to perform than the lateral approach as the bone is easily palpable. However, there are several anatomical pitfalls. If present, the corona mortis is easily damaged, which may lead to profuse bleeding and limb-threatening complications [4]. These aberrant vessels have been described in 30% of the population [9]; in this study it was found in 6 of the 12 cases. During the lateral approach these vessels are not reached as they remain further medial, and thus they cannot be demaged. Addition-


**Fig. 3** **a** Anteroposterior radiograph taken directly after triple osteotomy and pubic osteotomy from the medial approach. Part of the pubic bone is still attached to the acetabular fragment. **b** fourteen years postoperatively there is a pseudo-arthrosis of the pubic bone (and of the ischium)

**Fig. 4** **a** Anteroposterior radiograph taken directly after triple osteotomy and pubic osteotomy from the lateral approach. The correction is comparable to that in Fig. 3, but the pubic bone has been cut further laterally, and therefore the translation in the osteotomy is smaller. **b** Nine years postoperatively the osteotomies have consolidated

ally, during the lateral approach, the femoral vein is protected by the iliopsoas muscle (Fig. 2), but this is not the case during the medial approach.

Because of the femoral vein and the corona mortis it is difficult to get close to the hip joint from the medial approach. A more medially placed osteotomy leads to a longer arm of bone attached to the acetabulum (Fig. 3). This has several unfavourable consequences for the acetabular re-orientation. First, it limits the degree of freedom of rotation of the acetabulum because of the attached soft tissues. Second, it leads to a longer lever arm, and so the bone at the osteotomy site has to displace more for the same amount of correction. Third, further medially the pubic bone is smaller in cross-sectional area and less cancellous than close to the hip joint. For these reasons, the further medial the osteotomy, the smaller the bone contact area after the correction, and the greater the chance of developing a non-union.

Using the lateral approach to the pubic bone, it is possible to cut the bone close to the hip joint (Fig. 4). The anatomical hazards are smaller, and the bone contact area at the osteotomy is greater leading to fewer non-unions. In an earlier study the rate of pubic non-union employing this approach was 1 of 51 cases [3]. Tönnis et al. [8] performs the pubic osteotomy from the medial approach, but adds osteosynthesis with two screws and a cerclage wire across the osteotomy to reduce the chance of developing a non-union. We feel that this makes the operation more complex, and it does not reduce the anatomical hazards of the medial approach.

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