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Technical note

# Percutaneous pelvic osteotomy in non-ambulatory cerebral palsy patients



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## ABSTRACT

The aim of this study was to describe the surgical technique of and indications for percutaneous pelvic osteotomy in patients with severe cerebral palsy. Forty non-ambulatory children and adolescents (47 hips) were consecutively treated with percutaneous pelvic osteotomy. The mean preoperative Reimers' migration percentage improved from 66.2% to 4.9% at the final follow-up. The mean preoperative acetabular angle (AA) improved from 32.4° to 13.2° at last follow-up. Percutaneous pelvic osteotomy is a less invasive surgical approach and appears to be a valid option with similar outcomes to standard techniques. This method results in less muscle stripping and blood loss and a shorter operating time.

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## 1. Introduction

Subluxations and dislocations of the hip are frequent in children with cerebral palsy (CP). The goal of surgical techniques that reshape, redirect or deepen the acetabulum is to obtain a reduced, stable, mobile and painless hip [1–4].

This study presents an original percutaneous pelvic osteotomy (PPO) technique in patients with grade IV and V cerebral palsy on the Gross Motor Function Classification System (GMFCS), and whose preliminary results have already been published in the *Journal of Pediatric Orthopaedics B* by Canavese et al. [1]. This technique was combined with a varus derotational, shortening proximal femoral osteotomy.

Based on the good results of this pilot study, the authors have continued to practice this surgical technique in their different hospitals.

The aim of this paper was to describe the surgical technique in detail and present the results of all of the patients operated on by this method.

## 2. Surgical technique

The surgical procedure is performed with the patient under general anesthesia. The patient is placed in the supine position with a

pillow under the gluteal area of the operated side. Before beginning surgery, hip range of motion is tested under fluoroscopic guidance. The fluoroscope is placed in front of the surgeon opposite the operated side.

The varus, derotational and shortening proximal osteotomy begins with a lateral approach to the proximal femur. The bone obtained from the femoral shortening can be used for the PPO.

The PPO is performed once the femoral osteotomy has been completed, without changing the patient's position.

### 2.1. Incision

A vertical line is drawn under fluoroscopic guidance 5–10 mm proximal to the roof of the acetabulum and corresponding the axis of the roof of the acetabulum. A second horizontal line is drawn beginning at the tip of the greater trochanter between the anterior superior iliac spine (ASIS) and the posterior iliac spine (PIS). The intersection between these two lines indicates where the incision should be made, measuring between 2–3.5 cm long and parallel to the axis of the femoral shaft (Fig. 1).

### 2.2. Superficial and deep dissection

Dissection through the subcutaneous fat is performed with surgical scissors. The proximal part of the tensor fascia lata muscle must be opened to reach the deep muscles, in particular the gluteus minimus and gluteus medius. The deep muscular plane is dissected to the outer table of the iliac bone using a Cobb

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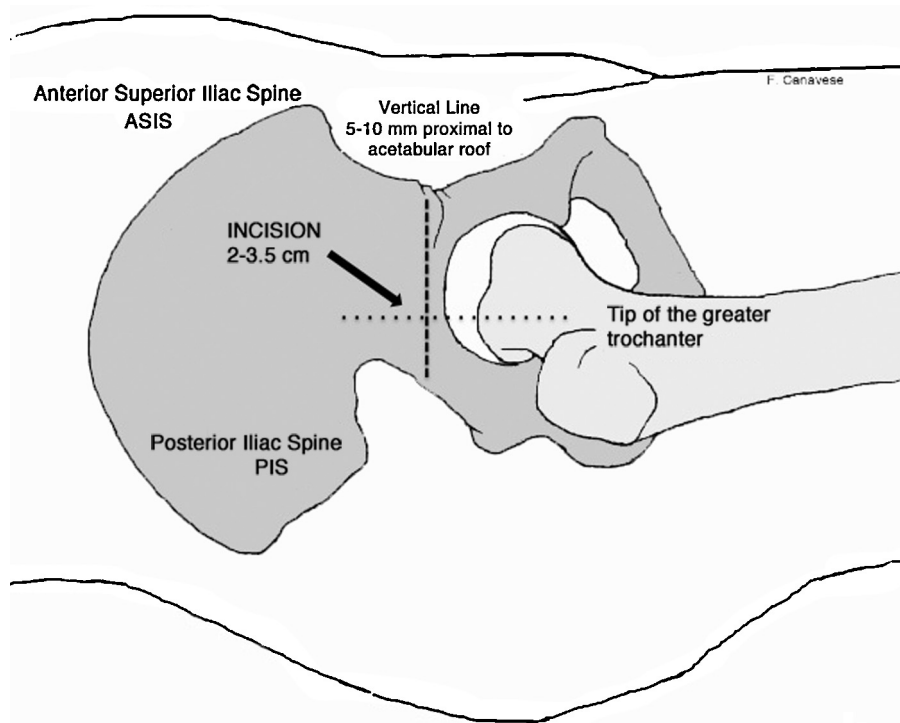


Fig. 1. Reference points for the incision.

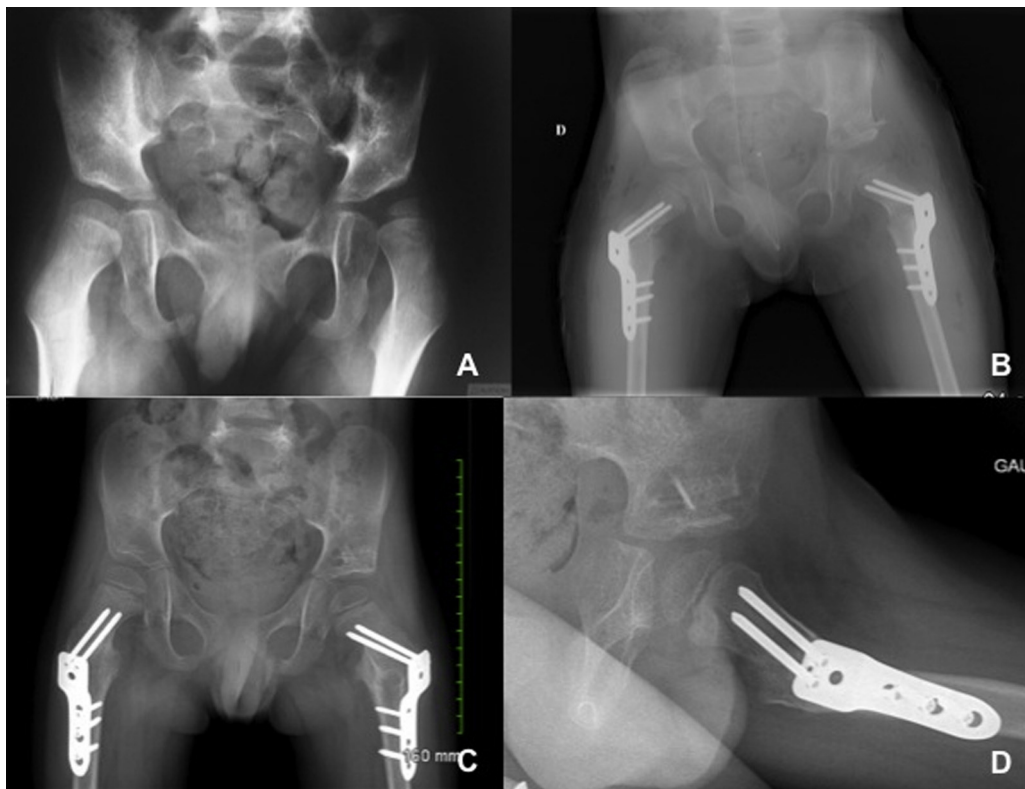


Fig. 2. Eight-year-old patient, Gross Motor Function Classification System (GMFCS) V, open triradiate cartilage. Preoperative (A) and postoperative (B) X-rays and at 18 months (C, D).

dissector and the muscle tissue is scraped off the iliac notch to the ASIS. A smooth dissector is slid under the periosteum to the sciatic notch to push apart the soft tissues and protect the nerves.

### 2.3. Pelvic osteotomy

The pelvic osteotomy is performed 5–10 mm proximal to the acetabular roof. Under fluoroscopic control, the osteotomy chisel

**Table 1**  
Demographic data.

	French series	Swiss series
Patients (n)	21	19
PPO (n)	22	25
Boy:Girl	13:8	11:8
Right:Left:Bilateral	8:12:1	6:7:6
GMFCS IV:V	17:4	13:6
Surgery (age)	10.2	8.5
Mean acetabular angle		
Preoperative	34°	31°
Postoperative		
6 months	13.9°	13.2°
12 months	14.3°	13.2°
24 months	13.6°	13.2°
Mean Reimers Index		
Preoperative	62.8%	69.2%
Postoperative		
6 months	6.4%	3.5%
12 months	6.1%	4.4%
24 months	6.4%	5.1%
24 months	4.3%	5%

PPO: percutaneous pelvic osteotomy; GMFCS: Gross Motor Function Classification System.

**Table 2**  
Complications.

Complications (n)	French Series	Swiss Series
Infection	0	0
Pain $\geq$ 6 months	2	2
Graft migration	0	1
Recurrent dislocation	0	1
Necrosis of the femoral epiphysis	0	3
Femoral fracture	2	1
Death	1 <sup>a</sup>	0

<sup>a</sup> After inhalation of vomit.

should appear as a thin straight line throughout the procedure, showing that it is perpendicular to the bone and parallel to the source of radiation.

A straight osteotome is used first for the osteotomy, then a curved osteotome to complete the procedure. The osteotomes must always be moved upwards towards the ASIS and downwards towards the ischiatic notch. Only the outer table of iliac bone should be cut from the ASIS to the ischiatic notch and the osteotomy should always be directed towards the triradiate cartilage; the osteotomy should reach but not cross the triradiate cartilage.

Once the osteotomy is complete, two straight osteotomes or a Meary spreader may be inserted and used as a lever to open the osteotomy site. In patients with closed triradiate cartilage, the osteotomy is performed with wider osteotomes using the same surgical technique.

#### 2.4. Insertion of the bone graft

Maximum opening of the osteotomy should be measured and the size of the bone graft, taken from the femoral shortening should be based on these measurements. A 2 mm Kirshner wire is inserted into the graft to push it and wedge it in the osteotomy opening.

Spreading the two osteotomes keeps the osteotomy site open and allows proper positioning of the bone graft so that it does not rotate around the wire. Once approximately 40% of the graft has passed beyond the outer table of the iliac bone, the osteotomes can be removed and the graft can be pushed more deeply into the opening. If necessary, a bone impactor can be used to finish impaction. The wire is not used for fixation but to help correctly position the graft. The soft tissues help stabilize the bone graft because of the more limited dissection than with standard techniques.

PPO lasts a mean 20 minutes per patient and per side (15–40).

#### 2.5. Postoperative immobilization

Immobilization with a spica case was used in patients with dys-tonia or abnormal movements. An abduction pad was used in others cases.

#### 2.6. Surgical indications

PPO is indicated in GMFCS IV and V patients with uni- or bilateral dislocation or subluxation of the hip and acetabular dysplasia.

There is a risk of retraction of the periarticular soft tissues in hips that have been dislocated for many years risk and PPO should not be performed if the hip is not reduced after femoral osteotomy and lengthening.

### 3. Results

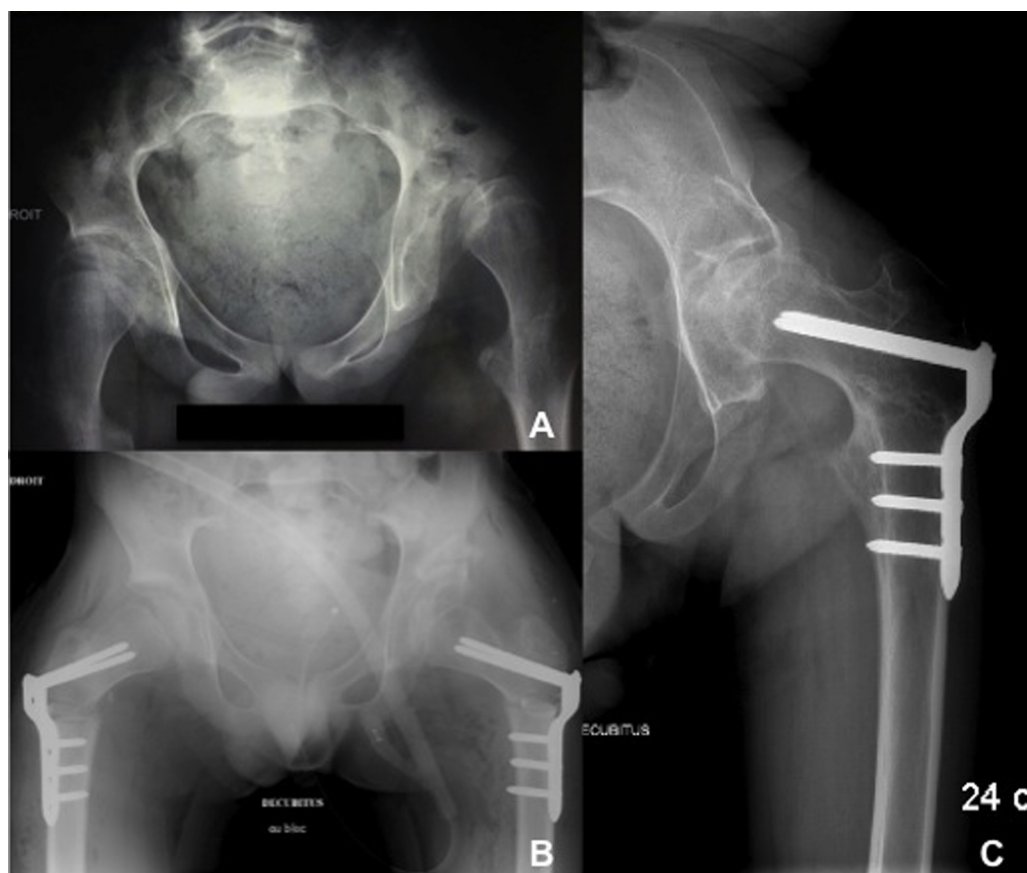
Forty children (47 hips) were treated consecutively by PPO associated with a femoral osteotomy.

Twenty-two PPO were performed in Clermont-Ferrand, France (2010–2013) and 25 in Geneva, Switzerland (2002–2013).

Demographic, radiological data and complications are described in [Tables 1 and 2](#).



**Fig. 3.** Fifteen-year-old patient, Gross Motor Function Classification System (GMFCS) IV, triradiate cartilage during closing. Preoperative (a) and postoperative (b, c) X-rays.



**Fig. 4.** Fifteen-year-old patient, Gross Motor Function Classification System (GMFCS) IV, closed triradiate cartilage. Preoperative (A), and postoperative (B) X-rays and at 18 months (C).

### 3.1. Complications

We recommend performing an incision after identifying reference points because the artery and the superior gluteal nerve are found 3 to 4 cm proximally from the incision.

To protect the sciatic nerve, a smooth dissector should be advanced under the periosteum to the sciatic notch.

No vascular or neurological lesions were reported with this technique.

No displacement of the bone graft was observed (Table 2).

## 4. Discussion

PPO provides results that are similar to those with standard techniques [1–4]. Radiological and clinical results are satisfactory, independent of age and the condition of the triradiate cartilage (Figs. 2–4). The osteotomy should reach the triradiate cartilage without crossing it to avoid premature closing. The osteotomy can be performed with the same technique in patients with closed triradiate cartilage, while taking advantage of the reduced resistance of osteoporotic iliac bone [5]. On the other hand, in this subgroup of patients, larger osteotomies should be used to keep the osteotomy space open and avoid collapse of porous iliac bone. The quality of correction of acetabular dysplasia is similar in patients with closed or open triradiate cartilage [1–5].

The soft tissue helps keep the bone graft in place by pushing it against the iliac bone. Percutaneous surgical dissection is less

invasive than with standard techniques. Moreover, the operating time is shorter than with standard techniques.

Our results indicate that PPO is an effective, reliable and minimally invasive surgical technique for treating acetabular dysplasia in patients with severe CP with open or closed triradiate cartilage. Moreover, patients with closed cartilage or presenting with a relative deformity of the femoral head can also benefit from this technique. There is less stripping of the muscles, surgery is shorter and results are similar to those with standard techniques.

### Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

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