Technical Note

Treatment of Acute Bony Avulsion of Ischial Tuberosity With Cortical Screw Fixation

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Abstract: Displaced bony avulsion of the hamstring origin is a rare condition that necessitates surgical treatment. This article describes the surgical treatment of acute apophyseal separation of the ischial tuberosity via open reduction and internal fixation with cortical screws.

The rarity of bony avulsion of the ischial tuberosity (BAIT) can pose technical challenges for surgeons, and details of the surgical technique have not yet been presented. The mostly addressed operative indication is greater than 2 cm displacement. Operative treatment of displaced avulsions yields better clinical results compared to conservative treatment.[1] Awareness of this condition is mandatory owing to superior outcomes with early intervention.[2] Recently, Mitchell et al.[3] published their classification for complete and partial bony avulsions and reported a rate of nonunion (78%) for complete avulsions that is 2 times the rate for partial avulsions.

There are multiple choices of surgical techniques and fixation methods for the treatment of BAIT, such as cancellous screw fixation, cannulated screw fixation,[4] suture anchor fixation,[5] plate fixation,[6] and excision of the fragment and refixation[1-3,6,7] or just fenestration.[8] This article presents a Technical Note for osteosynthesis of BAIT (Video 1). The strengths and weaknesses of this surgical technique are presented in Table 1, and technical tricks are presented in Table 2.

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Surgical Technique

Preoperative Imaging

Imaging is important to measure the size of the bony fragment and displacement. Radiographic examination of the pelvis may confirm the diagnosis (Fig 1); however, the orientation, contours, and volume of the fragment are better visualized with computed tomography (Fig 2). Magnetic resonance imaging better shows the amount of hematoma and muscular contusion (Fig 3); nevertheless, care is needed to distinguish the bony fragment (Fig 4). In an acute case, ultrasound examination may also help to describe the avulsion and consequent hematoma in experienced hands.

Patient Positioning and Preparation

Under spinal anesthesia, the patient is placed on the radiolucent operating table in the prone position. The intergluteal cleft is draped to avoid gastrointestinal contamination. The gluteal crease is marked before draping (Fig 5). Image-intensifier control is needed for visualization of the pelvis (Fig 6). A U-shaped leg holder with a side bar is attached to the table to keep the knee in a position of flexion and abduction during the operation. After disinfection of the skin, a single-use hip draping set is applied.

Superficial Dissection

The ischial tuberosity is palpated and localized. An incision is placed on the gluteal crease, centered at the vertical projection of the lateral facet of the ischial tuberosity. An approximately 10-cm-long incision is generally sufficient for exposure. The subcutaneous fat is sharply dissected. The inferior border of the gluteus maximus is localized, and the fascia overlying the gluteus maximus is incised. The inferior border of the

Table 1. Strengths and Weaknesses of Transverse Incision and Cortical Screw Fixation of BAIT

Strengths
The exposure is large enough to access the fragment and the ischium.
The proximal part of the sciatic nerve is clearly visualized.
The transverse incision permits the avoidance of skin or nerve lesions during drilling.
The scar is cosmetically more acceptable.
Strong purchase of bone is achieved with prevention of fragment rotation by 2 screws.
Weaknesses
In case of displacement >5 cm, dissection of the nerve may be difficult.
The incision is extensile with the loss of the cosmetic advantage.
There is a risk of laceration of the intrapelvic structures or sciatic nerve during drilling of second cortex.

BAIT, bony avulsion of ischial tuberosity.

gluteus maximus is elevated with gentle dissection to elevate the gluteus maximus muscle, which is the principal tissue preventing exposure (Fig 7).

Deep Dissection

There are small neurovascular bundles containing cutaneous nerve branches that are identified under the inferior border of the gluteus maximus muscle when elevated. Preservation of these bundles may prevent postoperative hypoesthesia over the corresponding regions. In case of rupture, these vessels may bleed abundantly, requiring cauterization. Under the gluteus maximus, the avulsed fragment may be palpated in the muscular sheath (Fig 8). This sheath is usually inflamed and fibrotic 2 weeks after initial trauma. The lower limb is abducted to facilitate sciatic nerve dissection. Frequently, the sciatic nerve is in contact with the muscular sheath and shows adherence to it. Liberation of the nerve requires gentle longitudinal dissection without any traction force applied to it. During the dissection of the nerve, monitoring of the foot motion may help avoid injury.

Table 2. Technical Tricks

The patient is Placed on the flat Operating Table (without hip Flexion) to Avoid Further displacement of the Fragment.
Knee support with a side bar facilitates fragment dissection and reduction while relaxing the tension of the nerve.
The gluteal crease should be marked before draping to avoid displacement of the incision site with traction of the drapes.
Image-intensifier control should be performed before draping to verify the visibility of the pelvis.
The volume as well as strength of the gluteus maximus is the principal obstacle to deep exposure.
Monitorization of foot movements is a simple and safe method to avoid sciatic nerve damage during dissection.
Screw tensioning must be performed gently to avoid fragment breakage.
A compressive hip spica bandage should be applied to prevent hematoma formation.

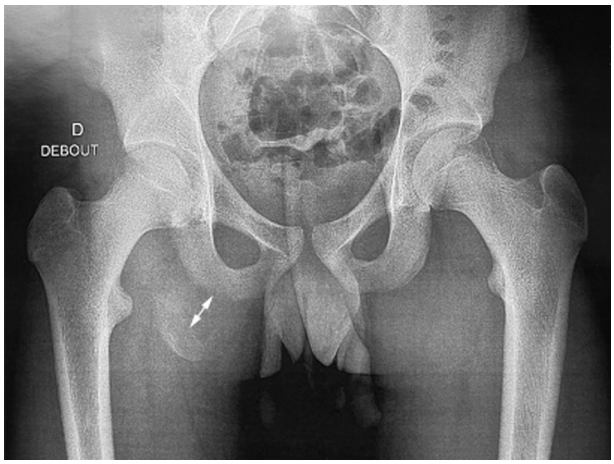

Fig 1. Preoperative radiography is the principal technique of examination in case of a displaced ischial tuberosity avulsion. Radiographic examination shows a right-sided bony avulsion of the ischial tuberosity. (D, right/debout = erect.)

After the nerve is protected, the osseous fragment is mobilized (Fig 9). The soft callus and fibrotic tissues are cleared off of the fragment (Fig 10). Three retractors are placed to visualize the ischial tuberosity. The first retractor is curved and is placed medially to the ischial tuberosity. The second retractor is placed caudally to the lateral side of the ischial tuberosity. For better visualization, a more stable Kolbel glenoid retractor is used to replace this Hohmann retractor. The ischial side

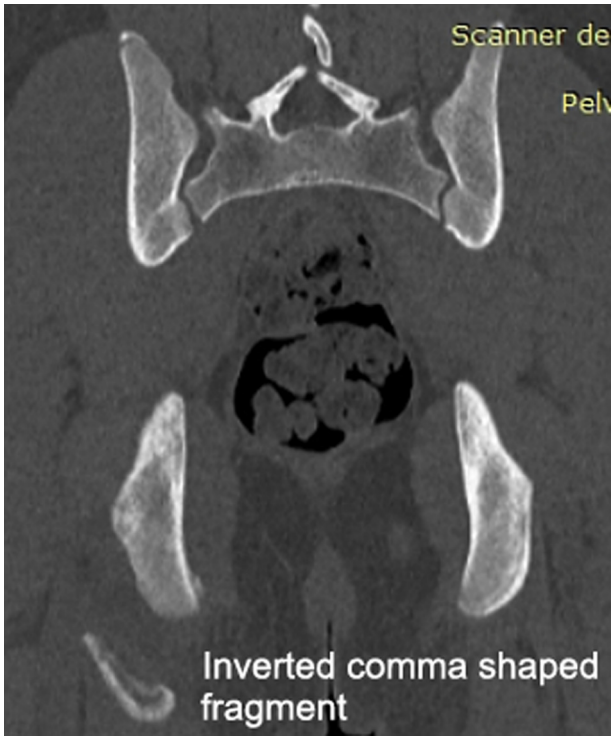

Fig 2. Preoperative sagittal computed tomography showing the displaced fragment in the form of an inverted comma.

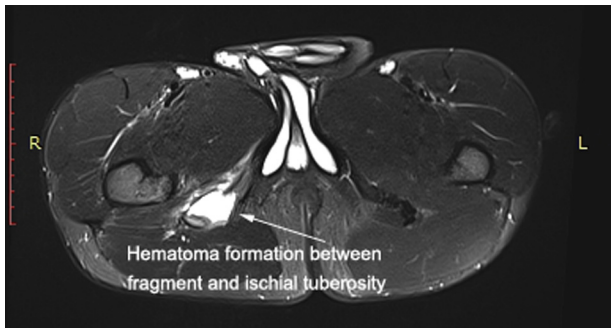

Fig 3. Hematoma formation is clearly visualized on a PD-weighted magnetic resonance image of the right hip. (L, left; R, right.)

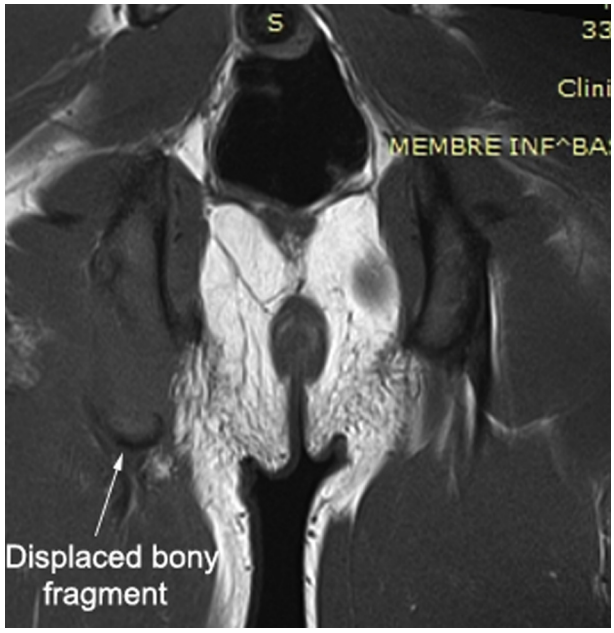

Fig 4. Coronal T1-weighted magnetic resonance image showing right-sided bony avulsion of the ischial tuberosity. One must pay attention to avoid a missed diagnosis while evaluating T1-weighted magnetic resonance imaging. (PD, proton-density; S, sigmoid colon)

Fig 5. The patient lies in the prone position. The gluteal fold is draped before surgical skin disinfection, and the gluteal skin fold is marked. A leg holder with a lateral extension is mandatory to keep the hip in an abducted and internally rotated position to preserve the sciatic nerve during dissection and screw placement.

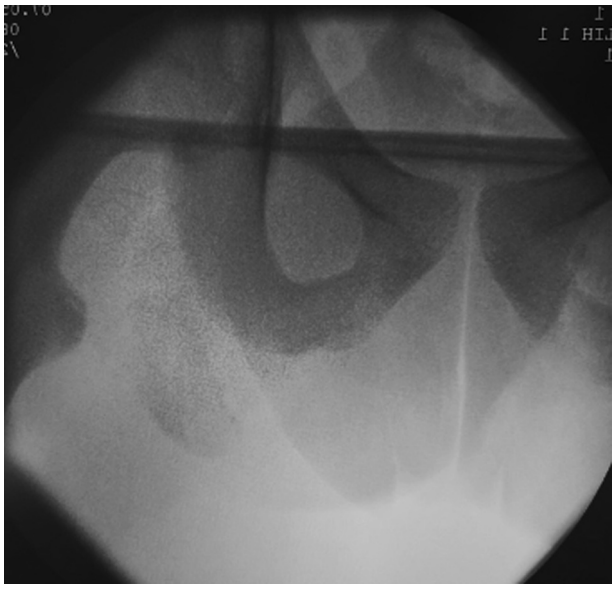

Fig 6. Preoperative fluoroscopic control is performed to ensure the visibility of the pelvis on the radiolucent table.

of the detachment is then clearly visualized. The third retractor is placed lateral to the ischial tuberosity to prevent the sciatic nerve injury is more acceptible.

Osteosynthesis

The footprint of the avulsed fragment is cleared of the soft tissues with the aid of a periosteal elevator. After reduction of the fragment, it is fixed with 2 temporary wires measuring 1.8 mm. The quality of reduction is controlled under the image intensifier. The trajectories of the 2 screws are decided based on the image-intensifier images. The orientation of the temporary wires may serve as a guide to screw placement. A 3.2-mm drill is used to prepare the holes. Care is needed during the second cortex drilling to avoid injury to the intrapelvic organs. After drilling, the screw lengths are measured and 2 cortical screws of 4.5 mm in diameter (Francemed, Arcueil, France) are applied with the aid of a screwdriver. The screws are tensioned once more to ensure fixation. Screw tensioning must be carried out gently and one by one with gradual progress to avoid breakage of the fragment. The fixation is controlled with the image intensifier (Fig 11).

The layers are closed accordingly with absorbable sutures. Use of a continuous subcutaneous absorbable suture is advised for better cosmesis (Fig 12). After

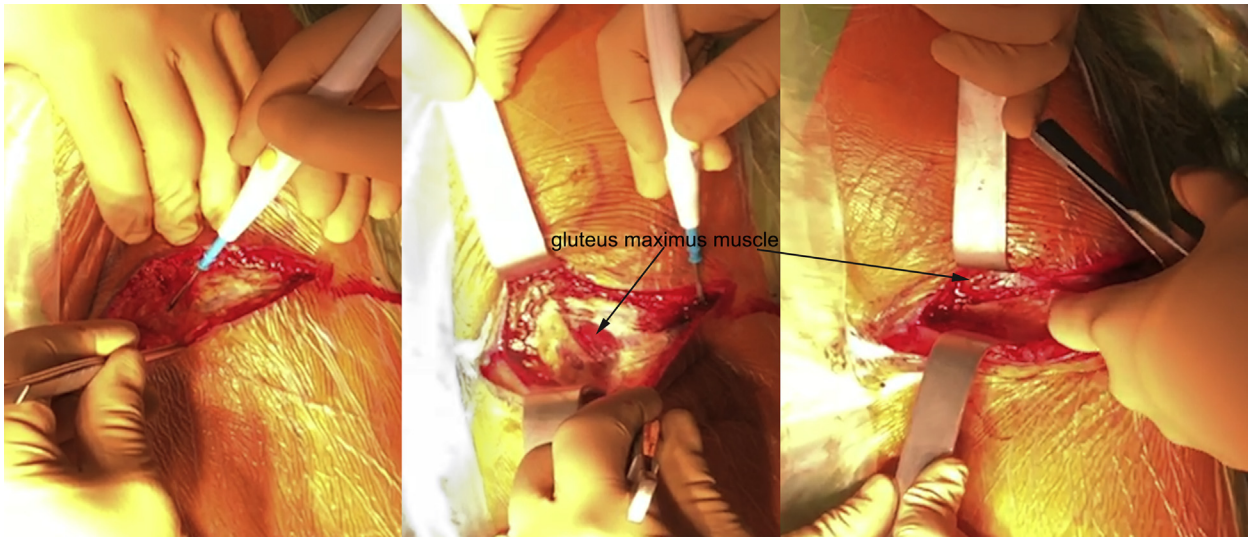

Fig 7. The skin is incised in a transverse manner, and the subcutaneous fat is dissected. The inferior border of the gluteus maximus muscle is found, and the muscle is elevated with blunt dissection.

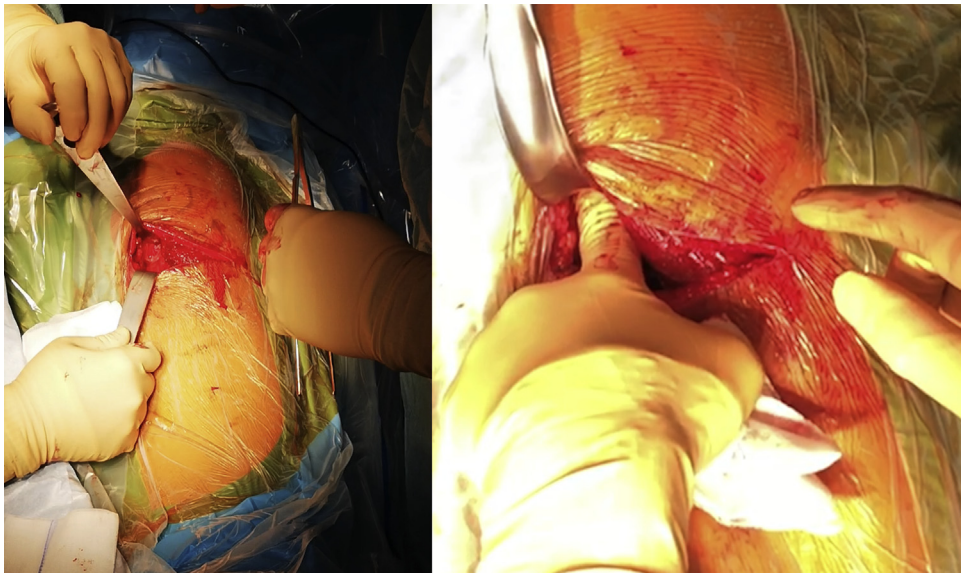

Fig 8. A retractor is placed superior to the ischial ramus, and the ischial tuberosity is palpated.

wound closure, a hip spica–type compressive bandage is applied to prevent hematoma formation. No drainage tubes are placed because of their potential to cause small lacerations in the surrounding soft tissues after their removal, which may lead to hematoma formation. Postoperative radiologic examination is required Fig 13).

Knee flexion is continuously preserved during the operation until a knee brace is applied (Fig 14). The range of motion of the brace is decided according to the tightness of the hamstring muscles. The preference of the senior author (NL) is a 50° extension block with free flexion.

Rehabilitation

To avoid fixation failure, a knee brace is applied for 6 weeks. Mobilization of the patient with crutches is advised the day after surgery. The duration of infection prophylaxis is 24 hours. Thromboprophylaxis is administered according to established protocols.

Discussion

The main purpose of this article is to describe the technical pearls and pitfalls of treatment of an acute BAIT to avoid its most feared complications such as sciatic nerve damage during dissection and fixation failure. According to cadaveric studies, the sciatic nerve

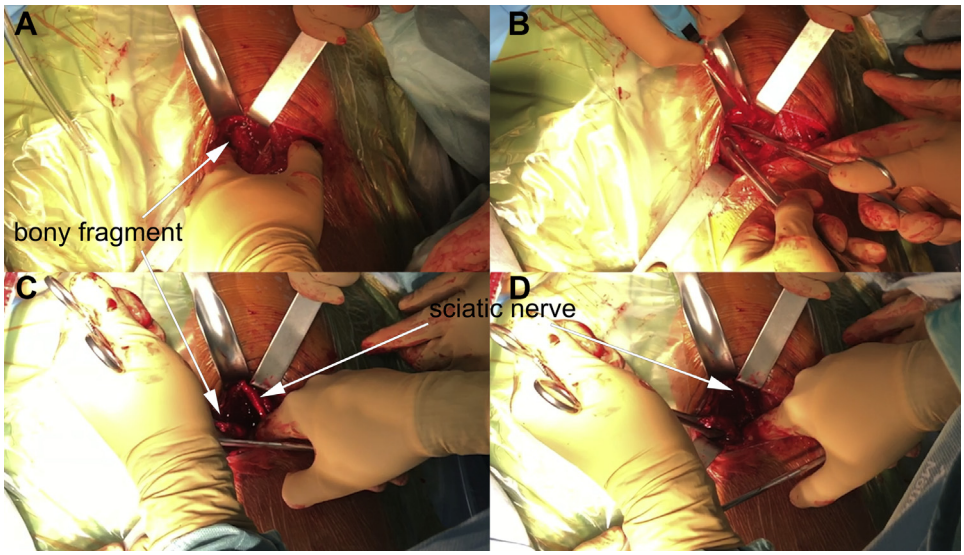

Fig 9. (A) The fragment is dissected beginning from the medial side. (B) Dissection of the lateral side is carried out longitudinally, with care, to the nerve fibers. As the fragment becomes more mobile, the bony fragment is handled with a sharp forceps to gain control of it. (C, D) The interval between the sciatic nerve and the avulsed proximal hamstring origin may be dissected bluntly with a finger until all of the adhesions between the nerve and the fragment are removed.

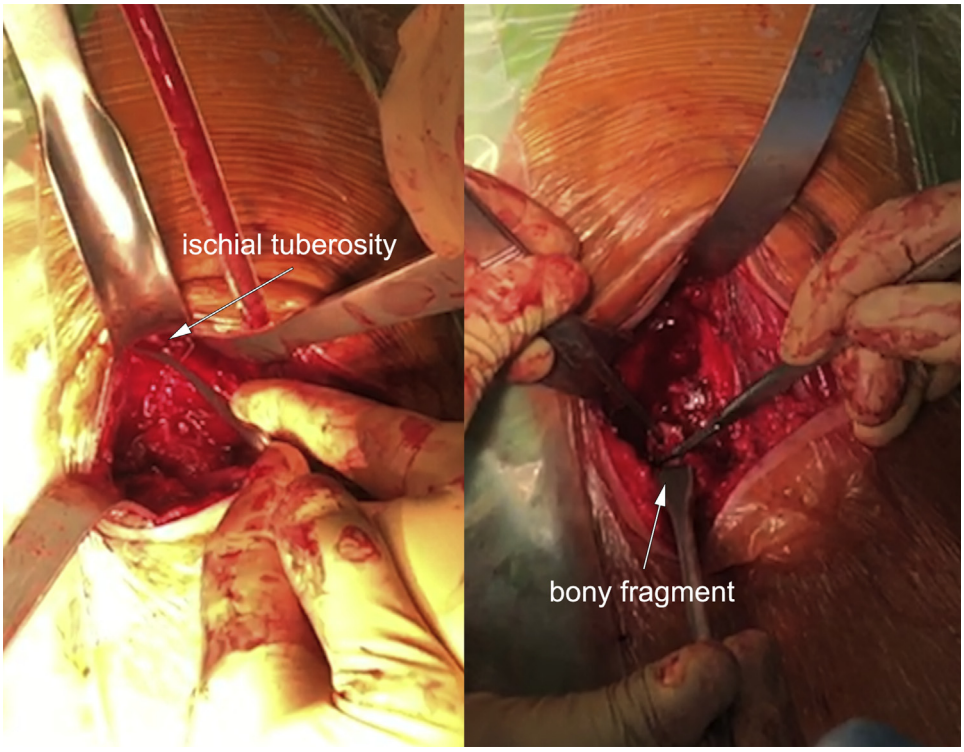

Fig 10. The ischial tuberosity and bony fragment are cleared of the fibrotic tissues.

lies an average of 1.2 ± 0.2 cm from the most lateral aspect of the ischial tuberosity.[9] However, in a displaced BAIT, the fragment lateralizes and a fibrous adhesion occurs between the nerve and the bony fragment. Because of this adhesion, it may be difficult to discriminate the sciatic nerve from its surroundings. Careful longitudinal dissection lateral to the bony fragment followed by finger dissection is needed to free the bony fragment from its adhesions to the sciatic nerve. Abduction of the lower extremity and flexion of the knee during the operation serve to lateralize the nerve and diminish the tissue tension. Bleeding from the epineural arch of the sciatic nerve must be avoided; when it occurs, it should be stopped by gentle compression or fine sutures rather than electrocoagulation. During dissection of the nerve, placement of a hand on the foot of the involved extremity may prevent the surgeon from causing iatrogenic sciatic nerve damage. Protection of the sciatic nerve during the provisional and decisive fixation steps is crucial; placement of a temporary Hohmann retractor lateral to the ischial tuberosity may help.

DeCoster et al.[10] described pullout strength differences between orthopaedic screws. Their results indicated that screw thread design, diameter, and pitch parameters influenced pullout strength. In particular,

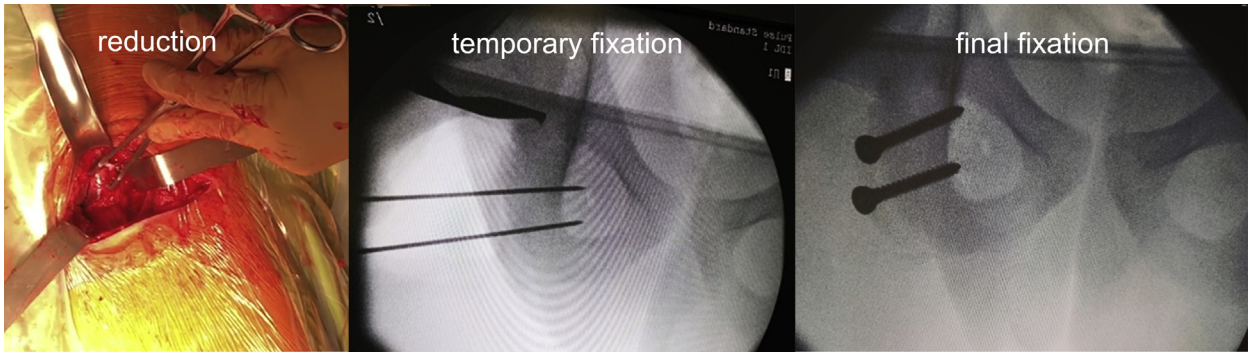

Fig 11. The fragment is reduced and secured with 2 K-wires. After fluoroscopic control, two 4.5-mm cortical screws are applied, with the orientation of the provisional K-wires taken as a reference. A fluoroscopic image of the final fixation confirms reduction and fixation of the fragment in a bicortical manner.

Fig 12. The horizontal skin incision is closed subcutaneously to obtain the best cosmetic result.

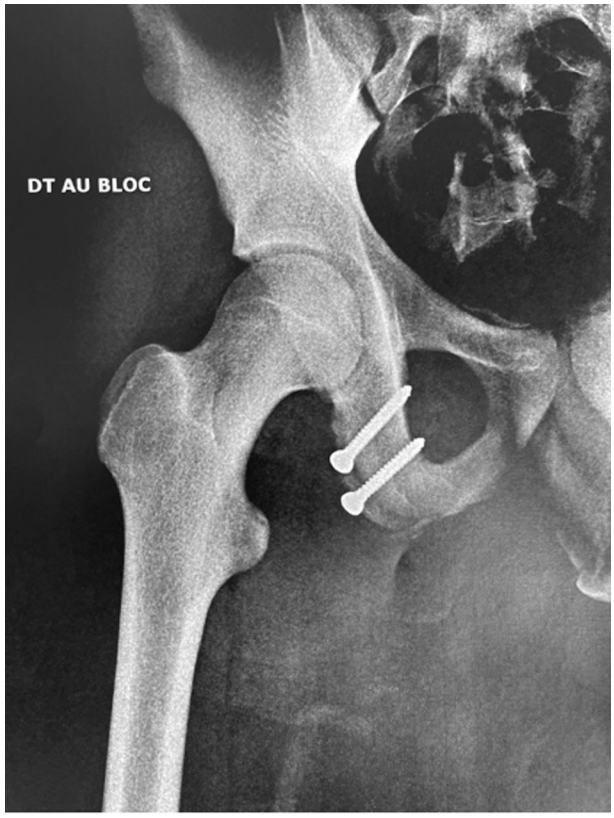

Fig 13. Postoperative radiograph showing fixation of bony avulsion of the ischial tuberosity with 2 cortical screws. (DT AU BLOC, right hip in the operating hall)

Fig 14. A hip spica bandage is applied to prevent postoperative bleeding, and an adjustable knee brace is used to limit knee extension.

major screw diameter and pitch were reported to be proportional to pullout strength.[10] Although there are studies showing equal resistance of very small-diameter cannulated screws with the same-diameter solid-core screws,[11] 3.5-mm cannulated screws have potential risks such as guidewire breakage and screw breakage or pullout, which may be difficult to manage.[12] Moreover, other proposed screw fixation methods have unicortical purchase, which diminishes the fixation strength remarkably. We propose the use of 4.5-mm bicortical cortical screws, which have a very high compression capacity leading to a strong fixation (Fig 11). The described procedure might help in all types of acute proximal surgical procedures on the proximal hamstring origin by showing the surgical steps, especially dissection and fixation.

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