

**A modified Levine approach for exposure of the anterior column, anterior wall and sacroiliac joint: a surgical technique and a case series**

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## **Summary**

Surgical exposure of the anterior column, anterior wall, pelvic brim, and sacroiliac joint is accessible through the lateral window of the ilioinguinal approach. Residual attachment of the abdominal muscles and inguinal ligament to the anterior superior iliac spine (ASIS) is often a limiting factor to expanded distal and medial exposure, especially in patients with a large abdomen that hangs over the pelvis. An ASIS osteotomy has been described to improve exposure, particularly of the distal anterior wall and joint capsule, pubic ramus, and anterior quadrilateral plate. However, an ASIS osteotomy can be troublesome to reattach. Herein, we introduce a soft tissue release technique to mobilize the abdominal muscles and inguinal ligament to allow expanded surgical access to the distal anterior column/wall and sacroiliac joint and to create a working space for fracture reduction and fixation.

## **Surgical Technique Description**

A patient is positioned supine on an operating table with the ipsilateral extremity being draped free. The surgical field includes draping down to the lower end of the rib cage. Major landmarks are identified including the ASIS, pubic symphysis, and lateral border of the patella. The incision starts at the point of the intersection of the lower border of the pubic symphysis and approximately 2cm lateral to the lateral border of the patella and then proceeds proximally and slightly curvilinearly (approximately 1 cm lateral to the ASIS). After it reaches the ASIS level, the incision continues cranially for about 4 cm (Fig 1). The incision begins 6 to 7 cm proximal to and roughly 1 cm lateral to the ASIS. It courses distally in a nearly linear path (curving very slightly laterally) to the level of the pubic symphysis aiming approximately 2 to 3 cm lateral to the lateral border of the patella.

The fascial interval between the abdominal musculature and the tensor fascia lata is identified on the palpable border of the pelvis. This is incised from 1 cm proximal to the ASIS coursing posteriorly until the curvature of the pelvis begins to curve back toward the midline of the body. It can be extended more posteriorly, if necessary, for improved access to the sacroiliac joint and posterior iliac wing. Care must be taken not to extend the fascial incision to the ASIS initially to avoid injury to the lateral femoral cutaneous nerve. The external oblique muscle insertion is released from the iliac crest and a Cobb elevator is used to lift the iliacus muscle from the internal iliac fossa. A blunt pelvic retractor (angled 45 degrees caudad) is placed over the pelvic brim between the iliacus muscle and the inner table of iliac wing. At this time no retraction force through the retractor is exerted. The fascia overlying the tensor fascia muscle is incised along from 1 cm proximal to the ASIS coursing distally in line with the skin incision. This should be done slowly and methodically with the surgeon looking closely for a laterally based lateral femoral cutaneous nerve (LFCN). The LFCN is typically not identified and rests in the fascial sleeve medial to the TFL. Subsequently, the hip is flexed by placing a sterile bump or triangle under the knee. This exposes the sartorius origin on the ASIS. A Meyerding retractor is placed under the sartorius and gentle medial retraction is provided, together with medial retraction by the previously placed blunt pelvic retractor, which collectively apply tension to the abdominal muscle and hip flexors (Fig 2). The origin of the sartorius, the inguinal ligament, and insertion of the abdominal muscles are sharply elevated off the ASIS as a single sleeve (Fig 3). Subsequently, blunt and sharp dissection are used to identify the undersurface of the sartorius muscle. Directly under the sartorius is a layer of investing fascia overlying the iliopsoas as it courses distally. It is important that this be released to mobilize the hip flexor musculature (Fig 4). The iliopsoas muscle is then elevated off the anterior column medially. Origin of the direct

head of the rectus femoris is identified and preserved. The iliopectineal fascia is incised along the pelvic brim and the blunt pelvic retractor is repositioned between the fascia and the quadrilateral surface. Medial exposure to obtain access to the superior ramus medial to the acetabulum is enhanced by accentuated flexion and adduction of the hip, and generous release of the iliopectineal fascia. Typically, a narrow Cobb elevator and bovie-based dissection can be carried out as far medial as the mid-superior ramus if necessary. A sharp Hohmann retractor can be placed to the superior pubic ramus to expose the nearly the entire anterior column of the acetabulum (Fig 5). To expose the anterior wall, direct head of the rectus femoris muscle is retracted medially or laterally depending on the desired exposure and fracture site. Occasionally, the direct head of the rectus femoris is released to view the anterior extent and of transverse oriented acetabular fractures that exit directly under the tendon origin. It should be noted that rehabilitation and duration of recovery are significantly extended if the rectus is released. The anterior sacroiliac joint exposure is facilitated by placing a Hohmann retractor over the posterior iliac crest and 1-1.5 cm on sacrum lateral to the L5 nerve. Medial and posterior retraction of the Hohmann retractor along with medial retraction of the previously placed blunt pelvic retractor contribute to visualization of the sacroiliac joint (see Figure, Supplemental Digital Content 1, <http://links.lww.com/JOT/B419> which demonstrate intraoperative visualization of sacroiliac joint). Medial retraction of the abdominal muscles and contents along with the hip flexors improve visualization and make a working space for applying reduction clamps (see Figure, Supplemental Digital Content 2, <http://links.lww.com/JOT/B420> which demonstrate the anterior extension of transverse acetabulum fracture and reduction clamp application) when a surgeon needs to have access to the anterior column/wall and sacroiliac joint.

The closure is achieved by placing two drill holes in the ASIS with a 2.0 mm drill bit and using #2 fiber wire® through the sartorius, inguinal ligament, and abdominal muscles tendons. The #1 Vicryl® suture is used to close the fascial incisions proximal and distal to the ASIS. The subcutaneous and skin closure is performed depending on the surgeon's preferences. Postoperatively, no specific restrictions are put forth with respect to protecting soft tissue repair.

### **Clinical Series**

The procedures were performed at a Level 1 academic trauma center between 2015 and 2017. The modified Levine approach was used in the surgical exposure of 33 acetabular fractures (9 ACPHT, 9 BC, 5 anterior column, 4 T-type, 3 transverse, 2 anterior column and wall, and 1 anterior wall), 13 of which were treated with a combined AIP and modified Levine approach. The decision to use the modified Levine approach was based on a fracture pattern which required direct visualization of anterior extension of fracture which typically exits at the iliopectineal eminence and isolated or associated anterior wall fracture. Postoperative follow-up ranged from 12 to 58 months (mean 28 months). Age of patients ranged from 22 to 79 years (mean 52 years). There were two superficial infections with the combined approach, and two deep infections, one of which was with the modified Levine and the other with the combined approach. Two patients experienced LFCN injury. The mean Patient-Reported Outcomes Measurement Information System (PROMIS) physical function score was 56.8, the mean PROMIS pain interference score 52.1 and the mean Harris hip score 82. By the final follow up appointment, there was no reported pain with flexion at the hip or knee and abdominal wall hernia in the current study.

## Discussion

The anterior approach to the hip and acetabulum has been developed and modified by many surgeons to address various trauma-related and non-trauma pathologic conditions. The Smith-Peterson approach is a classical approach whereby the abductor muscles are dissected from the iliac crest.<sup>1</sup> Levine<sup>2</sup> later modified the Smith-Peterson approach to address the acetabular fractures by leaving the abductor muscles intact but elevating the abdominal muscles to gain access to the pelvis. The sartorius is released from the ASIS and direct head of the rectus femoris is released from the anterior inferior iliac spine (AIIS). The Levine approach was later replaced by the ilioinguinal approach<sup>3</sup> which provides complete access to the anterior column and wall. The anterior intrapelvic approach (AIP)<sup>4,5</sup> has recently gained popularity among surgeons. A major advantage of the AIP is that the femoral neurovascular bundle is not dissected and the overall operative time is reduced.<sup>6</sup> Accordingly, the majority of complex column-based and anterior-based acetabular fractures, previously treated with a traditional ilioinguinal approach, can be treated with the AIP and a lateral window. However, direct access to the iliopectineal eminence and the region lateral to the iliopectineal eminence is limited. Access to an anterior column/wall or to the anterior limb of transversely oriented acetabular fractures is notably limited due to the residual attachment of the external oblique abdominal muscle.<sup>7</sup>

To improve visualization of any anterior column and wall fracture, an ASIS osteotomy can be performed. Sheean et al<sup>8</sup> reported significant improvement of visualization and access to the iliopectineal eminence in their cadaveric study. Surgical technique of the ASIS osteotomy has been well described by Sagi et al.<sup>7</sup> The ASIS osteotomy not only improves visualization of the iliopectineal eminence and sacroiliac joint but also expands the working space for the

reduction and fixation by mobilizing abdominal wall musculature medially. The technique we describe provides equal expansion of surgical access compared to the ASIS osteotomy but negates the need for reduction and internal fixation of the osteotomized fragment at the end of an operation.

The modifications were developed primarily in a large series of periacetabular osteotomies by one of the authors and extended into fracture care. In the series of periacetabular osteotomies, the surgeon (TOM) clearly noted that the soft-tissue detachment and reattachment (used in approximately 500 PAOs performed since 2006) described in this manuscript was notably easier and faster than the ASIS osteotomy (initial 150 PAOs performed prior to 2006). In addition, it was the surgeon's experience that there were no differences in hip flexion strength with either method. Finally, there is no hardware-related tenderness with our described technique over the ASIS. In most cases, the origin of the rectus femoris can be left intact and this facilitates postoperative rehabilitation.<sup>9</sup> However, for fractures that exit anteriorly directly underneath the rectus tendon, it can and potentially should be released to ascertain an anatomic reduction. The relatively straighter incision, compared to the incision with the original Levine approach, facilitates easier retraction of the abdominal muscles/contents, direct visualization of anterior sacroiliac joint, and reduces wound complications particularly in obese patients. The LFCN was injured in two patients in our case series. This likely resulted from a more lateral variant location of the nerve. Rudin et al<sup>10</sup>, determined that 38% of the time, the LFCN courses directly above or lateral to the ASIS where the nerve could have been injured. In the 40 patients reported by Sagi et al<sup>7</sup>, no LFCN injury occurred. They related this finding to a potential advantage of protecting LFCN by releasing the nerve from the tensor fascia allowing medial retraction of the nerve along with external oblique and sartorius in ASIS osteotomy. Based on

this observation, a similar strategy should be adopted with the technique we report which should be equally protective of the LFCN. The clinical results in our case series study on patients treated with the modified Levine approach showed similar outcomes, in comparison with relevant reports in literature.

In conclusion, a modified Levine approach is an alternate approach to ASIS osteotomy that can provide excellent visualization and access to anterior column/wall and anterior sacroiliac joint by further retraction of the abdominal wall/contents and iliopsoas muscle.

### **Disclosure**

The authors have not received grant support, research funding or have any proprietary interests in the materials described in the article.

**Figure 1.** Incision for the modified Levine approach

**Figure 2.** Medial retraction of the external oblique through the lateral window and sartorius prior to release of their attachment at ASIS

**Figure 3.** Soft tissue release at the ASIS as a single sleeve

**Figure 4.** Surgical instrument over the psoas fascia

**Figure 5.** Medial retraction of the external oblique, sartorius, and inguinal ligament with retractor positioning demonstrating improved visualization of the entire anterior column, pubic root and iliac fossa



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