The Modified Stoppa Approach for Acetabular Fracture

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The video that accompanies this article is "The Modified Stoppa Approach for Fractures of the Acetabulum," available on the *Orthopaedic Knowledge Online* Web site, at http://www5.aaos.org/oko/jaaos/surgical.cfm.

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Judet et al[1] and Letournel and Judet[2] laid the groundwork for the current understanding and management of acetabular fractures. They developed a classification system and novel surgical approaches that still serve as the standard of care. Modifications of these approaches (eg, ilioinguinal, Kocher-Langenbeck) have been developed to improve surgical outcomes.[3-7]

The Stoppa approach is used in the repair of inguinal hernias.[8,9] Hirvensalo et al[10] and Cole and Bolhofner[11] described a modified Stoppa approach involving an anterior intrapelvic (AIP) extraperitoneal approach through the rectus abdominis muscle for internal fixation of pelvic and acetabular fractures. This approach provides direct access to the pubis, the posterior surface of the ramus, the quadrilateral surface, the pubic eminence, and the infrapectineal surface, as well as the sciatic buttress, sciatic notch, and the anterior sacroiliac joint. The modified Stoppa (ie, AIP) approach provides improved exposure of the quadrilateral surface and posterior column. Additionally, with the AIP approach, the so-called middle window of the ilioinguinal approach can frequently be avoided, resulting in minimal dissection of the inguinal canal, femoral nerve, and external iliac vessels.

Indications and Contraindications

General agreement exists for the use of the modified Stoppa approach for all fractures that can be managed with an ilioinguinal approach.[3,4,6,7,11] This includes anterior wall, anterior column, and associated anterior column and posterior hemitransverse fractures, as well as certain both-column, T-shaped, and transverse fractures. The AIP approach is particularly useful for fractures that involve the quadrilateral surface with or without comminution and medial dislocation of the femoral head.

The AIP approach is contraindicated in fractures with posterior-only patterns (eg, posterior wall, posterior column, transverse) that exit below the ischial spine. These fracture patterns are best addressed with a posterior approach, such as the Kocher-Langenbeck. A history of cesarean section, hysterectomy, bladder injury, or bladder surgery may increase the risk of cystotomy and contamination or infection and may preclude the AIP and any other anterior approach. Additionally, a history of prostatectomy may increase the risk of perioperative bleeding because of excessive scarring of the structures in the Retzius space. Neither a history of previous hernia surgery nor current hernia is a contraindication to the AIP approach.

Surgical Technique

Setup

The patient is placed supine on a radiolucent operating table that allows adequate visualization on AP and Judet radiographs. A table that facilitates lateral traction of the hip is

helpful in eliminating deforming forces on the anterior column and quadrilateral surface. The injured limb is draped free, and the ipsilateral hip and knee are maintained in slight flexion using traction on the flexed leg or a radiolucent triangle. This position relaxes the iliopsoas muscle and the external iliac vascular bundle. A Foley catheter is used to protect the bladder, improve visualization, and monitor fluid balance. Typically, the surgeon stands on the contralateral side to improve visualization of and access to the true intrapelvic cavity. A head lamp or a fiber-optic light retractor may be useful, as well.

Approach

A Pfannenstiel incision is made 1 to 2 cm superior to the pubic symphysis (Figure 1) (**video, 0:20**). Dissection is carried down through the skin and subcutaneous tissue to the level of the rectus fascia. The rectus fascia is split in line with its fibers, and the transversalis fascia is incised just superior to the pubic symphysis. Far lateral dissection is discouraged because of the risk of injury to the spermatic cord or round ligament as they exit the external ring. The limiting factor in the exposure is the extent of vertical dissection of the rectus, not lateral dissection superficial to the rectus. Blunt dissection of the Retzius space is performed. This space is packed with laparotomy sponges to protect the urinary bladder and urethra (**video, 1:00**).

Figure 1

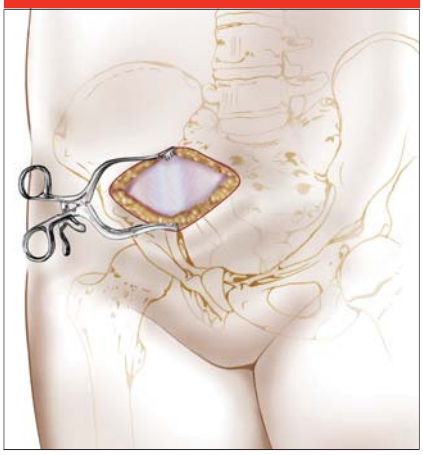

Illustration demonstrating the Pfannenstiel incision, which is made 1 to 2 cm above the pubic symphysis.

Figure 2

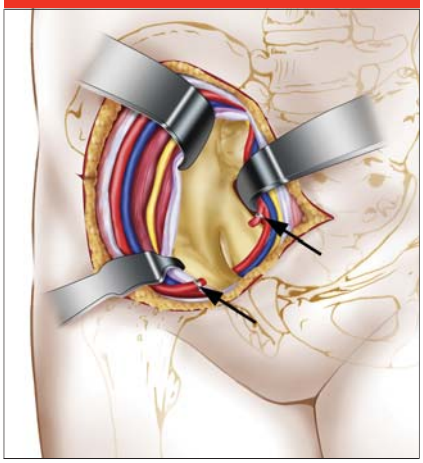

Illustration demonstrating the surgeon's view through the modified Stoppa approach from the contralateral side. A pointed Hohmann retractor placed over the pubic tubercle is used to retract the rectus musculature (lower left). A Taylor or Deaver retractor is placed under the iliopsoas muscle to protect the external iliac vessels (upper left). A narrow malleable retractor placed in the sciatic notch is used to protect the obturator neurovascular bundle (right). The corona mortis (arrows) is clipped to allow further access to the pelvic brim and the quadrilateral surface.

Subperiosteal dissection is performed along the pubis, superior pubic ramus, posterior surface of the ramus, and pelvic brim up into the internal iliac fossa. A pointed Hohmann retractor may be placed over the pubic tubercle to reflect the rectus musculature (Figure 2). As the dissection is extended toward the acetabulum, a Deaver retractor or malleable retractor is used to protect and elevate the external iliac vessels and the iliopsoas muscle. The vascular anastomoses between the external iliac and obturator vessels (ie, corona mortis) are encountered as the artery and vein course over the superior ramus traveling toward the obturator foramen. These vessels must be ligated or clipped to advance the dissection farther along the pelvic brim and quadrilateral surface (Figure 2) (**video, 2:30**).

Additional exposure is obtained with distal extension of periosteal dissection along the pelvic brim. The iliopectineal fascia is detached over the anterior column and the dome of

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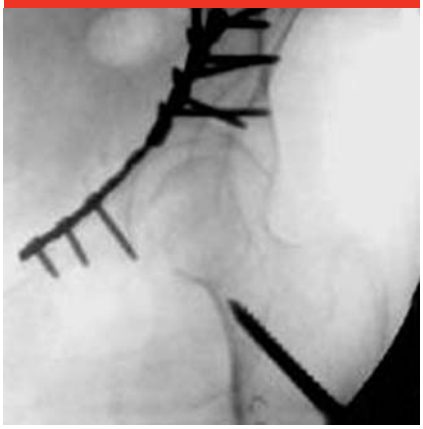
the acetabulum. A Taylor or Deaver retractor may be placed under the iliopsoas muscle to protect the external iliac vessels. Alternatively, a long Hohmann retractor may be placed along the anterior lip of the acetabulum deep to the psoas and iliac vessels. Dissection is continued toward the anterior aspect of the sacroiliac joint to expose the entire pelvic brim (Figure 2).

Next, the quadrilateral surface and the medial aspect of the posterior column are exposed. The obturator neurovascular bundle is identified in the fat medial to the internal obturator muscle (**video, 3:50**). This bundle may be isolated and protected with a narrow malleable retractor placed gently in the sciatic notch or between the quadrilateral surface and the internal obturator muscle (Figure 2). Alternatively, the bundle may be indirectly retracted with mobilization of the abdominal contents away from the surgical site with slight Trendelenburg positioning of the operating table and/or placement of a deep retractor. Mobilization of the bundle allows the surgeon to work above and below the bundle, which is helpful in reducing the quadrilateral plate and posterior column. Lateral retraction of the femoral head with a trochanteric traction pin facilitates exposure and reduction by eliminating deforming forces on the medially displaced fracture (Figure 3). This maneuver also releases tension on the obturator neurovascular bundle during retraction.

Anterior column fractures that exit the iliac crest and fractures that cannot be adequately reduced and/or stabilized using the AIP window may be accessed using the lateral window of the ilioinguinal approach (**video, 6:25**). An incision is made along the iliac crest to expose the insertion of the oblique abdominal muscles. These muscles are released to allow dissection over the crest into the internal iliac fossa. The iliac muscle is elevated subperiosteally, exposing the iliac fossa to the pelvic brim as well as the anterior aspect of the sacroiliac joint. Frequently, nutrient vessel foramina are encountered along the internal iliac fossa; these can be a source of brisk hemorrhage. Bone wax is applied to the foramina to control bleeding. A Ganz or blunt Hohmann retractor may be placed carefully into the sciatic notch or along the quadrilateral surface to improve visualization. This adjunct lateral window facilitates reduction of high anterior column fractures and placement of posterior column lag screws (Figure 4).

Figure 3



Fluoroscopic view of the hip joint demonstrating placement of a trochanteric traction pin approximately 130° collinear with the femoral neck. The pin is used to apply lateral retraction of the femoral head.

Figure 4

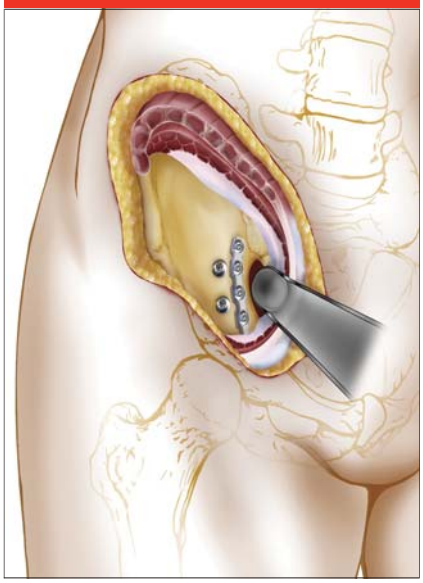


Illustration demonstrating the lateral window used in the ilioinguinal approach. This approach is used in the management of fractures that cannot be adequately stabilized through the modified Stoppa window. A blunt Hohmann retractor is placed into the sciatic notch or along the quadrilateral surface to improve visualization. Two pelvic brim lag screws are noted just lateral to the plate. They are inserted parallel to the quadrilateral surface to stabilize the posterior column components.

Reduction and Stabilization

Posterior Column

A pelvic reduction clamp or a pelvic Collinear Reduction Clamp (Synthes, Paoli, PA) placed through the AIP or the lateral window may be used to reduce the posterior column. Depending on the fracture pattern, the inferior tine of the clamp is placed either in the greater sciatic notch or along the ischial spine. Lateral traction of the femoral head eliminates medial deforming forces on the quadrilateral surface and aids in reducing the posterior column. For posterior column fractures that exit into the greater sciatic notch, a pelvic reconstruction plate may be placed on the medial surface of the posterior column to stabilize and maintain the reduction. Posterior column fractures that exit at or below the level of the ischial spine may be stabilized with posterior column lag screws placed through the lateral window (Figure 4). Lag screws also may be placed through the AIP window along the quadrilateral surface, similar to those placed via the second window of the ilioinguinal approach,

Figure 5

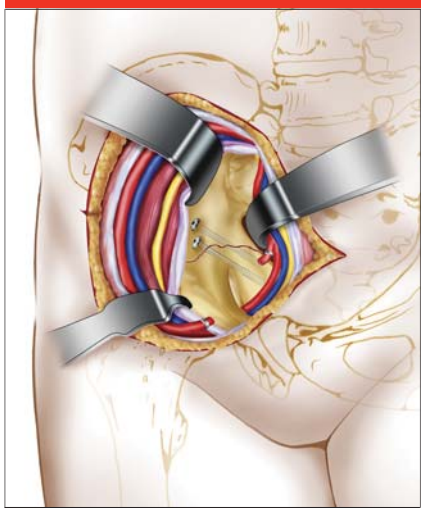


Illustration demonstrating lag screw placement along the quadrilateral surface through the modified Stoppa window.

Figure 6

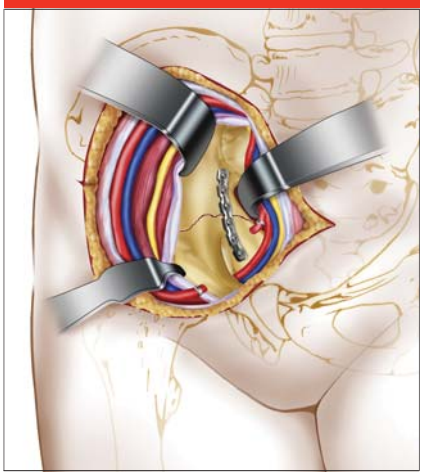


Illustration demonstrating stabilization of a quadrilateral surface fracture that extends toward the ischial spine. The plate extends from the sciatic buttress to the ischial spine and the inferior pubic ramus.

Figure 7

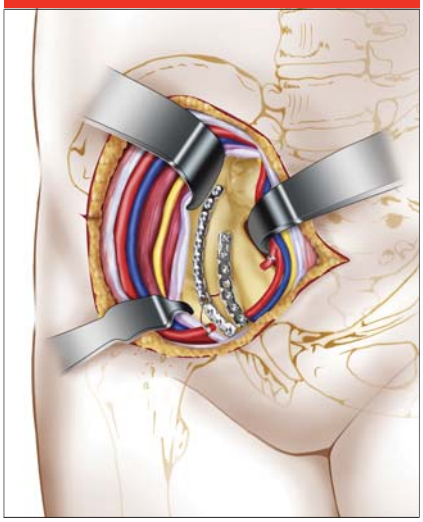


Illustration demonstrating fixation with a pelvic brim plate and an undercontoured infrapectineal plate that is secured posteriorly to the sciatic buttress and anteriorly to the posterior surface of the superior pubic ramus. This combination is particularly useful for stabilization of unstable and/or comminuted fractures, which are frequently seen in elderly patients.

as described by Letournel and Judet[2] (Figure 5).

Quadrilateral Surface

An infrapectineal buttress plate may be used to stabilize fractures of the quadrilateral surface (**video, 9:20**). The fracture pattern and degree of comminution determine the position of the plate. For fractures that extend toward the ischial spine, the plate can be contoured to run from the sciatic buttress toward the ischial spine and inferior pubic ramus or from the internal iliac fossa over the pelvic brim toward the ischial spine and inferior pubic ramus under the obturator neurovascular structures[12] (Figure 6). Depending on the fracture pattern of the quadrilateral surface and the location of the buttress plate, this contoured plate may be fixed with screws inserted into the posterior column or it may be applied in pure buttress fashion with undercontouring in a manner similar to that of spring plating.[6] This technique is particularly useful in combination with a traditional pelvic brim plate for management of comminuted fractures, which are frequently seen in elderly patients (Figure 7).

Anterior Column

The anterior column is reduced through the AIP approach and/or a lateral window. A pelvic Collinear Reduction Clamp (Synthes), standard pelvic reduction clamp, or ball-spike pusher (ie, picador) is used to reduce the anterior fracture. The reduction is stabilized in standard fashion with a pelvic reconstruction plate with or without lag screws along the pelvic brim and pubic eminence (Figure 7).

Superior Roof or Dome Impaction

An impacted section of the superior and/or superoposterior roof of the acetabulum is often encountered in elderly patients. This marginally impacted section may be reduced using the AIP approach or a lateral window before fixation of the columns. This section is supported with a bone graft, bone graft substitute, or buttress screw.

Closure and Postoperative Care

After the wound is irrigated and hemostasis is achieved, a drain is placed in the Retzius space. If the lateral window was used, a second drain is placed in the internal iliac fossa. The rectus abdominis muscle and the interval between the external oblique muscles and the abductors are closed with absorbable sutures, followed by layered closure of the subcutaneous and cutaneous tissues.

Drains are removed when drainage falls below 25 mL per 8 hours. Physical therapy with toe-touch weight bearing is done for 12 weeks. Return of bowel and bladder function must be carefully monitored. The wound is checked 7 to 14 days after discharge from the hospital. Additional postoperative follow-up is done at 6

Pearls

- Preoperative skeletal femoral traction helps to prevent articular damage to the femoral head.
- For optimal access to the true intrapelvic region, the surgeon should stand on the side contralateral to the fracture.
- The vertical length of the rectus incision is the limiting factor in the exposure.
- Undercontoured plates provide additional buttress support to the fracture.

Pitfalls

- Extension of the skin incision and subcutaneous dissection too far laterally may result in injury to the spermatic cord or round ligament.
- Vascular anastomoses between the external iliac and obturator vessels must be identified and ligated.
- When exposing the quadrilateral surface, risk of obturator nerve palsy can be minimized with careful surgical dissection, mobilization, and gentle retraction of the obturator neurovascular bundle.
- The sciatic nerve is stretched with the hip and knee in flexion. To avoid injury to this nerve, care must be taken when inserting retractors into the sciatic notch and along the inferior surface of the quadrilateral plate.
- Intra-articular hardware penetration is a risk with screws placed directly adjacent to the quadrilateral surface. Screw placement may be assessed on fluoroscopy and postoperative CT.

and 12 weeks postoperatively. Beginning at week 12, weight bearing is progressively advanced until full weight bearing is achieved. Patients are radiographically assessed at 6 months, 1 year, and once per year thereafter.

Complications

In our experience, the most common complications associated with the modified Stoppa approach are wound infection, external iliac vein injury, sciatic nerve palsy, obturator nerve palsy, and fixation failure. Other complications have been reported, including inguinal hernia, violation of the peritoneal cavity, cystotomy, lateral femoral cutaneous nerve palsy, injury to the superior gluteal artery, atrophy of the rectus abdominis muscle, and deep vein thrombosis.[4,11,13]

Outcomes

Cole and Bolhofner[11] reviewed 55 acetabular fractures with an average follow-up of 17.7 months. They reported excellent or good radiographic and clinical outcomes in 89% of patients and fair or poor outcome in 11% of patients. Complications included one case of peritoneum violation; one case of wound dehiscence that required surgical closure; two transient obturator nerve palsies; six cases of posttraumatic arthritis, one of which required hip arthroplasty; one inguinal hernia requiring surgical repair; and one case of deep infection requiring hardware removal.

Jakob et al[4] reviewed 20 patients—14 with acetabular fracture and 6 with pelvic ring fracture. In one patient, conversion to a standard ilioinguinal approach was required to address difficulties with the reduction. Anatomic and satisfactory reduction was achieved in 13 of 14 patients with acetabular fracture. Clinical outcome at 1-year follow-up was good to excellent in 17 patients and fair to poor in 3. Complications included one lateral femoral cutaneous nerve injury and one infection.

Sagi et al[13] reported on 57 patients treated with the modified Stoppa approach. At 1-year follow-up, 91% of patients had good or excellent clinical outcomes. Seventy percent of reductions were excellent, 22% were good, and 8% were poor. Average blood loss was 750 mL, and the mean surgical time was 263 minutes. Complications included one vascular injury requiring embolization, one lateral window wound infection, and one case of atrophy and denervation of the rectus abdominis muscle. Thirteen patients experienced weakness of the hip adductors postoperatively; all but one resolved and improved within 6 months.

Hirvensalo et al[10] reported on the largest serial experience using the modified Stoppa approach for acetabular fractures. In 164 patients, 84% of reductions were good, 9% were fair, and 7% were poor. In this study, 75% of patients achieved a Harris Hip Score of ≥80 on clinical examination and functional outcome scoring.

Summary

The modified Stoppa or AIP approach to the acetabulum provides

anatomic exposure that can be used for direct access to the pelvic brim, posterior column of the acetabulum, and the quadrilateral surface. The improved visualization provided by this approach facilitates fracture reduction and stabilization. The modified Stoppa approach is less invasive than standard approaches because it does not require surgical dissection of the inguinal canal and femoral neurovascular bundle. The traditional lateral window may be incorporated to facilitate reduction and stabilization of anterior column fracture, if necessary.

References

Evidence-based Medicine: Levels of evidence are described in the table of contents. In this article, there are no level I or level III studies. Reference 12 is a level II study. References 1, 3-5, 8-11, and 13 are level IV studies. References 6 and 7 are level V expert opinion.

References printed in **bold type** are those published within the past 5 years.

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