Massive hemorrhage associated with displaced pelvic fractures is one of the most serious emergencies faced by orthopaedic and trauma surgeons. Postmortem angiography and studies performed by Huittinen and Statis and angiography studies on pelvic fracture patients in a number of institutions indicate that the source of bleeding in 90% of these injuries is the pelvic veins and fracture surfaces.

Despite the fact that these are low pressure systems, large volumes of blood can collect in the extraperitoneal and retroperitoneal space over a period of several hours. Uncontrolled hemorrhage is often complicated by hypothermia and coagulopathy which leads to profound shock and death within hours of admission to the hospital.

Because of the geometry of the pelvis, a few centimeters of displacement can lead to a doubling of the potential intrapelvic volume for hematoma formation. Movement of the unstable hemipelvis during the initial period of physical examination, resuscitation and x-ray studies will interfere with clot formation and aggravate the bleeding. To overcome these problems, the displaced pelvis must be reduced and stabilized immediately after the pelvic ring disruption is identified.

The pneumatic antishock garment (MAST trousers) has been used effectively for this purpose. This device limits access to the abdomen and perineum and can cause compartment syndrome, particularly in hypotensive patients. External fixation is an excellent method to achieve reduction and provisional stabilization of the displaced pelvic ring. Because of the equipment requirements, an external fixator is most frequently applied in the operating room. The procedure is often delayed until after the completion of resuscitation, x-ray evaluation and head, chest and abdominal surgery. Internal fixation, which is appropriate for some fracture patients, must also be delayed until other index surgery is completed.

Recognizing the difficulties in using the pneumatic antishock garment, external fixation, and internal fixation, the Pelvic Stabilizer has been developed as a method to provide emergent reduction and stabilization of pelvic ring disruption with associated hemorrhage. This device was designed to be applied in the Emergency Room with a local anesthetic. It can be affixed to the patient rapidly and easily as soon as the displaced pelvic ring disruption is identified. Its design and position of application allow unobstructed access to the abdomen and perineum for subsequent radiographic studies and surgical procedures. Initial results show its effectiveness in reduction and stabilization of the pelvic ring, in maintenance of the reduction and in achieving patient hemodynamic stability. Finally, this new device may help identify the few patients who have arterial, in addition to venous, hemorrhage in the pelvis.
The Pelvic Stabilizer is composed of two semi-circular aluminum tubes connected by a central ratcheting gear (Figure 1). The design of the ratchet gear allows the two gear faces to be disengaged by compressing the central spring to allow the device to be opened to accommodate patients of varying sizes and to simplify application. With the central control knob screwed down into an intermediate position, the ratchet gear will allow the two aluminum tubes to be pushed incrementally together while prohibiting them from being separated. Additional compression is transmitted to the pelvis through two 1.0 cm or 1.5 cm titanium pins which contain a sharp central spike. This pin tip is designed to avoid disengagement from the pelvis while decreasing the likelihood of penetration. The opposite ends of the pins contain a groove in which a small container ring is seated. Pins are inserted into Threaded Pin Holders which are attached to the ends of the aluminum tubes. Each threaded pin holder has a knurled knob which can be turned clockwise to apply additional compression after the aluminum tubes of the Pelvic Stabilizer have been pushed together maximally (Figure 2).
INDICATIONS AND PIN INSERTION SITES

The Pelvic Stabilizer is intended for use in pelvic ring disruptions of the Tile B and Tile C type injuries with external rotation displacement greater than 2.5 cm (Figure 3) or superior displacement of greater than 1.0 cm (Figure 4).

1. Anterior: The anterior site for pin application is 5.0 - 6.0 cm from the iliac crest on the dense column of iliac bone just above the acetabulum. This spot is located midway along a line drawn between the tip of the greater trochanter and a spot on the iliac crest three finger breadths posterior to the anterior superior spine (Figure 5). When applied here, the Pelvic Stabilizer is very effective in reducing the externally rotated hemipelvis and closing the diastasis.

2. Posterior: The posterior site for pin application is 4.0 - 5.0 cm anterior to the posterior iliac spine on the dense iliac bone opposite the sacroiliac joint (Figure 5). When applied here, the Pelvic Stabilizer transmits greater compression across the posterior pelvic arch which may be desirable for stabilizing a vertical shear injury.

The Pelvic Stabilizer was designed to clamp down on the outer surface of the pelvis to apply lateral compressive force. The device has two primary uses. The first is to reduce the external rotation component of a pelvic ring disruption to decrease the intrapelvic volume and tamponade venous bleeding. The second is to stabilize the pelvic ring disruption so that one hemipelvis cannot move with respect to the other. The second function can be utilized to control pelvic ring disruptions that have vertical displacement as well as external rotation, but the vertical displacement component of the pelvic ring disruption must be reduced by manual or skeletal traction prior to the application of the device.

CAUTION: Care must be exercised in patients with generalized or pelvic osteopenia. The other danger associated particularly with the posterior insertion site is the possibility of the pin slipping into the greater sciatic notch where it could cause injury to the superior gluteal vessels or the sciatic nerve. When using the posterior site, it is essential to dissect bluntly down to the ilium with a hemostat to insure that the pin will purchase against solid bone.
CONTRAINDICATIONS AND POSTOPERATIVE CARE

The use of the Pelvic Stabilizer is contraindicated in stable pelvic ring disruptions with under 2.5cm of anterior diastasis or one centimeter of vertical displacement. It is also inappropriate or potentially dangerous to use this device on patients with pelvic ring disruptions that contain internal rotation deformities resulting from lateral compression or major acetabular fractures.

The Pelvic Stabilizer is designed to allow its application in the Emergency Room as soon as hemodynamically unstable patients are determined to have appropriate displaced pelvic ring disruptions. The device is intended to serve as a provisional stabilization method until definitive internal or external fixation can be applied. It can be left in place for one to two weeks if the patient’s condition prohibits this definitive surgery. If it is left in place for several days the cessation of the bleeding and resorption of the pelvic hematoma will decrease the hydrostatic pressure resisting the clamping together of the pelvis which may result in loosening of the fixation. If the device is kept in place for several days, it is therefore advisable to check the integrity of the stabilization and apply additional compression as necessary by turning the Threaded Pin Holders at the ends of the aluminum tubes in a clockwise fashion. The Pelvic Stabilizer may also be used as an indirect reduction device to aid in holding the position of the innominate bones during definitive internal or external stabilization procedures.

FIGURE 6

CAUTION: Although the pin tip is designed to reduce the likelihood of penetrating the ilium, this pin can easily penetrate the thin area of bone in the center of the iliac fossa which exists even in young patients (Figure 6).
The device is applied with the patient in the supine position. Vertical displacement of the hemipelvis must be reduced prior to application of the Pelvic Stabilizer with manual or skeletal traction (Figure 7). The skin over the intended area of pin insertion on both sides is prepped with an antiseptic solution. After intradermal and periosteal infiltration with xylocaine, stab wounds are made and the muscle is dissected down to the bone with a hemostat. Appropriate sterile practices must be followed when applying the device. In all cases the pins must be sterile. To prepare the device for application, the central control knob must be loosened into an intermediate position so that depression of the central clutch mechanism will disengage the gear teeth and allow the device to be opened. To open the device, compress the central control knob while grasping the circular flange to disengage the ratchet (Figure 8). The pins can then be inserted into the corresponding recess in the Threaded Pin Holders. The articulations at the end of the aluminum tubes should be adjusted so that the pins will be oriented toward one another along a single axis once the device is clamped onto the pelvis (Figure 9). The orientation of the pins should be set initially with the device opened but may have to be adjusted secondarily once the Pelvic Stabilizer is applied.
The Pelvic Stabilizer should be applied by holding it at a nearly horizontal position with the central gear positioned over the patient's thighs. As the device is closed down, the ratchet gear will engage and allow continuous compression to be applied (Figure 10). Once the two aluminum tubes have been grossly approximated to the pelvis, the central control knob of the central ratcheting gear should be tightened completely to avoid any inadvertent loosening. Reduction is confirmed radiographically. Additional compression can then be applied by turning either one of the knobs of the Threaded Pin Holders at the end of the aluminum tubes. Turn clockwise until the central spike of the pin is driven into the bone and the flat surface at the end of the pin pushes up against the external surface of the ilium (Figure 11). After application, the Pelvic Stabilizer will usually be positioned over the patient's mid thigh. In this location, the device allows unobstructed access to the abdomen for further radiographic studies and abdominal surgery. If it is necessary to gain further access to the perineum for additional physical examination of the genitals or the anus or for wound treatment, the device can be rotated along the axis of the pins so that the central ratcheting gear comes to lie over the chest. If rotation is difficult or impossible check single axis alignment as shown in Figures 9 and 10. When the device is kept in place for several days prior to definitive surgical stabilization of pelvic ring disruption, the nurse and the patient can readily rotate the device along the pins and lift the central ratcheting gear off the patient's thighs for nursing care.
OSTEOPOROSIS PIN INSERTION

As previously discussed, when the pelvic bone is osteopenic, even properly located pins can be driven through the bone utilizing standard compression forces. To avoid this possibility, the specially designed Osteoporosis Pin should be used instead of the regular pin when applying the Pelvic Stabilizer to patients with osteopenia (Figure 12).

When using the Osteoporosis Pin, the specially designed sheath and trocar should be used to avoid catching the spikes of the pin on the muscle tissue. A standard incision approximately 3.0 - 3.5cm should be made in the appropriate area and the muscle is dissected down to the bone with a hemostat. Insert the sheath and trocar and remove the trocar once the sheath has engaged the bone. The Osteoporosis Pin is then inserted through the sheath to the bone. Repeat the procedure for the contralateral side.

The Pelvic Stabilizer can now be attached to these two pins. An alternate method for using the Osteoporosis Pins is to first attach them to the Pelvic Stabilizer. The sheaths are inserted as described above. While an assistant holds both sheaths into place against the bone, the entire device is clamped around the patient and the Osteoporosis Pins are inserted through the sheaths and down to the bone. Once the initial compression has been placed on the pelvis, the two sheaths can be removed. The sheath is designed with a slot to allow for removal after the Pelvic Stabilizer is in place.

REMOVAL

To remove the device, simply loosen the central control knob, grasp the rim around the central ratcheting gear and depress the knob. This will depress the spring, disengaging the ratchet gear plates. Next, separate the aluminum tubes of the stabilizer distracting the pins from the surface of the pelvis. On occasion, the central spike of the pin will be lodged firmly in the iliac bone. In such cases, it may be necessary to strike the inner surface of the aluminum tube just above the articulation with the palm of the hand.
ACE PELVIC STABILIZER PARTS LIST

6060 Sheath and Trochar Assembly Not Pictured
6065 Osteoporosis Pin E
6072 Threaded Pin Holder D
6075-1.0 Pelvic Stabilizer Pin, 1.0cm Not Pictured
6075-1.5 Pelvic Stabilizer Pin, 1.5cm F
6081 Pelvic Stabilizer A
Osteoporosis Pin Assembly
(Assembly consists of 6065 and 6072) B
Pelvic Stabilizer Pin Assembly
(Assembly consists of 6072 and 6075-xx) C