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Literature Review

Articles That May Change Your Practice: Pelvic Binders

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Injuries to the pelvic ring can be devastating and life-threatening. They are commonly observed in victims of motor vehicle crashes, motorcycle crashes, pedestrians struck by vehicles, and falls from a height. Pelvic ring injuries have an associated mortality ranging from 9% to 22%, which is increased to 33% to 57% in the presence of shock. External pelvic immobilizer devices are increasingly popular as a way to manage suspected pelvic ring injuries in the prehospital and transport setting. Pelvic circumferential compression devices have become standard practice in this setting as a way to stabilize an injured pelvis and mitigate further blood loss.

The goal of binding a pelvis is to minimize or prevent movement of bony fragments and reduce potential secondary injury to the pelvic vasculature. This can reduce the potential space for blood to accumulate and may promote clot stability, minimizing further blood loss. A simple sheet and binder that are properly applied can be sufficient to immobilize the pelvis in the setting of a suspected injury, and there are commercially available binders that make pelvic immobilization quick and easy.

The science and collective experience with pelvic binders continue to grow. In this article, we examine the evidence supporting use of pelvic binders in the prehospital and transport setting, with special attention on the importance of accurate placement of these devices to ensure patient benefit.

Bonner TJ, Eardley WG, Newell N, et al. Accurate placement of a pelvic binder improves reduction of unstable fractures of the pelvic ring. *J Bone Joint Surg Br.* 2011;93:1524-1528.

Despite the growing evidence to support the benefits of pelvic binders, there was little

information about either the accuracy of their application or their ability to reduce a pelvic fracture. Cadaveric studies suggested the best method to accurately reduce symphyseal diastasis is to apply a pelvic binder at the level of the greater trochanters. However, there is little clinical evidence to assess the validity of this biomechanical evidence. The authors of this retrospective study assessed the accuracy of placement of pelvic binders and determined whether circumferential compression at the level of the greater trochanters is the best method of achieving reduction of symphyseal diastasis.

The authors reviewed pelvic radiographs in which the buckle of the pelvic binder was clearly visible. The patients were divided into the following groups according to the position of the buckle in relation to the greater trochanters: high, trochanteric, or low. Reduction of symphyseal diastasis was measured in a subgroup of patients with an open-book fracture, which consisted of an injury to the symphysis and disruption of the posterior pelvic arch.

They found 167 radiographs with a clearly visible pelvic binder and suitable for interpretation, 45 (27%) of which had a pelvic fracture. In 83 (50%), the binder was positioned correctly at the level of the greater trochanters. The binder was most commonly misplaced in the high position (65, 39%) and less so in the low position (19, 11%). A subset of 17 patients with pelvic fractures was used to assess the effect of pelvic binder position on diastasis reduction. The mean symphyseal diastasis gap was 2.8 times greater (mean difference = 22 mm) in the high group compared with the trochanteric group ($P < .01$).

Although dated, this study provided the first clinical evidence to show that placement of a pelvic binder at the level of the greater trochanters provides the best

reduction of the symphyseal diastasis in an unstable fracture of the pelvic ring. Application of a binder above the greater trochanters is a common mistake and results in inadequate reduction of the fracture. Misplacement of the binder may result in further blood loss and indirectly delay cardiovascular recovery in patients with multisystem injuries. The study's results are limited because it is a radiologic study that does not include data about the effect of reduction of diastasis on the control of hemorrhage. However, reduction of diastasis increases pelvic stability and promotes hemodynamic recovery. The stability of a pelvic fracture is also important because it reduces pain and promotes platelet-dependent clot formation.

Morris R, Loftus A, Friedmann Y, Parker P, Pallister I. Intra-pelvic pressure changes after pelvic fracture: a cadaveric study quantifying the effect of a pelvic binder and limb bandaging over a bolster. *Injury.* 2017;48:833-840.

Noninvasive methods of reducing and stabilizing unstable pelvic fractures include application of a pelvic binder or lower limb bandaging over a knee flexion bolster. These methods help close the pelvic ring and can tamponade bleeding. The authors of this cadaveric study quantified the intrapelvic pressure changes that took place with 3 different maneuvers: lower limb bandaging over a bolster, a commercially available pelvic binder, and a combination of both. The authors used 6 nonembalmed cadavers and created an unstable pelvic fracture by dividing the pelvic ring anteriorly and posteriorly. They placed a manometric water-filled balloon in the retropubic space and filled it to achieve a baseline of 8 cm H₂O, mimicking

the average central venous pressure. The steady-state intrapelvic pressures were measured after each intervention to stabilize the pelvis. The authors found the intrapelvic pressures were significantly greater after each intervention when compared with the baseline (binder = 24 cm H₂O, bolster = 15.5 cm H₂O), with the combination greater (31 cm H₂O) than the result for each individual method. The authors concluded that both methods are effective to significantly increase intrapelvic pressures. These findings support the use of either technique to achieve nonsurgical hemorrhage control of venous bleeding in a fractured pelvis.

Schweigkofler U, Wohlrath B, Trentschi H, et al. Diagnostics and early treatment in prehospital and emergency room phase in suspicious pelvic ring fractures. *Eur J Trauma Emerg Surg.* 2018;44:747-752.

The purpose of this prospective, multicenter study was to examine the clinical diagnostic approach to potential pelvic injuries before imaging takes place. A standardized and anonymized questionnaire was completed by the emergency room team during the initial examination and treatment in the emergency trauma room. The results of the pelvic stability examination (before completion of radiologic diagnostics) were collected prospectively. All patients arriving directly from the prehospital setting with a strong clinical suspicion of pelvic injury and initial treatment in the emergency trauma room were included. Patients who had received treatment at another hospital and were secondarily transferred were excluded.

The study included 254 patients with a suspected pelvic fracture transported to 12 German trauma centers over 2 consecutive years. Of the 254, 166 (65.4%) had their pelvis immobilized by prehospital personnel before arrival in the hospital. Imaging revealed that 138 of these patients (54.3%) had a pelvic fracture, with 43 considered stable and 95 considered unstable. Most notably, there were no reports of complications like “overcorrection” of the fracture because of the immobilizer, no pressure marks or skin necrosis, and no associated injury with the use of the pelvic binder for up to 72 hours.

The manual examination of pelvic stability was documented in 156 cases (61.4%). Twenty-five patients (16% of tested patients) were found to have pelvic instability upon clinical examination, and 18 of them showed unstable pelvic ring fractures on computed tomographic imaging. The manual examination of pelvic stability had a sensitivity of

31.6% and a specificity of 92.2% in detecting unstable pelvic fractures. The positive and negative predictive values were 72% and 68%, respectively, and 68.4% of all unstable pelvic fractures were missed clinically. Although this may be caused by 199 of the 254 (78.3%) patients having limited accessibility of clinical examination because of intubation, drugs, or reduced level of consciousness, it points out how unreliable the clinical examination is regarding fractures of the pelvic ring.

The results of this prospective study show the unreliable nature of the manual examination of the pelvis, and the significant number of pelvic fractures that were not identified during bedside examination. More importantly, the study indicates there are no significant risks to pelvic immobilization. The authors point out that with the noninvasive stabilization possible with a binder, this emergency therapy can be offered without negative side effects even before a fracture is radiologically proven, making it worthwhile to put on a pelvic binder at the earliest occasion based on the trauma mechanism or clinical findings in an attempt to reduce the potential risk of serious pelvic bleeding.

Hsu SD, Chen CJ, Chou YC, Wang SH, Chan DC. Effect of early pelvic binder use in the emergency management of suspected pelvic trauma: a retrospective cohort study. *Int J Environ Res Public Health.* 2017;14:E1217.

The authors of this retrospective, single-center cohort study examined the effect of early pelvic binder use in the emergency management of suspected pelvic trauma (study group) compared with the conventional stepwise approach of pelvic binding only after confirmation of pelvic fracture (historic control group). Patients were enrolled if they had a traumatic injury requiring a trauma team and at least 1 of the following: loss of consciousness or a Glasgow Coma Score less than 13, systolic blood pressure less than 90 mm Hg, fall from a height of 6 or more meters, injury to multiple vital organs, or suspected pelvic injury.

All 204 cases included in this study received early application of a pelvic immobilization device on arrival in the emergency department. If a pelvic fracture was ruled out on radiography, the device was removed. Of the 204 cases, 56 patients were found to have a pelvic fracture. The study cohort was compared with a historic control of 148 patients who were treated at the same facility before the initiation of the “early pelvic binding” protocol.

The survival was comparable in both groups (91.1% vs. 88.5%, $P=0.785$). However, the study group had a reduction in blood product transfusion requirements ($P=0.009$), suggesting that pelvic binding mitigated blood loss because of the pelvic fracture.

This study did not show a survival benefit because of the small number of patients enrolled. What it does show is a potential benefit in mitigating blood loss. This alone may strengthen the case for early pelvic binding because preventing ongoing blood loss may delay the onset of hemodynamically unstable or exhibiting hemorrhagic shock before the patient reaches definitive care. This carries virtually no risk to the patient or any significant delay in reaching definitive care and may show a survival benefit in larger cohorts.

Traditional teaching that advocates for clinical examination of the pelvis and imaging before pelvic binding is no longer valid. There is a higher likelihood of an unstable pelvic fracture as the number of indirect signs of a pelvic injury (such as spontaneous or compression pain, hematoma, circulatory problem, visible pelvic or leg length deformity, or perineal bleeding) increases. The use of clinical findings alone to identify or rule out pelvic fractures is unreliable because more than two thirds of all unstable pelvic fractures would be missed if manual examination was the only diagnostic tool.

In summary, a pelvic binder should be applied early in patients with suspected pelvic fractures based on the mechanism of injury and physical examination of patients independent of pelvic stability examination results. The evidence supports early application, ideally in the prehospital and transport setting, given it is safe and without negative side effects. The evidence also suggests the method used to bind the pelvis, commercial or otherwise, is not as important as ensuring whatever method used is correctly positioned at the level of the greater trochanters. Pelvic binding is increasingly common practice, and this review indicates the practice is evidence based and carries with it a margin of safety to support its ongoing use.

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