TITLE: The Use of Pelvic Binders for Trauma Patients: Clinical Effectiveness, Cost-Effectiveness, and Safety

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RESEARCH QUESTIONS

1. What is the clinical effectiveness of pelvic binders for patients with high trauma to the pelvis?
2. What is the clinical evidence regarding the safety of pelvic binders for patients with high trauma to the pelvis?
3. What is the cost-effectiveness of pelvic binders for patients with high trauma to the pelvis?

KEY MESSAGE

Pelvic binders appear to be effective in reducing pelvic volume and stabilizing pelvic fractures in patients with high trauma to the pelvis. However, their impact on the reduction of hemorrhage, transfusions, and mortality is unclear.

METHODS

A limited literature search was conducted on key resources including PubMed, The Cochrane Library (2011, Issue 7), University of York Centre for Reviews and Dissemination (CRD) databases, Canadian and major international health technology agencies, as well as a focused Internet search. No filters were applied to limit the retrieval by study type. Where possible, retrieval was limited to the human population. The search was also limited to English language documents published between January 1, 2006 and July 12, 2011. Internet links were provided, where available.

The summary of findings was prepared from the abstracts of the relevant information. Please note that data contained in abstracts may not always be an accurate reflection of the data contained within the full article.
RESULTS

Rapid Response reports are organized so that the higher quality evidence is presented first. Therefore, health technology assessment reports, systematic reviews, and meta-analyses are presented first. These are followed by randomized controlled trials, non-randomized studies, and economic evaluations.

One systematic review and three non-randomized studies were identified regarding the use of pelvic binders for patients with high trauma to the pelvis. No relevant health technology assessments, meta-analyses, randomized controlled trials, or economic evaluations were found. Additional articles of potential interest can be found in the appendix.

OVERALL SUMMARY OF FINDINGS

Two studies\textsuperscript{1,2} concluded that pelvic binders provided an effective means of early stabilization of a fractured pelvis in patients with high trauma.

The authors of the systematic review\textsuperscript{1} concluded that insufficient evidence currently exists to evaluate the effectiveness of pelvic binders in reducing mortality while also stating that complications such as pressure sores have been noted. One non-randomized study\textsuperscript{3} found that early application of pelvic binders to patients with pelvic trauma had no effect on hemorrhaging, the need for transfusions, or mortality as compared to a control group. A second non-randomized study\textsuperscript{4} claimed that in patients who received pelvic binder application after pelvic trauma, the length of hospital stay, need for continued transfusions, and mortality were all reduced. Length of hospital stay and the need for transfusions were both significantly reduced when compared with patients who received external pelvic fixation.

Only one non-randomized study\textsuperscript{2} identified a particular pelvic binder (T-POD). This study showed that application of the T-POD can reduce symphyseal diastasis and heart rate while also increasing mean arterial pressure in patients with high pelvic trauma.

No evidence was presented on the cost-effectiveness of pelvic binders.
REFERENCES SUMMARIZED

Health Technology Assessments
No literature identified.

Systematic Reviews and Meta-Analyses


BACKGROUND: Pelvic fractures can cause massive haemorrhage. Early stabilisation and compression of unstable fractures is thought to limit blood loss. Reposition of fracture parts and reduction of pelvic volume may provide haemorrhage control. Several non-invasive techniques for early stabilisation have been proposed, like the specifically designed pelvic circumferential compression devices (PCCD). The purpose of this systematic review was to investigate current evidence for the effectiveness and safety of non-invasive PCCDs. METHODS: To investigate current literature the search string: "pelvi* AND fract* AND (bind* OR t-pod OR tpod OR wrap OR circumferential compression OR sling OR sheet)" was entered into EMBASE, PubMed (Medline), PiCarta, WebofScience, Cochrane Online, UptoDate, CINAHL, and Scopus. All scientific publications published in indexed journals were included. RESULTS: The search resulted in 17 included articles, none of which were level I or II studies. One clinical cohort study (level III) and 1 case-control study (level IV) were found. These showed a significant reduction of pelvic volume after applying a PCCD, without an effect on outcome. Other included literature consisted of 4 case series (level V). Two biomechanical analysis studies of fractures in human cadavers showed pelvic stabilisation and effective volume reduction by PCCD, especially when applied around the greater trochanters. Finally, 7 case reports (level VI) and 3 expert opinions (level VII) were identified. These case reports suggested complications such as pressure sores and nerve palsy. CONCLUSION: PCCDs seem to be effective in early stabilisation of unstable pelvic fractures. However, prospective data concerning mortality and complications is lacking. Some complications, like pressure sores have been described.

Randomized controlled trials
No literature identified.

Non-Randomized studies


BACKGROUND: Pelvic fractures, often the result of high energy blunt trauma, are associated with severe morbidity and mortality. A new pelvic stabilizer (T-POD(R)) provides secure and effective simultaneous circumferential compression of the
pelvis. METHODS: In this study we describe 15 patients with a prehospital untreated unstable pelvic fracture with signs of hypovolaemic shock with the T-POD(R). Before and 2 min after applying the T-POD(R), heart rate and blood pressure were measured. An X-ray before and directly after applying the T-POD(R) was made to measure the effect on reduction in symphyseal diastasis. RESULTS: Application of the T-POD(R) reduced the symphyseal diastasis with 60% (p = 0.01). The mean arterial pressure (MAP) increased significant from 65.3 to 81.2 mm Hg (p = 0.03) and the heart rate declined from 107 beats per minute to 94 (p = 0.02). Out of ten patients in whom the circulatory response before and after the T-POD(R) was recorded, seven were good responders, one had a transient response and two responded poor. CONCLUSION: In the acute setting, the T-POD(R) device has a clear compressive effect on the pelvic volume in unstable pelvic fractures. The T-POD(R) is therefore an effective and easy to use device in (temporarily) stabilizing the pelvic ring in haemodynamically unstable patients.


BACKGROUND: We hypothesized that early use of external mechanical compression (EMC) reduces hemorrhage and mortality associated with pelvic fractures. METHODS: Patients with pelvic fractures and one of the following risk factors for hemorrhage were studied retrospectively: (1) unstable fracture pattern, or (2) any fracture in patients older than 55 years of age, or (3) fracture with systemic hypotension. Starting in November of 2003, EMC was performed using circumferential pelvic binders on patient arrival and continued for 24 to 72 hours. Patients who underwent EMC (n = 118) were compared with historical controls in the preceding year (n = 119). RESULTS: Patients in the EMC and control groups had similar fracture patterns, age, and injury severity. EMC had no effect on mortality (23% vs 23%, P = .92), need for pelvic angioembolization (11% vs 15%, P = .35), or 24-hour transfusions (5.2 +/- 9 U vs 4.6 +/- 9 U, P = .64). CONCLUSIONS: Early EMC with pelvic binders does not reduce hemorrhage or mortality associated with pelvic fractures.


BACKGROUND: An alternative to embolization or external pelvic fixation (EPF) in patients with multiple pelvic fractures and hemorrhage is a pelvic orthotic device (POD), which may easily be placed in the resuscitation area. Little published information is available about its effectiveness. This study evaluated the efficacy of the POD compared with EPF in patients with life-threatening pelvic fractures. STUDY DESIGN: We evaluated patients with blunt pelvic fractures over a 10-year period. Inclusion required multiple pelvic fractures with vascular disruption and severe retroperitoneal hematoma, open book fracture with symphyses diastasis, or sacroiliac disruption with vertical shear. Patients with EPF were compared with those in whom a POD was used. Outcomes included transfusions, hospital stay, and mortality. RESULTS: There were 3,359 patients with pelvic fractures who were admitted: 186 (6%) met entry criteria; 93 had EPF and 93 had POD. There were no differences in age or shock
severity. Both 24-hour (4.9 versus 17.1 U, p < 0.0001) and 48-hour transfusions (6.0 versus 18.6 U, p < 0.0001) were reduced with POD. Twenty-three percent of each group underwent pelvic angiography, and 24-hour transfusion amounts for those patients were also reduced with POD (9.9 versus 21.5 U, p < 0.007). Hospital length of stay (16.5 versus 24.4 days, p < 0.03) was less with POD. Although there was decreased mortality with POD (26%) versus EPF (37%), it was not statistically significant (p=0.11). CONCLUSIONS: The therapeutic shift to POD has substantially reduced transfusion requirements and length of hospital stay, and has reduced mortality in patients with unstable pelvic fractures. POD has made a major contribution to the care of critically injured patients with the most severe pelvic fractures.

Economic Evaluations
No literature identified.

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APPENDIX – FURTHER INFORMATION:

Non Randomized Studies – Other Populations


BACKGROUND: Pelvic circumferential compression devices are designed to stabilize the pelvic ring and reduce the volume of the pelvis following trauma. It is uncertain whether pelvic circumferential compression devices can be safely applied for all types of pelvic fractures because the effects of the devices on the reduction of fracture fragments are unknown. The aim of this study was to compare the effects of circumferential compression devices on the dynamic realignment and final reduction of the pelvic fractures as a measure of the quality of reduction. METHODS: Three circumferential compression devices were evaluated: the Pelvic Binder, the SAM Sling, and the T-POD. In sixteen cadavers, four fracture types were generated according to the Tile classification system. Infrared retroreflective markers were fixed in the different fracture fragments of each pelvis. The circumferential compression device was applied sequentially in a randomized order with gradually increasing forces applied. Fracture fragment movement was studied with use of a three-dimensional infrared video system. Dynamic realignment and final reduction of the fracture fragments during closure of the circumferential compression devices were determined. A factorial repeated-measures analysis of variance with pairwise post hoc comparisons was performed to analyze the differences in pulling force between the circumferential compression devices. RESULTS: In the partially stable and unstable (Tile type-B and C) pelvic fractures, all circumferential compression devices accomplished closure of the pelvic ring and consequently reduced the pelvic volume. No adverse fracture displacement (>5 mm) was observed in these fracture types. The required pulling force to attain complete reduction at the symphysis pubis varied substantially among the three different circumferential compression devices, with a mean (and standard error of the mean) of 43 +/- 7 N for the T-POD, 60 +/- 9 N for the Pelvic Binder, and 112 +/- 10 N for the SAM Sling. CONCLUSIONS: The Pelvic Binder, SAM Sling, and T-POD provided sufficient reduction in partially stable and unstable (Tile type-B1 and C) pelvic fractures. No undesirable overreduction was noted. The pulling force that was needed to attain complete reduction of the fracture parts varied significantly among the three devices, with the T-POD requiring the lowest pulling force for fracture reduction.


OBJECTIVE: To demonstrate that a commercially available pelvic binder the trauma pelvic orthotic device (T-POD) is an effective way to provisionally stabilise anterior-posterior compression type pelvic injuries. METHODS: Rotationally unstable pelvic injuries were created in 12 non-embalmed human cadaveric specimens. Each pelvis was then stabilised first with a standard bed sheet wrapped circumferentially around the pelvis and held in place with a clamp. After recreating the symphyseal diastasis, the pelvis
was stabilised with the T-POD. Reduction of the symphyseal diastasis was assessed by comparing measurements obtained via pre- and post-stabilisation AP radiographs. RESULTS: The mean symphyseal diastasis was reduced from 39.3mm (95% CI 30.95-47.55) to 17.4mm (95% CI -0.14 to 34.98) with the bed sheet, and to 7.1mm (95% CI -2.19 to 16.35) with the T-POD. CONCLUSIONS: Although both a circumferential sheet and the T-POD were able to decrease symphyseal diastasis consistently, only the T-POD showed a statistically significant improvement in diastasis when compared to injury measurements. In 75% of the cadaveric specimens (9 of 12), the T-POD was able to reduce the symphysis to normal (<10mm diastasis). Both a circumferential sheet and the T-POD are effective in provisionally stabilising Burgess and Young anterior-posterior compression II type pelvic injuries, but the T-POD is more effective in reducing symphyseal diastasis.

Review Articles


Pelvic fractures are associated with significant morbidity and mortality. Despite advances in emergency, radiologic, surgical, and ICU care that have improved survival during the past decade, the morbidity and the mortality remain significantly high. This article focuses on the recent developments in the initial management of pelvic fractures including the use of external pelvic binders, radiographic imaging, interventional radiology, and extraperitoneal packing.


The past 50 years have been a time of rapid progress in the control of mortality and morbidity of pelvic fracture. Early understanding of the anatomic features of the fracture and the potential for major, life-threatening arterial hemorrhage in a small proportion of patients led to multidisciplinary approaches designed to control hemorrhage and temporarily stabilize the fracture. Progress in the diagnosis and management of lower urinary tract injuries has resulted in maintenance of urinary continence and sexual function in a large proportion of patients with pelvic fracture-associated urinary tract injury. Finally, definitive open reduction and fixation of the fracture has led to permanent pelvic stability and pain-free walking in most patients. With successful combination of these approaches, survival and return to a satisfactory level of function is now the rule rather than the exception for patients with severe pelvic fracture.

Emergent life-saving treatment is required for high-energy pelvic fracture with associated hemorrhage and hemodynamic instability. Advances in prehospital, interventional, surgical, and critical care have led to increased survival rates. **Pelvic binders have largely replaced military antishock trousers.** The availability and precision of interventional angiography have expanded considerably. External pelvic fixation can be rapidly applied, often reduces the pelvic volume, and provides temporary fracture stabilization. Pelvic packing, popularized in Europe, is now used in certain centers in North America. **The use of standardized treatment algorithms may improve decision making and patient survival rates.** Active involvement of an experienced orthopaedic surgeon in the evaluation and care of these critically injured patients is essential.


Pelvic fractures are one of the potentially life-threatening injuries that should be identified during the primary survey in patients sustaining major trauma. Early suspicion, identification and management of a pelvic fracture at the prehospital stage is essential to reduce the risk of death as a result of hypovolaemia and to allow appropriate triage of the patient. **The assessment and management of pelvic fractures in the prehospital environment is reviewed here.** It is advocated that the pelvis should not be examined by palpation or springing, and that the patient should not be log rolled. Pelvic immobilisation should be used routinely if there is any suspicion of pelvic fracture based on the mechanism of injury, symptoms and clinical findings.


BACKGROUND: Pelvic fractures occur when there is high kinetic energy transfer to the patient such as would be expected in motor vehicle crashes, auto-pedestrian collisions, motorcycle crashes, falls, and crush injuries. High-force impact implies an increased risk for associated injuries to accompany the pelvic fracture, as well as significant mortality and morbidity risks. Choosing the optimum course of diagnosis and treatment for these patients can be challenging. The purpose of this review is to supply a contemporary view of the diagnosis and therapy of patients with this important group of injuries. **METHODS: A comprehensive review of the medical literature, focusing on publications produced in the last 10 years, was undertaken.** The principal sources were found in surgical, orthopedic, and radiographic journals. **CONCLUSIONS:** The central challenge for the clinician evaluating and managing a patient with a pelvic fracture is to determine the most immediate threat to life and control this threat. **Treatment approaches will vary depending on whether the main threat arises from pelvic fracture hemorrhage, associated injuries, or both simultaneously.** Functional outcomes in the long-term depend on the quality of the rigid fixation of the fracture, as well as associated pelvic neural and visceral injuries.
Additional References


We present a study of the pressures developed at the bony prominences (greater trochanter, iliac crest and sacrum) when a pelvic binder was applied to 10 healthy individuals. The pressures developed between the pelvic binder and the skin over the prominences were all greater than the pressure recommended at interfaces to avoid the development of pressure sores. This suggests that patients with pelvic fractures who are treated with temporary pelvic binders are at risk of developing pressure sores. This should be recognised and the skin inspected if the binder is to be in place for a prolonged period.