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Research Article

Pelvic Binders in Trauma Patients-Are We Doing it Right?

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Abstract

Introduction: Pelvic fractures from high energy trauma require immediate stabilisation to avoid significant morbidity and mortality. When applied correctly over the level of the greater trochanters (GT) pelvic binders provide adequate stabilisation of unstable pelvic fractures. The aim of this study was to identify the accuracy of placement of pelvic binders in patients presenting to the local Major Trauma Centre (MTC).

Methods: A retrospective study was carried out to assess the level of the pelvic binders in relation to the greater trochanters of the patient-classified as optimal or sub-optimal.

Results: An initial review of the computed tomography (CT) trauma series in 28 consecutive patients with pelvic binders revealed that more than 50% of the pelvic binders were placed above the level of the GT, reducing the efficacy of the pelvic binders. A regional educational and training day was held with a focus on pelvic fracture management. Following this, a review was conducted on the placement of the pelvic binder in 100 consecutive patients. This confirmed a significant improvement in the position of the pelvic binder by over 70%.

Conclusion: Inaccurately positioned pelvic binders provided suboptimal stabilisation of pelvic fractures. With education and awareness, there has been an improvement in the accuracy of pelvic binder placement in trauma patients. This study has highlighted the need for regular audit of current practice, in combination with regular education and training.

Keywords: Pelvic binder placement; Pelvic fractures; T-POD; SAM splint.

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Introduction

Pelvic fractures due to high energy trauma are potentially life threatening due to catastrophic hemorrhage [1]. These injuries demand prompt pre-hospital care and require thorough assessment in the emergency department [2-4]. Controlling the hemorrhage remains a challenge to pre-hospital, emergency department clinicians and surgeons because of the many potential sources bleeding within the pelvis [5]. Pelvic fractures can be classified by the vector and the degree of bony displacement–anterior-posterior compression (APC), lateral compression (LC), vertical shear (VS) and a combination of mechanisms [6,7]. High grade APC and VS fractures are associated with increased risk of significant bleeding when compared to LC-type injuries [8]. Haemorrhage can be controlled by reducing the fracture using any compressive device [9]. Historically this was achieved using a bedsheet placed under the patient at the level of the greater trochanters. The sheet is tied in front of the patient and the ankles are held together, indirectly reducing the potential volume within the pelvis [10,11]. Readily available pelvic binders can used to control significant hemorrhage from unstable pelvic fractures in emergency situations; these allow rapid closure of the unstable pelvic ring fracture when applied correctly and tightened to a known tension [12]. Commercially available pelvic binders use Velcro straps with strings on a pulley system (T-POD) or buckles (SAM Splint) allowing rapid stabilization (Figure 1). They have been used widely in pre-hospital settings and they also help reduce fracture motion while the patient is being transferred and are endorsed by Advanced Trauma Life Support (ATLS) [13,14]. SAM splints are placed over the greater trochanters and the buckle is used to fasten and secure the pelvis. The T-POD pelvic binder is placed over the greater trochanters and using Velcro straps and strings, the pelvis is secured.

Figure 1: Commercially available pelvic binders–Sam Splint (left) and T-POD (right).

The manufacturers recommend that the binders should be placed at the level of the greater trochanters, and this was later supported by a cadaveric study [10]. A retrospective review in military trauma patients showed that the placement of a pelvic binder at or below the level of the greater trochanters achieved the best

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reduction of the symphyseal diastasis in an unstable pelvic fracture. Early stabilisation of the fracture in a hemodynamically compromised patient has shown to improve survival rates [15].

The aim of this study was to assess the position of pelvic binder in trauma patients admitted to the major trauma centre, University Hospital Southampton (UHS).

Methods

This was a prospective rolling audit that was carried out by the members of the Trauma and Orthopaedic team at UHS. The patients were identified using the local trauma database at UHS. The pelvic binders commonly used by local pre-hospital care staff were the SAM Splint and T-POD. The position of the binder was assessed on plain radiographs and CT scanograms using the digital Picture Archiving and Communication System (PACS). The buckle in the SAM splint and the buttons of the T-POD were easily identified on the scanograms or radiographs. The initial investigators reviewed the positioning of the binders on the scanograms by measuring the distance between a line drawn through the tips of the greater trochanters and a line passing through the midpoint of the pelvic binder. Pelvic binders placed above the level of greater trochanters were classed to be sub-optimal whereas ones placed at the level or below the trochanters were optimal (Figure 2a and b).

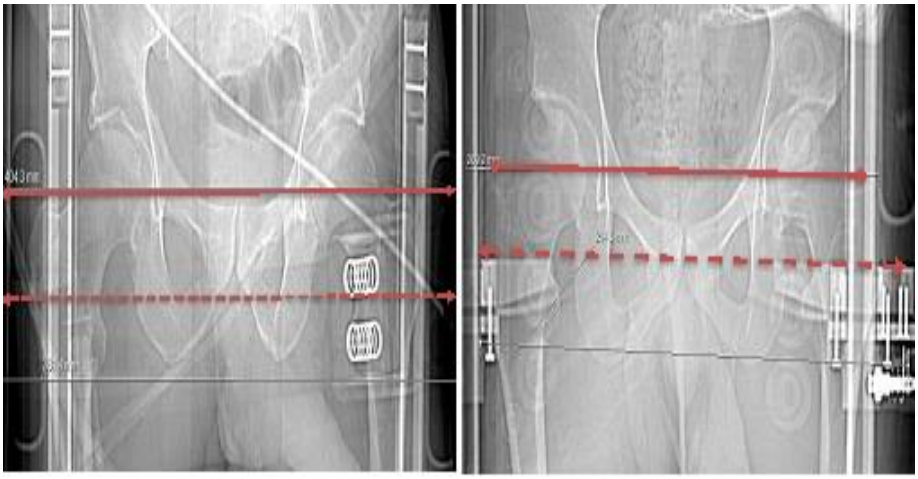

Figure 2a and b: Distance between the line connecting the greater trochanters (straight line) and the middle of the SAM Splint (left) and T-POD (right).

Intervention

These results were presented at the local Trauma multi-disciplinary team (MDT) meetings. An educational day was led by a local pelvic surgeon and the team organised hands-on training of pelvic binders and the management of pelvic fractures – pre-hospital settings and definitive fixation. The target audience included paramedics, nursing staff, doctors from emergency medicine and orthopaedics (See the illustration- 'How to apply a pelvic binder') [16].

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Figure 3: Illustration–How to apply a pelvic binder.

The prospective study of trauma patients with pelvic binders was repeated. In this arm of the study, the anatomical level was identified by drawing two transverse lines between the superior limits of both greater trochanters and the inferior limits of both lesser trochanters, this was validated by Bonner et al. The binder was deemed to be at the level of the trochanters if more than half of either spring within its buckle of the SAM splint lay between these two lines [15]. In case of the T-POD, presence of two or more buttons within the trochanteric area was deemed to be satisfactory. In the study by Bonner et al. the

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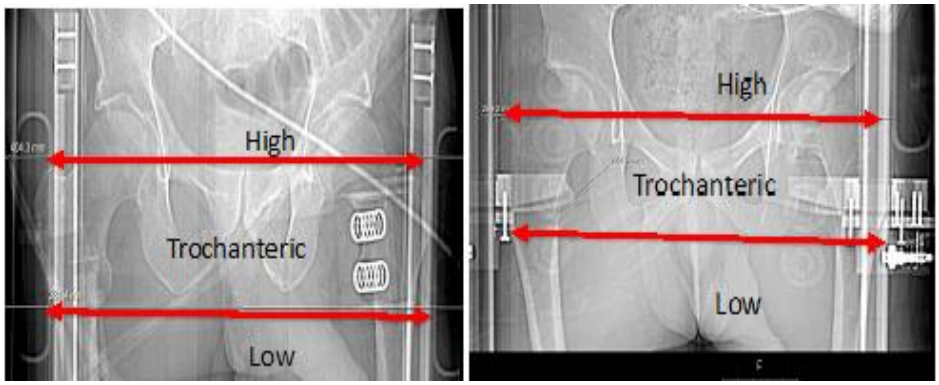
patients were divided into three groups–high, trochanteric and low depending on whether the spring (in case of Sam splint) or more than two buttons (in T-POD) were above, within or below the area between the two transverse lines. Pelvic binders placed above the level of greater trochanters were deemed sub-optimal and optimal positioning was defined as those placed at or below the level of greater trochanters (Figures 4a and b).



Figures 4a and b: Position of the SAM Splint (left) and T-POD (right).

Results

In the first cohort of twenty-eight patients (n=28) pelvic binders were placed inaccurately in 54% of the patients. Sub-optimal placement was identified early, and the intervention included training and education. For the second part of the study, we identified 100 patients with CT-Trauma series who had pelvic binders applied due to significant mechanisms of injury. The binder was positioned appropriately at the level or below of the trochanters in 77% and high in 23% of the patients (Figure 5). Fisher exact test confirmed this difference to be significant ($p<0.05$).

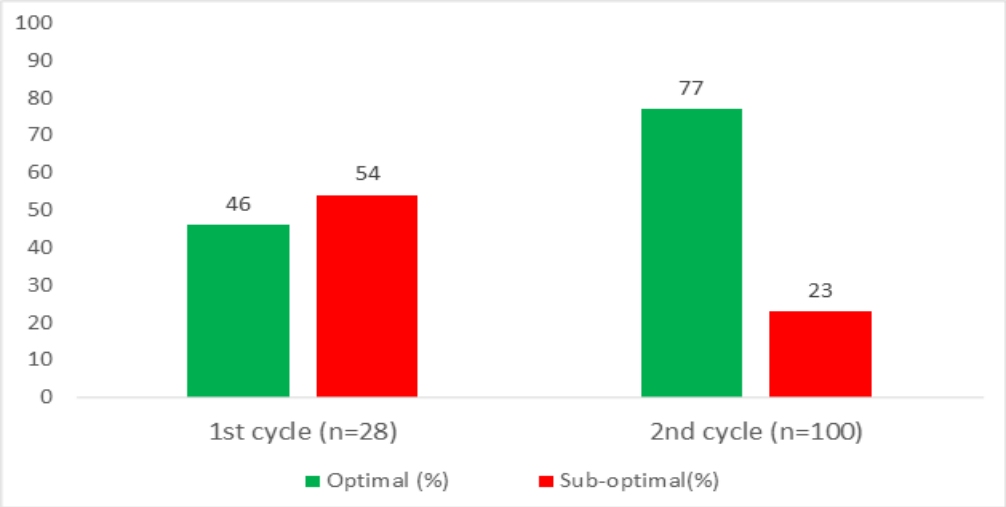


Figure 5: Representation of positioning of pelvic binders (optimal vs sub-optimal) as a percentage (%).

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Further analysis revealed T-PODs were more commonly used than the SAM splints (61% vs 39%) and there was no significant difference in overall appropriate placement of these two devices (T-PODs 69.6% vs SAM splint 69.4%).

Discussion

The ATLS teaching advocates the use of pelvic binders in patients with suspicion of pelvic injuries. The index of suspicion for pelvic fractures must be high as clinical diagnosis may be difficult, especially with other obvious or distracting injuries in polytrauma. Given the catastrophic consequences of missing an unstable fracture, application of pelvic binders must be emphasised to practitioners in emergency and pre-hospital settings. This study has highlighted that with education and training, the placement of the pelvic binders can be improved significantly.

A nationwide study revealed that emergency medicine and orthopaedic trainees were unable to accurately identify the greater trochanters as the correct level of pelvic binder application. Lack of regular training was identified as a key factor [17]. More recently a study carried out by another major centre re-iterated the findings of our first cycle. In their work, 110 patients with pelvic binders were reviewed. Only 49.1% of the binders were placed in a satisfactory position – at the level of trochanters. The authors have highlighted the fact that in 44.8% of patients with a pelvic ring injury, there was no attempt to apply any pelvic binder [18]. These findings reflect civilian practice in the USA where pelvic binders were absent in 53% of patients with an unstable pelvic fracture [19]. A military study showed similar findings of the pelvic binder placement at 61% (at the level or below the greater trochanters) in 172 patients (27% had significant pelvic fractures). This study showed that the mean residual gap in the pubic symphysis was 2.8 times greater in binders placed above the level of the trochanters when compared placement at the level of the trochanters. Relatively low compressive forces are required to reduce the diastasis when the binder is placed at the trochanters due to paucity of soft tissue between binder and trochanter. When the binder is placed above the trochanters, compressive forces are instead transferred to the gluteal muscles and the posterior pelvis [15].

Various cadaveric and biomechanical studies have analysed the optimal position of pelvic binders. Bottlang et al. examined the reduction of the pubic symphysis in partially stable and unstable open-book pelvic fractures created in human cadavers [20]. Their results showed optimal reduction of the pubic symphysis and better stability of the pelvis when the binder was placed at the level of the trochanters as opposed to higher placement. A more recent study has shown that T-POD placement at the level of trochanters provides more stability and reduced movement within the pelvis during transfers when compared to placement at the anterior superior iliac spine (ASIS-level above the greater trochanters) [21].

Sub-optimal placement of pelvic binders can be ineffective in controlling haemorrhage in pelvic fractures. Identifying landmarks (the greater trochanters) on an overweight and obese patient can be difficult. One can argue

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that the pelvic binder might have been placed at the correct level initially but during moving and transferring the patient, there is a possibility that the position of the binder might have changed. Given the compressive forces applied by a binder this is unlikely, although not impossible. As pelvic binders are usually placed by pre-hospital paramedics and emergency doctors the clinical experience of the person applying the pelvic binder is an important variable that can contribute to the positioning. Applying the binder from underneath the lumbar spine and moving it down the buttocks may render the final position high (above the level of the greater trochanters). Conversely, applying the binder underneath the knees and then moving it up the buttocks may position the binder low (below the level of the greater trochanters). This should be emphasized in ATLS and pre-hospital training courses. There are other factors that can affect the position of the pelvic binders. In trauma settings, binders are placed by pre-hospital clinicians under stressful conditions with other injuries to address and other factors in play such as the number of casualties, difficult extraction, layers of clothing, the environment around and the availability of other personnel. A recent study by Williamson et al. showed that females had a greater risk of sub-optimal placement due to the gynoid fat distribution. However, in this study there was no association with sub-optimal placement and age, mechanism of trauma, injury severity score, number of body regions injured or Glasgow Coma Scale (GCS) [22].

Limitations of this study

This rolling study is a snapshot review of the practice of pelvic binder placement at the given time period and hence the numbers involved were small. However, the deficiency in practice was identified early and intervention was carried out without too much delay. Further review included consecutive patients with pelvic binders, and we did not stratify patients with true pelvic injuries. There no was intention to analyse the efficacy of pelvic binders in 'true' pelvic injuries and the prognosis. It represents the practice in a single major trauma centre and the pre-hospital settings within this region.

Conclusion

This is the first study that has demonstrated that pelvic binder placement can be improved with appropriate training and education. This audit cycle has displayed the success in continuing education for paramedics, emergency department personnel and teams dealing with trauma patients. We believe regular review of current practices across pre-hospital/paramedic settings and within major trauma centres can highlight areas of improvement and will improve the care of trauma patients. Other widely available circumferential pelvic binders can also be used effectively with the correct training, allowing rapid stabilisation of the pelvis in pre-hospital settings or in the emergency department. This study can be replicated across different hospitals or major trauma centres to better assess current practice across the trauma networks in the UK.

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Key points

- Pelvic binders should be placed at the level of the trochanters.
- Regular training of application of pelvic binders improves position and practice.

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