The measurement of the effect of knee binding on patients with symphyseal separation

Julian Foote *, Onur Berber, Gorav Datta, Martin Bircher

St George’s Hospital, Blackshaw Road, Tooting, London SW17 0QT, United Kingdom

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A B S T R A C T

Knee binding enhances pelvic reduction in patients with unstable pelvic fractures. The aim of this study was to measure the effect of knee binding on patients with certain pelvic fractures. 13 consecutive patients who underwent open reduction and internal fixation of pubic symphysis diastasis ± sacroiliac joint fixation were recruited prospectively. These patients were transferred to this National level 1 trauma centre for definitive pelvic fracture management in an elective setting. All patients had sustained anteroposterior compression type pelvic injuries. In theatre, a centred anteroposterior radiograph of the pelvis was taken both with and without binding of the knees. Measurements of symphyses pubis widening were made of the digital images taken in theatre. With knee binding, the average percentage closure of the pubic symphysis as compared to the pre-operative, pre-reduction, position was 50%. When compared to the anatomically reduced position after internal fixation, there was a 69% closure of the symphysis pubis, with knee binding. This manoeuvre is rarely employed in patients in the field but is useful both as a simple resuscitation type tool and during definitive reconstruction in the operating theatre. Just over two-thirds of the reduction can be achieved prior to commencement of the operation.

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1. Introduction

Pelvic fractures are caused by a spectrum of violence in various directions. Classifications usually include some form of Vectra of this force i.e. lateral compression, anteroposterior compression (APC) or vertical shear. In the APC type injury with opening of the symphysis pubis, as the force proceeds from front to back, various pelvic floor ligaments and sacroiliac ligaments are disrupted in sequence. The injuries may be uni-lateral or bilateral. Pelvic fractures and particularly more severe APC type injuries are associated with severe haemorrhage. Bleeding can come from the bones but also from vessels that traverse the pelvis. The resultant haemorrhage and secondary coagulopathy can be lethal.5 Haemodynamically compromised patients with biomechanically unstable pelvic fractures need reduction of the pelvic volume to affect tamponade of bleeding.2,3,6,11 This can be achieved in a number of ways but more recently the pelvic binder has become the mainstay of acute management.13,16 This is a more sophisticated device as compared to a sheet.19,20 Other forms of posterior and anterior external fixation are also used.7,9,18 Reconstruction of these unstable injuries usually involves some form of internal fixation both anteriorly and posteriorly.10,12,17 Pelvic binders are now recommended in the Advanced Trauma and Life Support (ATLS) approach, in the early management of these injuries.1 Knee binding and the rationale for this are often overlooked. Knee binding has been described previously.8 The aim of this study was to investigate whether there was an effect on the symphyses pubis closure in bringing the knees together, particularly in the APC type fracture, and to quantify this.

2. Material and methods

13 consecutive patients who underwent open reduction and internal fixation of pubic symphysis diastasis ± sacroiliac joint fixation were recruited prospectively. These patients were transferred from peripheral hospitals to this national tertiary referral level 1 trauma centre for definitive pelvic fracture management. All patients had sustained closed, APC type pelvic injuries. There were no other significant injuries in these patients. Patients had been medically stabilised prior to transfer and none had had any surgical intervention prior to admission to our unit. All patients were transferred with pelvic binders in situ. Demographic information was recorded including patient’s age, sex, mechanism of injury and the Young and Burgess Classification of pelvic injury.4 All patients had routine anteroposterior (AP) radiographs and CT scanning of the pelvis prior to transfer. At surgery, once anaesthetised, the patients were positioned supine on a radiolucent table with both arms abducted (Fig. 1). An examination under anaesthesia was performed

* Corresponding author. Tel.: +44 0208 672 1255.
E-mail addresses: julian.foote@btinternet.com (J. Foote), onurberber@yahoo.co.uk (O. Berber), gdatta@doctors.org.uk (G. Datta), martinbircher@hotmail.com (M. Bircher).

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to assess the degree of instability at the pubic symphysis and sacroiliac joints, under image intensifier guidance. Cystourethrograms were also performed on all patients as is the routine in this unit. In addition to this routine assessment, a plain AP radiograph was taken by the image intensifier in theatre without any form of binding or external fixation applied to the pelvis (Fig. 2). The intensifier was centred on the pubic symphysis. The knees were then bound together (Fig. 3). A further AP radiograph was then taken with the legs secured in this position (Fig. 4). For both of these images a marker was placed on the patient's abdomen so that we could accurately calibrate the measurements taken. Fixation of the pubic diastasis and sacroiliac joint was performed in the standard manner. A final AP radiograph was taken post fixation (Fig. 5). Measurements of symphysis pubis widening pre binding were made using a micrometre of the digital images taken in the operating theatre (A). The symphysis gap following this manoeuvre (B), and also after fixation (C), were recorded. The gap post-manoeuvre was therefore expressed as a percentage of the gap pre-manoeuvre \((A - B)/A \times 100\). We also compared the gap post-manoeuvre as a percentage of the final gap, post-fixation \((A - B)/A - C \times 100\).

### 3. Results

Data was collected on 13 consecutive patients on the day of surgery. No patients were omitted. All patients had pelvic binder support but none had had knee binding applied prior to arrival at the unit. The study population included 11 men and 2 women. The average age for the study population was 45.5 (30–69) (male average: 47.3 years, range: 30–69, female average: 41.5 years, range: 37–46). Injury was all secondary to high energy trauma, with road traffic accident being the commonest cause (7 patients). Injuries were all classified according to the Young and Burgess classification. The majority of injuries were APC II (9 patients), 4 patients sustained APC I injuries and there were no patients with APC III injuries. The average time from the point of injury to performing this procedure was 6.7 days (range: 2–20 days).

Measurements of the gaps taken from the image intensifier images were accurately calibrated using surface markers. Two percentages were recorded as there is obviously a difference due to the natural gap of the symphyseal cartilage. The first was the symphysis gap post-manoeuvre as a percentage of the symphysis.
gap pre-manoeuvre. The mean reduction in symphysis closure in this case was 50.0%.

The second percentage was the symphysis gap post manoeuvre as a percentage of the final reduced symphysis gap following fixation. These percentages and their relation to time from injury are illustrated in Fig. 6. The mean reduction in symphysis closure in this case was 69.0%. To clarify this second measurement, if the manoeuvre reduced the symphysis gap to exactly the same as the symphysis gap post-fixation the percentage would be 100%. If it made no difference at all it would be 0%. For the APC I injuries, where the anterior interosseous ligaments are stretched, the mean percentage closure was 71%. For the APC II injuries, where the anterior interosseous ligaments are torn, the mean percentage closure was 68%.

4. Discussion

This is the first study to quantify the amount of closure of the pubic symphysis following the simple manoeuvre of knee binding. Binding the knees together achieved a 69.0% closure as compared to the reduction achieved at the time of operation. The influence of the posterior aspect of the pelvis did not seem to affect the degree of closure achieved (71% for APC I vs. 68% for APC II). The numbers however are too small to draw any meaningful conclusion from this. Knee binding is not new and is recommended in standard ATLS teaching. There is, however, no supporting literature to quantify the effect of this manoeuvre. Our impression is that it is rarely employed in patients in the field, in the emergency department and in the operating theatre. Pelvic binders have become the mainstay of management of acute pelvic fractures and we would certainly advocate their use. However, this is not the only temporising measure and they will always reduce access to the pelvis. They can also put patients at risk of developing pressure sores over bony prominences.13 Pelvic binders are only a temporary reduction method and internal fixation should take place as soon as possible. During the assessment of the patient, particularly the abdomen, it may be useful to keep the knees bound whilst the pelvic binder is removed.

In this study we employed a simple reproducible technique and were able to accurately measure the percentage changes in radiographs in patients being treated operatively. The study was purely looking at the mechanical effects of this manoeuvre and did not correlate with changes in the haemodynamic status of the patients. All of these patients had been stabilised prior to coming to theatre. It is important to note that this study showed that widening is not completely reduced by this manoeuvre and should not be used as a definitive treatment modality. However it is clear that it is a simple and useful method that can be used both in the field and in the emergency department. Sometimes a binder is not available but a simple crepe bandage can be applied around the supracondylar area of the knees. Care must be taken not to apply it below the joint line as there is a theoretical potential problem of damage to the common peroneal nerve – especially if the binders are left on for a significant period.

As this unit is a tertiary referral centre, there was an inevitable delay in the transfer of patients from regional hospitals. In some circumstances several days had passed prior to performing the knee binding procedure. This longer the delay could have meant a smaller a reduction in separation to that achieved if the procedure had been performed at the time of the incident. The patient numbers are too small to prove this assumption, however the study is ongoing and this will form part of a further study along with statistical significance testing of the size of effect. Knee binding is also a very useful method that can be used during definitive reconstruction in patients with APC I and APC II type fractures. Significant reduction can be achieved even a number of days following injury and it can enhance and improve the definitive operative stabilisation.

References