Pelvic Binder Radiography Detects Occult Instability in Cadaveric Simulated Lateral Compression Type I (LC1) Pelvic Ring Injuries

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Introduction: Occult instability in minimally displaced lateral compression (LC) pelvic ring injuries may have clinical relevance for treatment. We describe two novel LC pelvis fracture stress examinations – pelvic binder stress radiography (PBR) and pelvic stress bladder manometry (PBM) – which do not require anesthesia, patient transport, or radiation of personnel.

Methods: A biomechanical study was performed with five fresh elderly cadavers. Sequential osteotomies of the pelvis simulated increasingly unstable LC pelvis fracture patterns (OTA/AO 61A2.2, 61B1.1a, 61B1.1b, 61B2.1). Compressive force was quantitatively applied using a pelvic binder and scale. Pelvis fracture displacement was measured on AP and inlet fluoroscopic views. Bladder pressure was measured using a Foley catheter as a water column. Institutional Review Board (IRB) approval was not required for this cadaver study which did not involve human subject research.

Results: Fracture displacement strongly correlated with force applied (R2=0.600-0.963). PBR discriminated between simulated LC injuries. Mean displacement of 61B1.1b injuries >1cm was observed at 3.8kg on AP view and 5kg on inlet view. Mean displacement of 61B1.1a injuries >1cm was observed above 8.2kg on AP view and 9.3kg on inlet view. 61A2.2 injuries did not displace >1cm at forces up to 10kg. >95% of 61B1.1a and 61B1.1b injuries displaced >1cm at 10kg. Bladder pressure moderately correlated with force applied (R2=0.517-0.842) and did not discriminate between LC injuries.

Discussion: PBR is feasible, precisely quantified occult mechanical instability in simulated LC pelvis fractures in response to reproducible applied force and discriminated between simulated LC pelvis fractures. PBM did not sufficiently discriminate between simulated LC fractures. Clinical validation of PBR for assessing occult instability in LC pelvis fracture is warranted.

Clinical Significance: PBR offers a quantitative and reproducible point-of-care method, which can be performed with minimal patient repositioning, providing an alternative for dynamic fluoroscopic stress examinations or manual stress radiography. It provides an objective outcome in response to a reproducible applied force, offering a potential tool for assessing fracture instability.

Figure 1. (A) Schematic of PBR testing apparatus including foley catheter with hydrostatic water column and application of lateral pelvic compression force quantified with hanging scale. (B) Sequential osteotomies of left superior and inferior public rami (OTA/AO 61A2.2), an incomplete osteotomy of the anterior 50% of S1 and S2 in Zone 1 of the ipsilateral left sacrum (OTA/AO 61B1.1a), and contralateral osteotomy of the superior and inferior pubic rami (OTA/AO 61B1.1b). (C) “Grip and rip” technique applying quantitative compression force with pelvic binder and hanging scale to cadaver with c-arm positioned for fluoroscopic pelvic inlet view. (D) Absolute displacement of simulated LC pelvic ring injuries versus pelvic binder compressive force on AP and inlet views. Error bars represent 95% confidence intervals.