TEMPORARY STABLIZATION OF PELVIC FRACTURES WITH THE TRAUMA PELVIC ORTHOTIC DEVICE IN THE POLYTRAUMA PATIENT

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Background:

Unstable pelvic fractures in the polytraumatized patient are a significant source of blood loss and mortality. In order to reduce ongoing blood loss, rapid and effective stabilization of unstable pelvic fractures is a means for proper resuscitation. Placement of a pelvic external fixator has long been the treatment of choice for emergent management of the hemodynamically unstable patient with concomitant unstable pelvic ring injury. Recently, there has been a lot of interest in devices that can reduce pelvic volume, which can be applied quickly and without complication. Recent studies examined the use of several devices including the simple anterior pelvic external fixation (SAPEF), the pelvic C-Clamp, and simple draw sheets. A majority of these studies have focused on cadaveric application of the devices and biomechanical studies. Few have shown application of these experimental devices in poly-trauma patients. The purpose of this study was to determine the effectiveness of the Trauma Pelvic Orthotic Device (T-POD) in stabilizing pelvic fractures in the acute setting. We hypothesize that the application of the T-POD would produce a similar reduction in pubic diastasis and pelvic cross-sectional area as definitive fixation.

Materials and Methods:

A retrospective analysis of the hospital charts and radiographs of twenty-seven trauma patients admitted to the Hospital of the University of Pennsylvania and the

Children's Hospital of Philadelphia between 2000 and 2003, who had application of the T-POD, was reviewed. Twelve of these patients had either non-operative pelvic fractures or no pelvic fractures at all. This left fifteen patients, with unstable pelvic fractures, for evaluation.

On admission each of the patients had the standard trauma series of radiographs (lateral cervical spine, AP chest, and AP pelvis). On diagnosis of an unstable pelvic fracture, each of the patients had application of the T-POD. Following application of the T-POD, the patients then had CT scans of the pelvis. Following definitive fixation of the pelvic fracture, a repeat CT scan of the pelvis was obtained.

All CT scans were performed utilizing a General Electric Lightspeed© scanner. Three to five millimeter thick sections through the pelvis, from the fifth lumbar vertebrae to the most inferior point of the pubic rami, were obtained.

The patients were stratified based on pelvic fracture pattern classification according to Burgess and Young. Radiographic measurements were made using the General Electric PACS software. For all anterior/posterior compression (APC) fractures, pubic diastasis was measured on plain radiographs pre-application of the T-POD and on CT Scan after T-POD application and after definitive fixation.

Cross-sectional area of the pelvis was measured at the level of the fovea of the femoral heads. The area was defined as the contours of the bony anatomy, at that level, and was measured using the PACS software. Cross-sectional area was measured for all patients with the T-POD in place and after definitive fixation.

All comparisons were made using a *matched pairs t-test*.

Results:

In the study group there were fifteen patients, two women and thirteen men. In regards to race, four patients were black and eleven were white. The average age was 41.1 years (range 14-73), the average Injury Severity Score (ISS) was 23.3 (range10-45). At the present time fourteen patients are alive, one dead as a result of their injuries. The mechanism of injury was motor vehicle accident in eight patients, motor vehicle versus pedestrian in two patients, fall from height in one, industrial accident in one and motorcycle accident in three.

Pelvic fractures were classified based on the Burgess and Young classification. Nine fractures were anterior/posterior compression (APC), three were lateral compression (LC), and three were vertical shear (VS) type injuries. Eight patients required anterior fixation only, none required posterior fixation only, while seven required both posterior and anterior fixation. Anterior treatment methods included application of an external fixator or pubic symphisis plating. Posterior fixation methods included sacro-illiac screws, sacro-illiac plating and trans-illiac bars.

For the nine APC fractures the average injury pubic diastasis, pre-intervention, was 39.9 mm and the average pubic diastasis with the TPOD in place was 11.3 mm. This represented an average reduction in pubic diastasis of 71.5% by applying the T-POD. Utilizing a matched pair *t-test*, these two groups were found to be statistically different ($p=0.05$). Comparing the measured pubic diastasis with the TPOD in place and after definitive operative fixation, there was no statistical difference noted between the groups, using the matched pair t-test.

All fifteen patients had the cross-sectional area of their pelvis measured with the T-POD in place and after definitive fixation. There was no statistical difference noted between the two groups using a matched pair t-test.

Discussion:

Emergent and safe stabilization of unstable pelvic ring injuries in the polytrauma patient remains a priority in proper resuscitation. Historically, unstable pelvic ring injuries have been treated with application of an anterior external fixator. Emergent application, of this device, can be difficult and fraught with complication. There is an interest, then, in developing safe and effective devices for quickly stabilizing pelvic ring injuries. These devices would not only have a role in the hospital setting, but if proven safe could be used in the field. There have been reports, in the literature, of sheets and pelvic slings being used to stabilize pelvic ring injuries. However, these devices have been only studied in cadevaric or biomechanical models. No reports of their safety or efficacy in real clinical settings have been reported.

To our knowledge, this is one of the first reported studies of a pelvic orthotic device tested in a clinical setting. We hypothesized that the application of the T-POD would produce a similar reduction in pubic diastasis and pelvic cross-sectional area as definitive fixation. Our data supports this assertion and also demonstrates that the T-POD can generate enough force to effectively reduce pubic diastasis generating a 75.1% reduction when compared to injury radiographs.

We only noted three wound complications associated with prolonged use of the T-POD (> 48hrs), these were partial thickness skin necrosis at the anterior superior iliac spine on relatively thin patients. These patients were early on in the study and since

changes in the T-POD, no observations of skin necrosis were noted. Only two patients experienced over correction as a result of T-POD application. These were both severely unstable bilateral VS and LC-III injuries. Neither suffered injury as a result of their over correction.

The ease of application and relatively small complication rate make the T-POD and devices like it attractive for field application. Stabilization of pelvic ring injuries has typically taken place in the hospital setting. The potential for field application would help reduce on going blood loss during transport from the field to the hospital. Pelvic stabilization during this critical time may prove invaluable.

To conclude the T-POD is as effective in reducing pubic diastasis and pelvic cross-sectional area as definitive fixation.

Reference:

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Table 1: Demographic Data for T-POD Patients

Patient	Age	Sex	Race	Mechanism	Fracture Pattern	Anterior Fixation	Posterior Fixation
TB	35	Male	White	MVA	APC2	Ex-Fix	
TL	36	Male	White	MVA	APC2	Ex-Fix	
JM	28	Male	White	MVA	APC2	Ex-Fix	R SI Screw
BM	28	Male	White	MVA	APC2	Pubic Plate	
RN	46	Male	Black	MVA	APC3	Pubic Plate	Illiac Bars
SM	47	Female	White	Motorcycle	LC2	Ex fix	B SI Screw
ES	73	Male	White	Industrial	APC2	Pubic Plate	
BM	36	Male	Black	MVA	LC3	Ant ORIF	Illiac Bars
DL	40	Male	White	Motorcycle	VS	Pubic Plate	Illiac Bars
EW	68	Female	White	MVA	LC1	Ex-Fix	
MV	31	Male	Black	MVA	APC 2	Ex-Fix	
KS	17	Male	White	Auto vs Ped	VS	Ex-Fix	B SI Plate
LG	61	Male	White	Motorcycle	APC2	Pubic Plate	
LJ	57	Male	Black	Fall	APC3	Pubic Plate	R SI Screw
NR	14	Male	White	Auto vs Ped	VS	Ex-Fix	R SI Screw

Table 2: Measured Radiographic Data for T-POD Patients

Patient	Fracture Pattern	Pre T-POD Pubic Diastasis (mm)	Post T-POD Pubic Diastasis (mm)	Post Fixation Pubic Diastasis (mm)	Post T-POD Pelvic Area (sq cm)	Post Fixation Pelvic Area (sq cm)
TB	APC2	34.1	6.7	6.2	83.64	81.41
TL	APC2	43.6	11.0	8.6	87.55	83.44
JM	APC2	31.4	0.0	5.0	84.97	96.63
BM	APC2	25.4	5.0	5.0	93.04	95.00
RN	APC3	80.0	31.9	20.6	87.22	85.11
SM	LC2				107.41	132.84
ES	APC2	31.2	10.0	9.4	85.44	84.44
BM	LC3				74.00	70.91
DL	VS				109.38	107.00
EW	LC1				101.33	96.77
MV	APC 2	31.0	4.2	6.8	104.28	97.87
KS	VS				61.41	82.48
LG	APC2	50.0	30.0	16.0	81.30	73.34
LJ	APC3	32.4	4.7	11.3	83.54	83.40
NR	VS				87.24	86.91