Outcomes of Operative Management of Traumatic Transverse Sacral Fractures;

Systematic Review and Meta-Analysis

Thesis

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Master Degree in ***Orthopedic Surgery***

Presented By

Peter Morad Wahib
MBBCH, Cairo University

Supervised By:

Prof. Ali Ibrahim Abdel Latif Hussein
Professor of Orthopedic Surgery
Faculty of Medicine
Ain Shams University

Dr. Mohamed Zayan Ibrahim
Lecturer of Orthopedic Surgery
Faculty of Medicine
Ain Shams University

Faculty of Medicine - Ain Shams University
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List of Contents

List of Abbreviations

Abbreviation	Full term
ATLS	Advanced Trauma Life Support
AP	Antero-Posterior
CI	Confidence Interval
CT	Computed Tomography
DF	Degree of Freedom
Fig.	Figure
Fx	Fixation
I^2	Inconsistency
K- Wire	Kirschner Wire
MRI	Magnetic Resonance Imaging
PPRFx	Posterior Pelvic Ring Fixation
PSIS	Posterior Superior Iliac Spine
RR	Risk Ratio
SAE	Serious Adverse Effect
SD	Standard Deviation
SI	Sacro-Iliac
SPFx	Spino-Pelvic Fixation
TI	Trans- Iliac
TS	Trans- Sacral
TSF	Transverse Sacral Fracture
VS	**Versus**

List of Tables

List of Tables cont...

Table No.	Title	Page No.

List of Tables cont...

List of Figures

List of Figures cont...

List of Figures cont...

List of Figures cont...

List of Figures cont...

Introduction

The pelvis is a ring-like structure made up of two innominate bones and the sacrum. These bones have no inherent stability. The stability of the pelvic ring is due mainly to its surrounding soft tissue envelope. The stabilizing structures of the pelvic ring are: the symphysis pubis, the posterior sacroiliac complex and the pelvic floor. The anterior structures: the symphysis pubis and the pubic rami contribute approximately 40% to the stiffness of the pelvis, the posterior structures, approximately 60% and this was shown by clinical and biomechanical studies ***(Hearn, 1995; Tile, 1996).***

The concept of pelvic stability:

Stability is defined as the ability of the pelvis to withstand normal physiological forces without abnormal deformation ***(Tile, 1984)***. Pelvic stability is dependent on an intact posterior sacroiliac complex and this is because the sacrum, contrary to what is expected, does not form the shape of a keystone in a Roman arch but is quite the reverse. The whole complex looks and functions like a suspension bridge, with the posterior superior iliac spines being the pillars, the interosseous sacroiliac ligaments acting like suspension bars, the sacrum being the bridge. The iliolumbar ligaments join the transverse processes of L5 to the iliac crest, further enhancing the suspensory mechanism, as do the transverse fibers of the sacroiliac ligaments. ***Grant and Basmajian (1965)*** describe the posterior sacroiliac interosseous ligament as the strongest ligament in the body. The anterior

sacroiliac ligaments afford some stability by resisting external rotation and shearing force. Slight rotatory motion is allowed at the sacroiliac joint during walking ***(Tile, 1987; Tile, 1996).***

Pelvic floor:

Running transversely the Sacrospinous ligament resists external rotation of the pelvic ring. The Sacrotuberous ligament positioned in the vertical plane, compared to the horizontal plane of the Sacrospinous ligament, resists vertical shearing forces applied to the 2 ligaments placed at 90° to each other, are extremely adapted to resist the two major forces acting upon the pelvis that is external rotation and vertical shearing forces ***(Tile, 1984).***

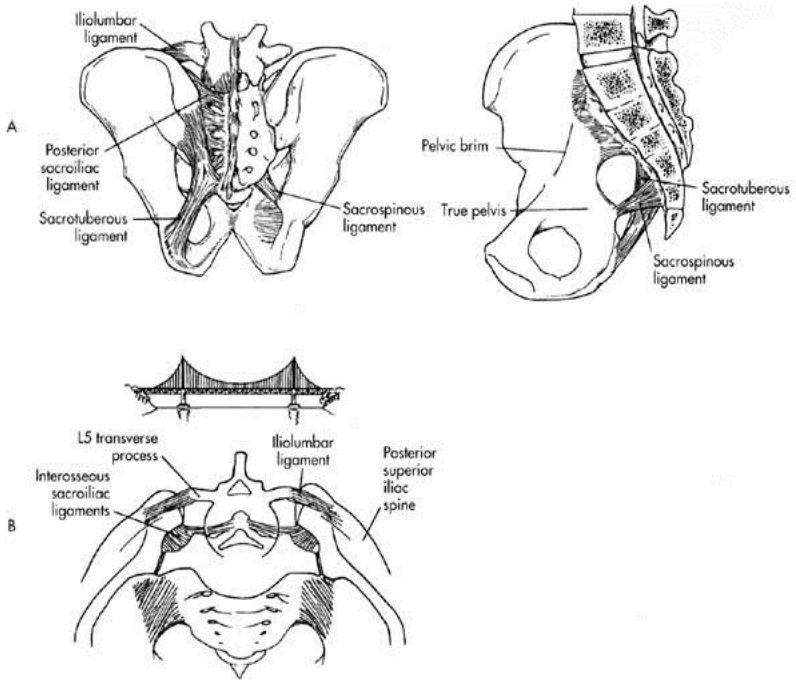

Figure (1): A, Major posterior stabilizing structures of pelvic ring (posterior view). B, Tile compares the relationship of posterior pelvic ligamentous and bony structures to suspension bridge, with sacrum suspended between two postero-superior iliac spines ***(Tile, 1996).***

Classification of Sacral Fractures

Classification of sacral fractures and posterior pelvic ring disruptions are generally sorted into three categories. The first category includes those that occur as a result of pelvic ring fractures. These are often vertical or longitudinal and are described by the Letournel, Tile, and AO-ASIF classification systems for pelvic fractures. The second category of sacral fractures consists of those that involve the lumbosacral junction; these fractures are difficult to diagnose. Because the lumbosacral ligaments are very strong, significant injury to this segment usually occurs only from high-energy trauma unless the patient is osteopenic. These fractures are best classified by the Isler system, which takes into account the location of the major fracture line relative to the L5-S1 facet and the potential for lumbosacral subluxation to complete lumbo-pelvic dissociation, See **Fig. (2)** ***(Isler, 1990).***

Type I fractures are through the sacrum and are lateral to the facet; these fractures are unlikely to have an impact on lumbosacral stability, but they may affect pelvic ring stability. Type II fractures are through the sacrum and run through the L5-S1 facet; they can be differentiated as extra-articular fractures of the lumbosacral junction and articular dislocation with displacement of the facet. Type III fractures occur through the sacrum and are medial to the facet crossing into the neural arch. These fractures may lead to significant instability; when bilateral, they can lead to lumbosacral dissociation, requiring stabilization ***(Mehta et al., 2006).***