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ORIGINAL ARTICLE

THE CORRELATION OF RADIOLOGICAL EXAMINATION AND VOLITIONAL VOIDING IN THORACO-LUMBAR FRACTURES AND SPINAL INJURY

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ABSTRACT: BACKGROUND: Spinal Cord Injury (SCI) is a devastating medical condition which results in paraplegia with decreased bladder and bowel control. Investigation used to predict volitional voiding in persons with acute SCI include clinical examination, X-rays of the spine, CT scan, MRI, even though the later ones are not available in every medical center and all cannot afford. **AIM:** To determine if those with a mild narrowing of the vertebral canal have a better prognosis for volitional voiding. **SETTINGS AND DESIGN:** Prospective study of 20 consecutive patients with thoracolumbar fractures and spinal injury, admitted in the Department of Physical Medicine Rehabilitation, Christian Medical College, and Vellore within three weeks of injury, were recruited into the study. **METHODS AND MATERIALS:** Initial neurological examination was performed on admission and final between 16 -20 weeks after the injury. Lateral and anteroposterior X-rays of the spine were done to measure the antero-posterior and transverse diameters of the spinal canal as well as the canal-body ratio at the level of the lesion. Bladder function was assessed between 16 -20 weeks following the injury by Urodynamic study. The bladder outcome was divided into first category was assisted bladder emptying, which included intermittent catheterization, indwelling catheterization and second category was with volitional voiding. **STATISTICAL ANALYSIS:** Data collection was subjected to statistical analysis using SPSS Version 11.0. Fisher's exact test, Independent t- test and Mann-Whitney test were used. **RESULTS AND CONCLUSIONS:** The level of fracture did not correspond to the type of bladder. The use of Canal body ratio at the level of vertebral fracture on plain radiographs was not useful in prediction of volitional voiding. (P> 0.05). Therefore plain radiography was not found to be a good predictor of bladder function in persons with spinal injuries.
KEYWORDS: Spinal cord injury, neurogenic bladder, urodynamics, x-rays, thoraco- lumbar fratcures.

INTRODUCTION: Spinal Cord Injury (SCI) is a devastating medical condition which results in decreased bladder and bowel control. SCI has long-term effects in many aspects of an individual's life. Anxiety about one's urinary continence is often one of the major preoccupations of a person with spinal cord injury. The degree of bladder dysfunction may be related to the injury itself, the level of the spinal cord affected by the injury, and the severity of neurological impairment. Investigation techniques used to help address the issue of predicting bladder outcome in persons with acute SCI include clinical examination, X-rays of the spine, CT scan, MRI and electrophysiological examinations. CT scan, MRI and electrophysiological examinations are not available in every medical center in our country and all cannot afford these investigations. This study was done to evaluate the use of X-rays, modalities widely available in our country, to predict urinary continence in persons with acute SCI.

METHODS: Prospective study of twenty consecutive patients with thoracolumbar fractures and spinal injury, admitted in the Department of Physical Medicine Rehabilitation, Christian Medical

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College, and Vellore within three weeks of injury, were recruited into the study. Patients with non-traumatic paraplegia and preexisting scoliosis were excluded.

METHODOLOGY OF THE STUDY:

- After initial neurological examination, Lateral and antero-posterior X-rays of the spine were done to measure the anteroposterior and transverse diameters of the spinal canal as well as the canal-body ratio at the level of the lesion. The spinal fractures were classified based on Denis classification.
- Bladder function was assessed between 16 -20 weeks following the injury clinically and by Urodynamic study.
- The bladder outcome was divided into two categories: first category was assisted bladder emptying, which included intermittent catheterization and or indwelling Foley catheterization. The second category was volitional voiding, defined as no collecting devices, no medication, and no surgical intervention but passing urine normally.

STATISTICS: The data was subjected to statistical analysis using SPSS Software Version. 11.0.

Data were expressed as number (%) and mean +/- standard deviation for categorical and continuous variables.

Chi-square/Fisher's exact tests were used for group comparisons.

Independent t- test (for normal data) and Mann-Whitney test (for non-normal data) were performed to compare the mean scores.

RESULTS: A total of 20 consecutive subjects satisfying the inclusion criteria were enrolled in the study.

DEMOGRAPGIC PROFILE:

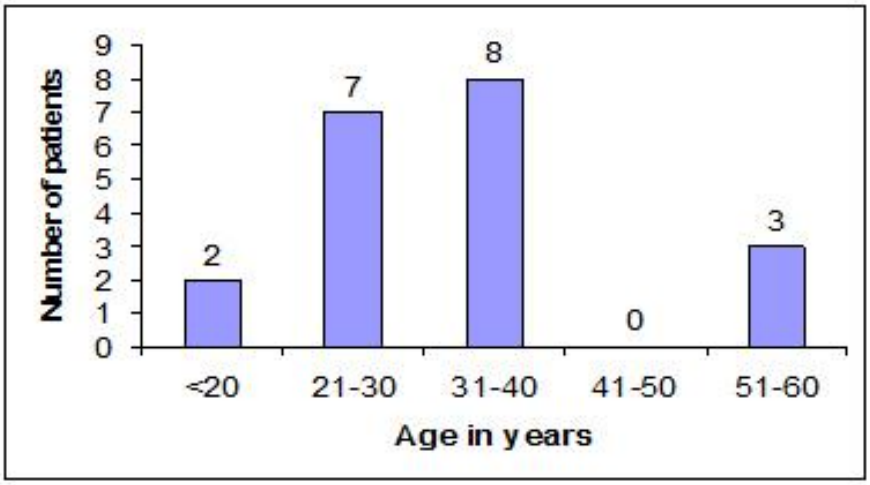

Fig. 1: Age distribution of patients recruited into the study

The patients with SCI ranged from 20 to 56 years of age, the average was 33.45 years and Standard Deviation 10.72. Out of 20 SCI patients 7 were in the third decade (age group of 21-30

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years) and 8 in the fourth decade (age group of 31-40 years). There were 3 patients above 50 years and two patients were less than 21 years.

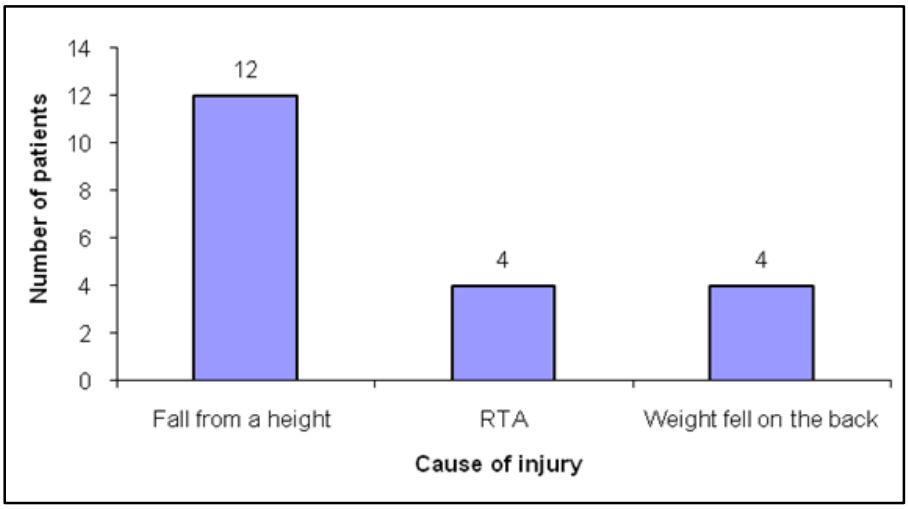

Fig. 2: Bar diagram showing causes of injury

The commonest cause of SCI in this study population was fall from the height 12 (60%). Four patients (20%) had road traffic accident (RTA) and an equal number had heavy objects falling on their back.

RADIOLOGICAL PREDICTION:

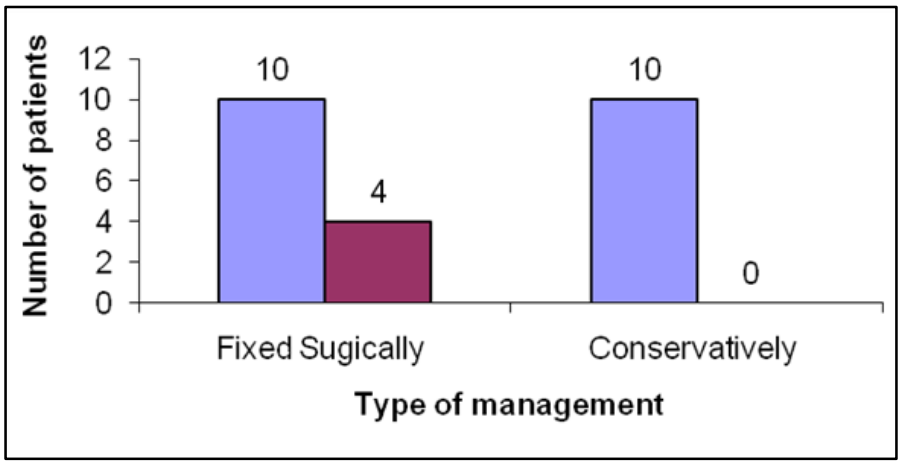

Fig. 3: Comparison of type of management with volitional voiding

Out of the 10 people who underwent surgical fixation 4 had volitional voiding compared to none managed conservatively. This difference was statistically not significant as shown in Table 1.

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Spinal fracture treatment	Assisted Voiding	Volitional Voiding	P Value
Surgically fixed spinal fractures	6	4	0.087
Conservative managed fractures	10	0	

Table 1: Showing distribution of assisted and volitional voiding among the surgically fixed and conservatively managed spinal fractures

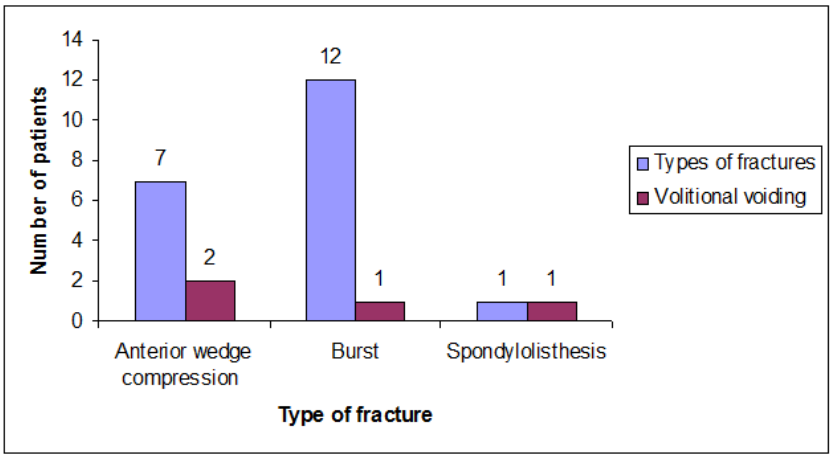

Fig. 4: Distribution of the volitional voiding among persons with different types of vertebral fractures

Two patients who had anterior wedge compression fracture had volitional voiding where as one each from burst type and spondylolisthesis had volitional voiding which was not statistically significant.

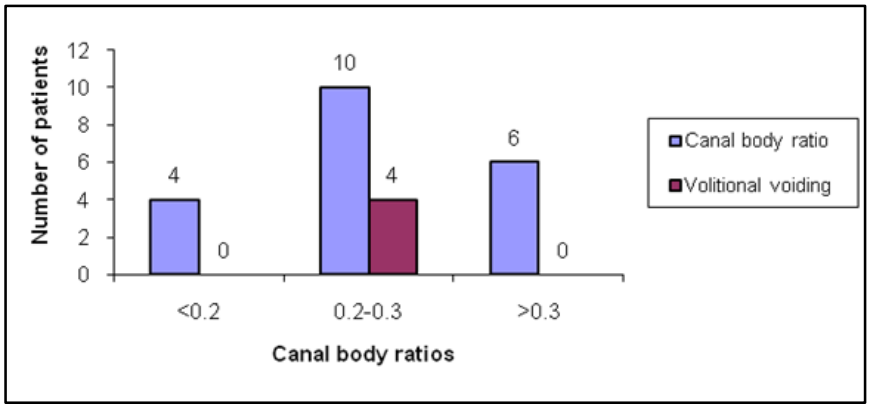

Fig. 5: Distribution of volitional voiding among the persons with canal body ratios

4 patients who had a canal body ratio in the moderate compression group had volitional voiding. None of other groups had any person with volitional voiding but these differences were not significant as shown in Table 2.

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Bladder Function	Vertebral Canal-body Ratio			P value
	<0.2	0.2-0.3	>0.3	
Assisted Voiding	4	6	6	0.082
Volitional voiding	0	4	0	

Table 2: Distribution of assisted and volitional voiding among persons with different vertebral Canal-body ratios

DISCUSSION: Recovery from SCI requires substantial coping by the patient and their carers, and an accurate prediction of outcome soon after the onset can be useful for the patients and carers to cope. Bors and Comarr[1] pointed out that SCI mainly affected young males; (Figure 1) this was true for this study as well: all the recruited patients were males. 75% of the patients were married and 25% were unmarried. This supports the data of Guttman[2] who also found that SCI occurs mainly among active young males in the peak of their productive life.

A large number of injuries (6 patients) were electricians who were working on electric-poles when they had an accidental fall as shown in Figure 2. This data needs to be examined carefully in a larger population, as accidents at work must be prevented. Out of the 50% patients who were surgically stabilized four patients (40%) improved in bladder function which was not statistically significant as shown in Figure 3 and Table 1. This reminds us that there is as yet no evidence that surgical fixation improves the neurological outcome in persons with thoraco-lumbar fractures and spinal cord injury.

RADIOLOGICAL EXAMINATION AFTER ACUTE SPINAL INJURY: Radiological investigations done for patients with SCI include antero-posterior and lateral radiographs of the cervical, thoracic, and lumbar spine. Because of the high prevalence of contiguous and noncontiguous associated spinal fractures, comprehensive radiographic evaluation, including the entire cervical, thoracic, lumbar, and sacral spine, is recommended for any patient who has sustained a high energy injury and in whom a spinal injury is suspected. Specific injury mechanisms and fracture patterns should trigger a targeted search for commonly associated non-spinal injuries. Chance fractures or flexion-distraction Chance variants are strongly associated with potentially life- threatening intra-abdominal injuries. Computed tomography scanning is generally the next step after plain radiographic evaluation.

The canal at the injured segment should be measured in the anteroposterior and transverse planes and compared with the levels cephalad and caudad to it. Alexander R. Vaccaro and colleagues found the most clinically useful measurement to be the ratio of the sagittal to the transverse canal diameter[3] using Computed tomographic scans. In their study, a smaller mid sagittal diameter and a greater transverse diameter (a widened interpedicular distance) suggests higher energy injury and correlated with an increased risk of neurological deficit.[3] In the absence of neurological injury Magnetic resonance imaging scans usually are not required for thoracolumbar injuries in the acute setting. They can occasionally be helpful for identifying a ligamentous lesion that is suspected but not confirmed on plain radiographs and computed tomography scans. When a patient has a neurological deficit, however, magnetic resonance imaging is recommended to identify any ongoing spinal cord compression, evaluate cord anatomy, and rule out an epidural hematoma.[4] Mechanical failure of the spinal column following high-energy trauma frequently occurs at the thoracolumbar junction as a

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result of its transitional anatomy and biomechanical environment. The most common fracture patterns at the thoracolumbar junction include compression fractures, burst fractures, flexion-distraction injuries, and fracture-dislocations. These injuries can be classified with use of either the anatomical three-column model of spinal stability described by Denis[5] or the mechanistic classification system of Ferguson and Allen.[6]

In the anatomical three-column model described by Denis[5], the anterior column includes the anterior longitudinal ligament and the anterior half of the vertebral body and the annulus fibrosus, the middle column includes the posterior half of the vertebral body and the annulus fibrosus along with the posterior longitudinal ligament, and the posterior column includes the bone and ligamentous structures posterior to the posterior longitudinal ligament. With the three-column model, thoracolumbar fractures are differentiated on the basis of the pattern of injury to the middle column. Compression fractures involve failure of the anterior column in compression without injury to the middle column, whereas burst fractures result in compression failure of both the anterior and the middle column. Injury to the middle column is considered to be a potentially unstable fracture pattern in this classification scheme. Failure in distraction is characteristic of Chance fractures and Chance variants,[4] whereas any translation or rotation through the middle column indicates a high degree of instability, characteristic of a rotational burst injury or a fracture-dislocation.

RELATIONSHIP BETWEEN RADIOLOGICAL PARAMETERS AND BLADDER RECOVERY: It is generally accepted that patients with incomplete injury to the cord or the cauda equina with less canal compromise initially have better chances of neurological improvement than patients who initially have complete cord injury.[7, 8, 9] This study also demonstrated this phenomenon. There were a total of 12 of burst fractures, 7 anterior wedge compression fractures and one person had spondylolisthesis as shown in Figure 4. Two patients who had anterior wedge compression fracture had improved bladder function which was not statistically significant. Although the Canal body ratio is different for different age groups and different genders and different also for thoracic and lumbar regions it is accepted that a ratio of 1: 2.5 to 1: 3 is normal. In this study there were 10 patients with a Canal body ratio at the level of vertebral fractures with moderate canal compromise and 4 had volitional voiding but this was not statistically significant as shown in Figure 5 and Table 2. Therefore plain radiographs was not useful in prediction of volitional voiding. (P> 0.05) Various authors have reported a relationship between the degree of canal compromise and the extent of neurologic deficit.[7,8;10-13] Others have noted that there is no correlation between the initial neurological impairment and the degree of spinal canal narrowing.[14-17] Therefore this parameter is not universally accepted as a good predictor of bladder function in persons with spinal injuries.

LIMITATIONS OF THE STUDY: There was heterogenesity in the management of the fracture spine as some had surgical fixation done, and some were conservatively managed.

This study could have been done with a larger sample size.

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