A Study of the Extent of Neurological Involvement and Neurological Deficit in Different Types of Sacral Fractures

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Research Article

Abstract: **Introduction:** Sacral fractures occur in approximately 45% of all pelvic fractures. Neurological deficit has been reported in some cases of sacral fracture. **Aims and Objectives:** To study the extent of neurological involvement and neurological deficit in different types of sacral fractures in accordance with the Gibbons classification. **Materials and method:** present study was conducted in tertiary care institute with total 32 patients of sacral fracture. Gibbons grading system was used to assess neurological deficit. **Results:** 15.7%% patients had neurological deficit. In Denis classification fractures neurological deficit was found in type 2 and 3 patients. Neurodeficit found in 37.5% of vertical shear type of sacral fracture. **Conclusion:** neurodeficit occours in some cases of sacral fracture. And it is common in sever grade of Denis classification and vertical shear fracture.

Keywords: sacral fracture, neurological deficit, Gibbons classification.

Introduction

Sacral fractures occur in approximately 45% of all pelvic fractures.[1] In a large retrospective study of sacral fractures, Denis et al.[2] reported that the chance of identifying a sacral fracture was increased by the presence of an associated neurological injury. An existing sacral fracture was correctly identified in 76% of patients presenting with a neurological deficit but in only 51% of neurologically intact patients.[2] Unrecognized and inadequately treated sacral fractures may lead to painful deformity and progressive loss of neurological function. Delayed surgery for post-traumatic sacral deformity is complex, and the results are often less favourable than those of early surgery. Therefore, determination of an integrated diagnostic and therapeutic approach to sacral fractures should be the goal.

Aims and Objectives

To study the extent of neurological involvement and neurological deficit in different types of sacral fractures in accordance with the Gibbons classification.

Materials and method

Present study was intended to study To study the extent of neurological involvement and neurological deficit. All patients with pelvic injuries admitted within the period of study were identified from the trauma registry and hospital records. Immediate post injury and post-operative and follow-up antero-posterior, inlet, and outlet radiographs for a minimum of 6 months post-injury were examined. The radiographic parameters and patient based outcomes of cases with sacral fractures and sacro-iliac joint injuries were evaluated in the operated and non operated groups.

Inclusion criteria

- All patients 18 - 80 years of age with sacral fract ures and sacro-iliac joint injuries with or without associated posterior pelvic ring injuries.

Exclusion criteria

- Those who were haemo-dynamically unstable and those with open thoracic or abdominal wounds.
- Also patients with degloving pelvic and perineal injuries.
- Patients with associated fractures of the acetabulum were also excluded to avoid confounding influence on outcome analysis.

Sample Size

Thus with respect to above inclusion and exclusion criteria total of 32 patients with sacral and sacro-iliac joint injuries were enrolled during the study duration.

Clinical Assessment

Clinical patient assessment was done in terms of the nature and severity of the injury (Road Traffic Accidents, Railway accidents, Traumatic Fall), the association of any other co-morbid injuries in terms of head injury,

abdominal injury, urogenital and perineal injuries and limb injuries. Neurological assessment at presentation was done using the Gibbons grading system[3].
Grade 1: no neurological injury
Grade 2: paresthesias only
Grade 3: motor loss but bowel and bladder control intact
Grade 4: impaired bowel and/or bladder control
Also assessment of individual nerve root function from L5 to S5 was included and documented along with the Gibbons grading.

Results

Table 1: Demographic data of study population

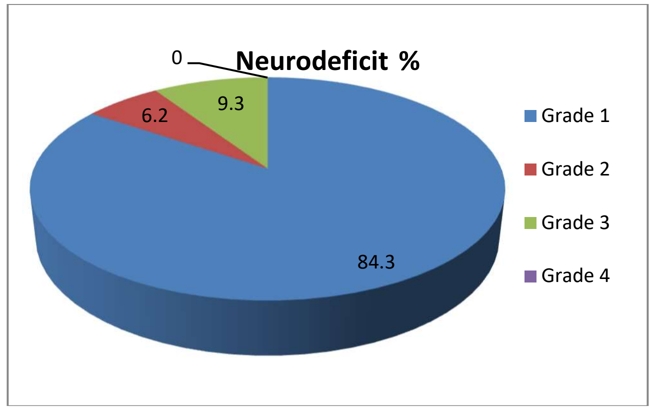
Parameter		No. of cases (total 32)	
		Conservative (14)	**Surgery (18)**
Age(yrs)	**Mean ± SD**	38.86 ± 17.51	30.28 ± 10.86
	Range	19 – 73 yrs	18 – 55 yrs
Sex	**Male**	12 (85.7)	13 (72.2)
	Female	02 (14.3)	05 (27.8)

Out of the total 32 patients of Sacral fractures 14 patients were managed conservatively and 18 were managed surgically. The mean age of patients managed conservatively was 38.86 ± 17.51 and of those managed surgically was 30.28 ± 10.86. In the study there were total 25 male and 7 female (Table 1).

Table 2: Analysis of neurodeficit: Gibbons grading

GIBBONS GRADING	Conservative (N=14)	Surgery (N=18)	Total (N=32)
Grade 1	12 (37.5)	15 (46.8%)	27 (84.3%)
Grade 2	2 (6.2%)	0	2 (6.2%)
Grade 3	0	3 (9.3%)	3 (9.3%)
Grade 4	0	0	0

84.3% of the total patients were found to be neurologically intact in this study. A total of 5 patients (15.6%) in this series had a quantifiable post injury neurodeficit according to the Gibbons grading system (Grades 2 and above). Amongst these 2 patients (6.2%) were found to have paresthesias in the region of S1, S2 dermatomal distribution without any motor deficits. 3 patients (9.3 %) were found to have motor deficits of S1 dermatome along with reduced perianal sensations (S2,S3 sensory dermatomes). None of the patients in this series had a type 4 pattern i.e. presence of bladder bowel incontinence. Also deficits of L5 nerve root were not seen in this series.



All patients with type 3 deficit underwent surgery in the form of stabilization with direct or indirect decompression whereas those with type 2 deficits (paresthesias only) were conserved in this series. At 6 months follow all patients had near complete recovery of neurology except for a single patient with type 2 deficit who reported persistence of symptoms in form of paresthesias.

Table 3: Analysis of neurodeficit in terms of the injury patterns (Denis three Zone classification)

Denis three Zone classification	Neurological deficit		Total
	Present	**Absent**	
01	00	16 (100%)	16 (100%)
02	03 (30%)	07 (70%)	10 (100%)
03	02 (100%)	00	02 (100%)

Patients having Denis type 1 injuries had no neurological deficits in this series. 30 % of the patients with Denis type 2 injuries (N=10) and 100 % of the patients with Denis type 3 injuries (N= 2) had a quantifiable neuro-deficit according to the Gibbons grading system.

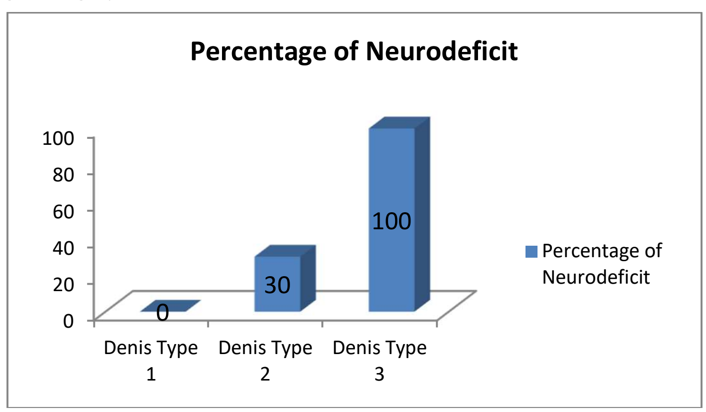
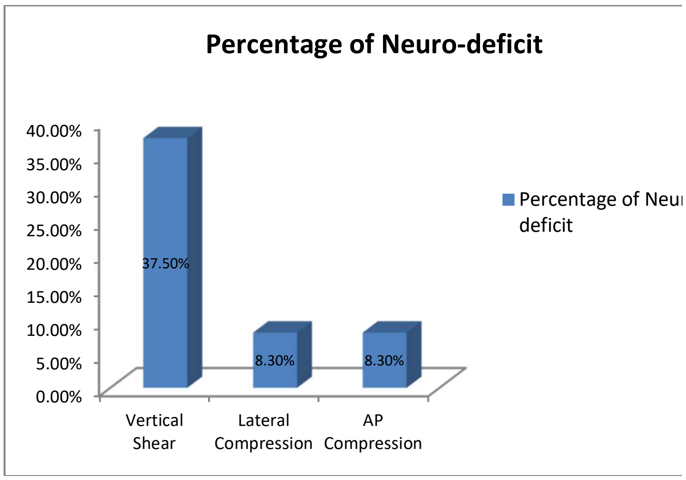


Table 4: Analysis of neurodeficit in terms of the injury patterns (Young and Burgess classification)

Young and Burgess classification	Neurological deficit		Total
	Present	Absent	
AP compression	01 (8.3%)	11 (91.7%)	12 (100%)
Lateral compression	01 (8.3%)	11 (91.7%)	12 (100%)
Vertical shear	03 (37.5%)	00 (62.5%)	08 (100%)

Patients with Vertical shear injury pattern (N=8) according to the Young and Burgess Classification had a 37.5 % incidence of neurological injury. Patients with Lateral Compression type injury pattern (N=12) and patients with Antero-Posterior type injury pattern (N=12) had an 8.3% incidence of neuro-deficit each.



Discussion

In the present study it was observed that most of the population was male. The close association of the lumbosacral plexus places the neurologic structures at risk of a traction injury or transection in high-energy displaced fractures. Neurologic injury associated with sacral fractures can range from an incomplete injury of a single nerve root to involvement of the entire cauda equina. Fractures of the sacrum may result in a neurologic injury in up to 25% of cases.[4] The nerve injury may involve >1 nerve roots, and may be unilateral or bilateral depending on the fracture pattern and location. The injury can range from a neuropraxic injury due to nerve contusion or shearing injury, to transection of individual nerve roots, or even complete transection of the cauda equina. The location of the fracture has been found to be a good predictor of neurologic injury deficits. Denis zone 3 fractures, while less frequent, were associated with the highest rate of nerve injury. In a retrospective review of 236 fractures, Denis et al[2] noted that 57% of patients with zone 3 injuries had a neurologic deficit. While Denis zone 1 injuries are the most frequent, they have the lowest rate of associated nerve injury. Six percent of patients with zone 1 fractures had a neurologic injury, which was localized to the sciatic nerve or L5 nerve root. Zone 2 fractures are intermediate in their frequency and rate of associated nerve injury. In the series by Denis et al the incidence of zone 2 fractures was 34% and the rate of neurologic injury was 28%. Unilateral injury of the L5, S1 or S2 nerve roots were noted in the zone 2 fractures. In a case series of transverse sacral fractures, Robles[5] reported that 97% of patients presented with some neurologic injury that ranged from radiculopathy to bowel and bladder disturbance. Complete nerve root transection has been reported in 35% of transverse sacral fractures.[6] However, the neurologic injury seen in transverse sacral fractures may be easy to overlook if the examination is limited simply to lower extremity motor and sensory function that primarily focuses on the L5 and S1 nerve root distribution.

In our study the incidence of neurological deficit was 15.6 % which was graded according to the Gibbons grading system (Grades 2 and above). 6.2% of the cases were found to have paresthesias in the region of S1, S2 dermatomal distribution without any motor deficits. 9.3% of the cases were found to have motor deficits of S1 dermatome along with reduced perianal sensations (S2,S3 sensory dermatomes). The metrical size of the upper sacral roots (S1 and S2) measures one-third to one-fourth the size of their respective foramina, whereas the size of S3 and S4 roots measures only one-sixth the size of S3 and S4 foramina. This explains our results showing that foraminal entrapment of S1 and S2 roots is more likely than S3 and S4. None of the patients in this series had a type 4 pattern i.e. presence of bladder bowel incontinence. Also deficits of L5 nerve root were not seen in this series. In our study also the incidence of neurological injuries were highest amongst those with higher injury grades according to the Denis and Young and Burgess classification systems. Patients having Denis type 1 injuries had no neurological deficits in this series whereas 30 % of the patients with Denis type 2 injuries and 100 % of the patients with Denis type 3 injuries had a quantifiable neuro-deficit according to the Gibbons grading system. Similarly patients with Vertical shear injury pattern according to the Young and Burgess classification had a 37.5 % incidence of neurological injury whereas those with Lateral Compression type injury and patients with Antero-Posterior type injury patterns had an 8.3% incidence of neuro-deficit each. A residual neurodeficit in the form of paraesthesias was found only in 1 case in our series. The patient had a type 2 Gibbons grade of neurological injury i.e. paresthesias only without any motor deficit of S1 and S2 dermatomal distribution. All the other patients with neurodeficit had a near complete recovery of their neurological deficit. However since a follow up period of only 6 months was taken as a cut-off for evaluation and since the sample size of this study was modest, any firm conclusions regarding the incidence of neuro-deficit and their status of recovery cannot be arrived upon. In a review of the literature concerning neurological recovery after sacral fractures, Taguchi et al.[7] found that, amongst the seven cases with neurological deficits, two cases improved completely and five cases improved partially during follow up. Mouhsine et al.[8] had four patients with neurological impairment. They showed a slow but complete recovery after 17 months follow up. Schildhauer et al.[9] had 22 cases with preoperative neurological deficits but only six of them recovered. They explained this low rate by the presence of nerve root avulsions in most of these cases. Bellabarba et al.[10] had ten cases (55%) with complete improvement of the neurological deficits, five cases (28%) with partial recovery and only three cases (17%) without recovery. Zelle et al.[11] had 13 patients with a neurological deficit; six patients underwent surgical decompression and seven patients were managed without surgical decompression.

Conclusion

Thus in the end we came conclude that neurological deficit increases with the severity of the type of fractures. We can also say that neurological deficit is common vertical shear as compared to AP and lateral compression.

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