

Prevalence of Osteoporosis in Chronic Spinal Cord Injury Patients Living in Rural Area- Descriptive Cross Sectional Study

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Abstract- BACKGROUND- - Spinal cord injury is a serious medical condition that can lead to severe morbidity and permanent disability, as well as psychological and socioeconomic challenges. The approximate incident rates in patients injured via high-energy mechanisms are 50%–70% in motor vehicle accidents. Fall from height, gunshot wounds, sports: 10%–15% Complications often result in a higher risk of illness and death, leading to more hospital visits and reduced job opportunities, thereby decreasing the quality of life. The complications are orthostatic hypotension, respiratory complications, autonomic dysreflexia, pressure ulcers, and osteoporosis. Osteoporosis is a skeletal disease characterized by low bone mass and deterioration of bone tissue, leading to increased bone fragility and the risk of fractures. Mechanical unloading, as evidenced by bone loss during space flights and bed rest, is believed to be the main cause. It is known that the first two weeks following an injury are the most susceptible to reducing bone growth. About 40% of bone loss may occur within 6 months of the injury; this rate of bone loss is much faster than that of non-SCI-immobile situations. Estimating hip and lumbar spine bone mineral density (BMD) using dual-energy X-ray absorptiometry (DXA) is the gold standard method for diagnosing osteoporosis. The cortical thickness index (CTI) is the most often used radiographic metric to evaluate the condition of the bones.

Methodology: - This study was a descriptive cross-sectional study with prospective data collection. It was approved by the ethical committee, PIMS-DU Loni. Informed consent was obtained from all the participants included in the study. Each patient was evaluated by history and physical examination. The history was obtained by direct interview. The data collected was age, gender, neurological level, ASIA,

duration of injury, and cause of injury. Radiological studies of the hips were done by x-ray. The cortical thickness index was calculated. Cortical thickness index is the ratio of femoral diaphyseal diameter [outer diameter (do)] minus the intramedullary canal [inner diameter (di)] to the femoral diaphyseal diameter.

Conclusion- The cortical thickness index was found to be lower in spinal cord injury patients. Osteoporosis and bone-related problems can be avoided by addressing bone health through medical management, physical therapy, and lowering the incidence of falls. The study emphasizes the importance of patient education about bone health and the creation of protocols to treat and prevent osteoporosis in spinal cord injury patients as part of a rehabilitation strategy.

Indexed Terms- Spinal cord injury, Osteoporosis, Cortical thickness index, Prevalence

I. INTRODUCTION

Spinal cord injury is a serious medical condition, that can lead to severe morbidity and permanent disability as well as psychological and socioeconomic challenges. Also, it is a life changing event that significantly impacts both physical and mental health. This occurs when the axons of nerves in the spinal cord is disrupted, resulting in the loss of sensory and motor function below the injury level. [1,2]. The approximate incident rates in patients injured via high energy mechanisms are - Motor vehicle accidents 50%-70%. Fall from height, Gunshot wounds, sports 10%-15% [2]. Complications often results in higher risk of illness and death, leading to more hospital visits and reduced job opportunities, hence decreases quality of life. Respiratory complications linked to spinal cord

injuries are the primary causes of morbidity and mortality in both acute and chronic phases. The severity of the breathing problems is determined by the spinal cord injury level and the extent of motor impairment. Often it leads to respiratory dysfunction, reduction in lung and chest wall compliance, reduction in vital capacity. Due to these problems respiratory failure, atelectasis and pneumonia are most common complications in SCI. Furthermore, SCI patients often experience a high occurrence of sleep related respiratory disorders, such as obstructive sleep apnea syndrome, which could negatively impact their quality of life and rehabilitation.[3]

Osteoporosis is a skeletal disease characterized by low bone mass and deterioration of bone tissue, leading to increased bone fragility and the risk of fractures [4]. The main cause is believed to be mechanical unloading, which has been supported by bone loss seen in space flights and bed rest. Neuronal and hormonal changes have also been found to play a role in its development. SCI results in acute disuse and a subsequent reduction in biomechanical stress on bones, which provides a significant stimulation for the osteocyte-controlled process of bone remodeling. When there is no mechanical stimulus, the body responds adaptively by increasing osteoclastic bone resorption and inhibiting osteoblastic bone production, which results in demineralization. Severe bone loss results from a persistent imbalance between the formation and resorption of bone [5]. People with osteoporosis have high levels of bone density loss, making them more likely to experience fractures. These fractures reduce their quality of life and increase medical expenses. Individuals with spinal cord injuries often experience frequent bone fractures due to osteopenia caused by lower osteogenic load and increased bone demineralization.[6] Over half of individuals with motor complete SCI will likely suffer an osteoporotic fracture after the injury. These fractures are most common in the distal femur and proximal tibia [7]. Individuals who suffer from SCI are more likely to develop disuse osteopenia due to their extended immobility and overall reduced ability to move around and do independent tasks. Ultimately, the active remodeling process in SCI is disconnected from the widespread loss of mobility and capacity to carry out typical weight bearing activities of daily living. It is known that first two weeks following an

injury are the most susceptible to reduce bone growth. About 40% of bone loss may occur within 6 months of the injury; this rate of bone loss is much faster than that of non-SCI immobile situations. Bone resorption in SCI progresses quickly in the very early stages following SCI [2,8]. The most severe bone loss is typically seen in the lower limbs, with the proximal tibia and distal femur being common fracture sites. This makes SCI-induced osteoporosis different from other types of osteoporosis [9] Almost all patients with hip-related diseases who see orthopaedists in modern medicine have hip X-rays on a regular basis and DXA scans rarely. Therefore, when DXA data are unavailable, X-rays can be used as a supporting radiographic tool to estimate the risk of fragility fracture and evaluate bone mineral density. The cortical thickness index (CTI) is the most often used radiographic metric to evaluate the condition of the bones.[10] Inclusion criteria for this study were age 18 to 60 years, both male and female, duration of injury >1 year, ASIA as A and B as per ASIA scale. The exclusion criteria for this study were not willing to participate, history of fracture, previous treatment of Vit-D deficiency, gastrointestinal disorders affecting calcium and Vit-D metabolism, suffering from hepatic, renal, endocrine disorders.

II. METHODOLOGY

This study was a descriptive cross-sectional study with prospective data collection. It was approved by the ethical committee, PIMS-DU Loni. Informed consent was obtained from all the participants included in the study. Each patient was evaluated by history and physical examination. The history was obtained by direct interview. The data collected was age, gender, neurological level, ASIA, duration of injury, and cause of injury. Radiological studies of the hips were done by x-ray. The cortical thickness index was calculated. The cortical thickness index is the ratio of the femoral diaphyseal diameter [outer diameter (do)] minus the intramedullary canal [inner diameter (di)] to the femoral diaphyseal diameter.



Fig.1a. AP view of Pelvis which shows osteoporotic changes
The cortical thickness of this patients is 0.45



Fig.1b. AP view of Pelvis which shows osteoporotic changes
The cortical thickness of this patients is 0.43

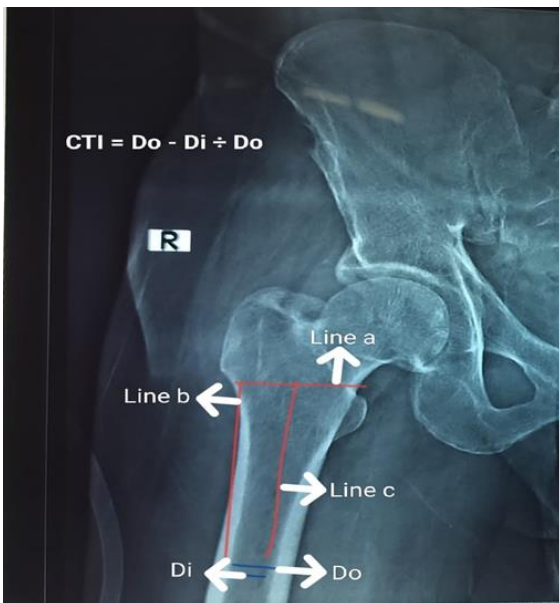


Fig.1c. Measurement of cortical thickness index on AP view radiograph

Table.1 Demographic Data of Participants

Demographic Data	Total (n=15)
Gender	
Male	15
Female	0
Mean age	31.46
Duration	
< than 1 year	3
> than 1 year	12
Level of injury	
Cervical	2
Thoracic	10
Lumbar	3
Etiology of injury	
RTA	9
Fall from height	6
ASIA level	
A	11
B	4

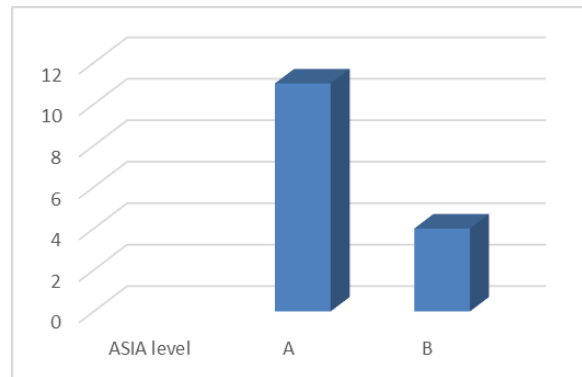


Fig. 1 Presentation of ASIA levels of participants

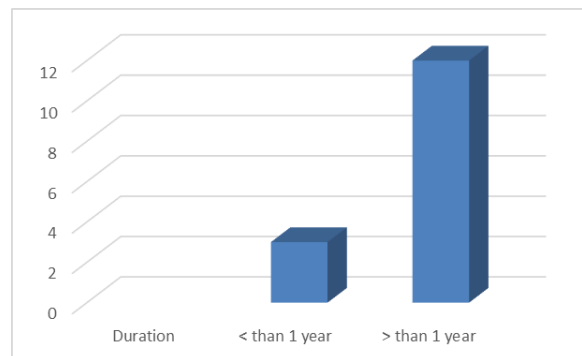


Fig.2 Presentation of duration of injury

A total of 15 spinal cord injury patients participated in the study which includes 15 males. The mean age of

the males was 31.46 years. The level of injury was cervical 2 (13.33%), thoracic 10 (66.66%), and lumbar 3 (20%). The participants on ASIA A level, they were 11 (73.33%), and on ASIA B level were 4 (26.66%). The duration of the injury was 1 year to 3 years. The patients with less than 1 year of injury were 3 (20%), and the patients with more than 1 year of injury were 12 (80%). [Table 1]

III. RESULTS

Table 2. Cortical Thickness Index of patients

Patients	Cortical thickness index
1	0.45
2	0.45
3	0.53
4	0.47
5	0.40
6	0.41
7	0.43
8	0.51
9	0.54
10	0.42
11	0.44
12	0.57
13	0.50
14	0.54
15	0.46

The cortical thickness index in the proximal femur was in between 0.40 to 0.56 in the participated males. The mean CTI in the proximal femur was 0.47. Out of 15 patients 9 patients have low cortical thickness index and most of this patient’s duration was more than 1 year. [Table 2]

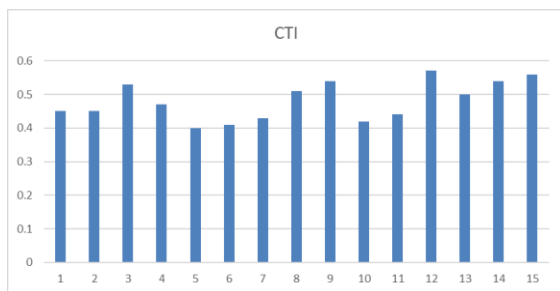


Fig.3 Presentation of the CTI of the participants

IV. DISCUSSION

The aim of the study was to investigate the prevalence of osteoporosis in chronic SCI patients living in rural areas. The main objective of the study was to determine the prevalence of osteoporosis in chronic spinal cord injury patients living in rural areas where DXA is not available.

In this study, we have investigated the prevalence of SCI-related osteoporosis based on data from 15 patients with chronic SCI. A study by Varacallo M. et al. said that the osteoporotic changes mostly occur due to prolonged immobilization and overall decreased mobility and independent functional capabilities. When combined with the previously indicated epidemiologic trends and patterns, more than 50% of patients with a full SCI experience osteoporosis within a year after the injury. The prevalence percentage rises to above 80% with long term follow up. But the fragility fracture is the most dangerous side effect of osteoporosis that follows SCI. At some point following the SCI more than half of these individuals will experience at least one low impact fracture. [11] People who have spinal cord injuries (SCI) are more likely to experience problems from being immobile due to paralysis; they also frequently experience rapid and severe loss of bone density. There are two stages to this bone loss. Rapid bone reabsorption characterises the first phase, which peaks 18–24 months after the injury. The second chronic phase is marked by a slow loss of bone mass and stunted bone growth. Because of this, approximately 40% of people with chronic SCI fracture, which is twice as likely to occur as in people without SCI. [12].

So, to predict the osteoporosis we used the standard anteroposterior hip radiograph at the time of admission. The cortical thickness index was calculated. We found that in our study out of 15, 9 patients have osteoporosis. We also found that the osteoporotic changes mostly occur in patients with chronic spinal cord injury (more than 1 year). The rate of bone loss is highest in the first year following SCI, with a 3.0% monthly decrease in proximal femoral bone mineral density (BMD). This decrease in BMD is followed by three times decrease in bone strength.[13] Even though DXA is the most helpful in BMD assessment. Orthopedics sometimes do not have

access to DXA results at the time of examination since it's not regularly requested and is not always available. In the Asia Pacific region wealthy nations have between 12-24 DXA machines per million people. Where poor nations have significantly fewer machines per million due to severe resources shortage.

Patients with SCI showed a distinct pattern of bone loss compared to individuals with endocrine diseases and disuse osteoporosis. In person with SCI a no of factors including extent of injury, muscle stiffness, age, sex, and time of the injury tend to have a significant impact on bone mass.

One additional risk factor that has been identified is the severity of SCI; patients with complete SCI have been reported to have a higher incidence of fractures than those with incomplete injuries. There is a correlation between the severity of bone loss and the risk of fracture in these patients, as these factors have been demonstrated to influence the amount of bone loss after SCI. [14]

Everyone with motor complete SCI develops osteoporosis below the level of injury. This may be the reason why fractures are twice as common in people with complete SCI as they are in healthy controls and up to 40% of people with chronic SCI encounter fractures.[15]

One noteworthy discovery from the review is that the rate of bone loss following SCI is not related to a patient's age or gender, but rather to the amount of time that has passed since the injury. Additionally, the level of the injury has an impact on bone loss, with patients who are wheelchair-dependent showing lower BMD levels than walking patients with SCI. The prone area to post-SCI osteoporosis is the femoral neck. In every study, the epiphyseal portion of the bone shows greater loss; cortical bone loss is higher than trabecular bone loss.[16]

CONCLUSION

The cortical thickness index was found to be lower in spinal cord injury patients. Osteoporosis and bone related problems can be avoided by addressing bone health through medical management, physical therapy, and lowering the incidence of falls. The study

emphasizes the importance of patient education about the bone health and creation of protocols to treat and prevent osteoporosis in the spinal cord injury patients as part of a rehabilitation strategy.

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Informed consent – Informed consent was obtained from the patients.

Ethical approval – Ethical clearance was received from the ethical committee of the Pravara Institute of Medical Sciences, Loni.

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