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Assessment of Walking Index in Spinal Cord Injury Patients Admitted to Tertiary Hospital in Western Maharashtra

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Abstract:

Background: Spinal cord is trauma or lesion to spinal cord which contains white matter [ascending tracts and descending tracts] and grey matter [sensory neuron and motor neurons] that results in paralysis of muscles and affects sensory abilities and other body functions below the level of injury. Recovery of walking after paralysis of the muscles of the lower extremities, particularly following acute spinal cord injury is one of the primary goals of patients. In fact, in patients with some preserved walking ability, improvements in walking quality were placed higher than bowel, bladder and sexual function. Physical limitation for walking secondary to impairment is defined at the person level and indicates the ability of a person to walk after spinal cord injury. The development of this assessment index required a rank ordering along a dimension of impairment, from the level of most severe impairment (0) to least severe impairment (20) based on the use of devices, braces and physical assistance of one or more persons.

Aim: Assessment of walking index in spinal cord injury patients admitted to tertiary hospital in western Maharashtra.

Methodology: The study was conducted in a Smt. Sindhutai E. Vikhe Patil Pravara Spinal Cord Centre for SCI Patients according to inclusion criteria. Convenient sampling was done for 20 individuals. The walking index for SCI patients was measured by WISCI II Scale.

Outcome Measure: Walking index for spinal cord injury (WISCII).

Results: It is observational descriptive study, there were 20 participants in this study (females 6 and males14, average age = 27.43 (male) and average age = 27.83(female) (SD =8.41) .WISCI II average Score = 6.45 (SD = 5.52) were documented for the assessment of walking index in spinal cord injury patient, It was found that Average WISCI II score for ASIA SCALE A was (5) (SD = 4.19), average WISCI II score for ASIA SCALE B was (9) (SD = 8.33), average WISCI II score for ASIA SCALE C was (8) (SD = 4.58) for patients admitted to tertiary hospital in western Maharashtra.

Conclusion: The present study concludes strong relation between WISCI II and ASIA A, B, C for patients admitted to tertiary hospital in western Maharashtra. Mean Average WISCI II score for ASIA A is (5) which is ambulates in parallel bars, with no braces and no physical assistance, for 10 meters. Mean Average WISCI II score for ASIA B is (9) ambulates with walker, with braces and no physical assistance, for 10 meters. Mean Average WISCI II score for ASIA C is (8) which is ambulates with

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walker, no braces and physical assistance of one person, for 10 meters for patients admitted to tertiary hospital in western Maharashtra.

Keywords: WISCI II: walking index in Spinal Cord injury. SCI: Spinal cord injury.

INTRODUCTION

The spinal cord is part of the central nervous system (CNS). It is situated inside the vertebral canal of the vertebral column. During development, there's a disproportion between spinal cord growth and vertebral column growth. The spinal cord finishes growing at the age of 4, while the vertebral column finishes growing at age 14-18. This is the reason why, in adults, the spinal cord occupies only the upper two thirds of the vertebral canal. The spinal cord is a continuation of the brainstem. It extends from the foramen magnum at the base of the skull to the L1/L2 vertebra where it terminates as the conus medullaris (medullary co ne). A thin thread called filum terminale extends from the tip of the conus medullaris all the way to the 1st coccygeal vertebra (Co1) and anchors the spinal cord in place. Throughout its length, the spinal cord shows two well defined enlargements to accommodate for innervation of the upper and lower limbs: one at the cervical level (upper limbs), and one at the lumbosacral level (lower limbs). Like the vertebral column, the spinal cord is divided into segments: cervical, thoracic, lumbar, sacral, and coccygeal. Each segment of the spinal cord provides several pairs of spinal nerves, which exit from vertebral canal through the intervertebral foramina. There are 8 pairs of cervical, 12 thoracic, 5 lumbar, 5 sacral, and 1 coccygeal pair of spinal nerves (a total of 31 pairs). The spinal cord is made of Gray and white matter just like other parts of the CNS. It shows four surfaces: anterior, posterior, and two laterals. They feature fissures (anterior) and sulci (anterolateral, posterolateral, and posterior). The Gray matter is the butterfly-shaped central part of the spinal cord and is comprised of neuronal cell bodies. It shows anterior, lateral, and posterior horns. White matter surrounds the gray matter and is made of axons. It contains pathways that connect the brain with the rest of the body. The spinal cord and spinal nerve roots are wrapped within three layers called meninges. The outermost is the dura mater, underneath it is the arachnoid mater, and the deepest is the pia mater. Dura mater has two layers (periosteal and meningeal), between which is the epidural space. Between the arachnoid and pia mater is the subarachnoid space, it is filled with cerebrospinal fluid. The spinal cord is supplied by branches of the vertebral and segmental arteries. The vertebral artery gives rise to anterior and posterior spinal arteries. Segmental arteries, such as the deep cervical, ascending cervical, and posterior intercostal give rise to 31 pairs of radicular arterial branches which supply the roots of spinal nerves.

Spinal cord injury is damage to any part of the spinal cord or nerve at the end of the spinal canal (cauda equina) which often causes permanent changes in strength, sensation and other body functions below the site of injury or a spinal cord is trauma or lesion to spinal cord which contains white matter [ascending tracts and descending tracts] and grey matter [sensory neuron and motor neurons] that results in paralysis of muscles and affects sensory abilities and other body functions below the level of injury.

Traumatic spinal cord injury (TSCI), one of the most devastating kinds of injury, may lead to different degrees of paralysis, loss of sensory and dysfunction of bladder or bowel. TSCI not only affect one's

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health, but also generates a huge economic burden on the family and society. Non-traumatic spinal cord injury (NTSCI) is a special type of SCI that is not caused by traumatic reasons.

The etiologist of NTSCI include vertebral spondylosis (spinal stenosis), tumorous compression, vascular ischemia and congenital disease. A complete spinal cord injury occurs when a person loses a sensory and motor function below the level of the spinal cord injury. When a person with a spinal cord injury retains some function below the level of the injury, they have an incomplete spinal cord injury.

The American Spinal Injury Association (ASIA) established a grading system called the ASIA Impairment Scale to describe the severity of spinal cord injuries. The system uses the letters A through E and is as follows.

ASIA A: complete spinal cord injury with no sensory or motor function

ASIA B: incomplete sensory function with complete loss of motor function

ASIA C: incomplete motor function with some movement, but fewer than half of the muscle groups can lift against gravity with a full range of motion

ASIA D: incomplete motor function with more than half of the muscle groups able to lift against gravity

ASIA E: normal.

Spinal cord injuries are classified in general terms of being neurologically “complete” or “incomplete” based upon sacral sparing. Sacral sparing "refers to the presence of sensory or motor function in the most caudal sacral segments as determined by the examination (i.e. preservation of light touch or pin prick sensation at the S4-5 dermatome, DAP [deep anal pressure] or voluntary anal sphincter contraction). The ranking of severity is based on the severity or the impairment and not on functional independence in the environment.

Recent multicentre studies have utilized the Functional Independence Measure (FIM) to determine ambulation status following acute spinal cord injury (SCI). The FIM, however, was developed as a measure to determine the burden of care or how much assistance a person with a disability requires and may have limitations as a measure of the functional limitation (capacity) for walking.

Rehabilitative measures following spinal cord injury depend on the level of neurological deficit and the extent of damage whether it is complete or incomplete. The rehabilitative measures include the use of orthoses, crutches, walkers, canes and wheelchairs. Recovery of upper extremity strength, lower extremity motor function, sensory recovery and the prognosis for walking after an injury can be predicted based on the standardized physical examination.

Patients with an incomplete ASIA Impairment Scale (AISA) B or C typically exhibit an extensive impairment at the beginning. However, AISA B and C have a good prognosis for regaining walking function. The WISCI assessment is carried out by physical therapist. To score the WISCI/WISCI II the descriptors that relate to the present walking performance of an individual with SCI is observed. Then, appropriate level of highest walking performance is assigned to the patient. The physical therapist selects the level at which the patient is safest as observed, with patient's comfort level described in addition to this. In case other devices apart from those that have been stated in the standard definitions are used during the assessment, they should be documented as descriptors. Also, if there is a discrepancy between two observers, the record with the higher level should be selected. The patient should be observed with the WISCI level documented on using the scale rated from 0 to 20 at baseline (called the Baseline WISCI), the subject is then observed again at the defined interval (called the interval WISCI).

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The gains in walking can be obtained by simply subtracting the baseline WISCI from the interval WISCI, which is known as the "changed WISCI".

MATERIALS & METHODS

Source of data: In patient department (IPD) and Outpatient department of Neuro Physiotherapy, Dr. APJAK College of Physiotherapy. Smt. Sindhutai Vitthalrao Vikhepatil Spinal Cord Injury Rehab Centre, Dr. APJAK. College of Physiotherapy, Loni.

Study setting: This study was conducted in the In-Department (IPD) of Spinal Cord Injury Rehab Centre, Department of Neuro-Physiotherapy, Dr. APJAK COPT, PIMS, LONI

Duration of study: 6 Months

Study design: Observational study.

Sample size: 20

Study population: Patients with Spinal Cord Injury.

Equipment to be use:

1. Informed Consent
2. Patient information Sheet
3. WISCI scale II

SELECTION CRITERIA

INCULSION CRITERIA:

1. Most often (ASIA) An Impairment Scale and (AISA) B, C, and D subject
2. Patients with lumbar, thoracic and low cervical level of injury.
3. Those willing to Participate.
4. Spinal cord injury subjects who are capable of standing and walking in parallel bars will be eligible for assessment

EXCULSION CRITERIA:

1. High cervical level injury individuals
2. Patients who require Ventilator Or oxygen therapy.
3. Patients under age 18
4. Hemodynamically unstable patients.

OUTCOME MEASURES

WISCI II (Walking index for spinal cord injury II) Walking index for spinal cord injury II: It is excellently reliable (100% of agreement) and valid to reflect independence in individuals with spinal cord injury ($\rho = 0.97$)

Ethical consideration: Ethical clearance was obtained from the IEC. (DR. APJAKCOPT/BPT/UG /2023/70). All the participants were selected as per the eligibility criteria of the study. Informed consent form of all the participant were obtained. Assessment was done on participants who were within the inclusion criteria. Demographic data was recorded and baseline information was taken at the beginning of the study. Then the participants were asked to answer the questions using WISCI II (waking index in spinal cord injury II) where the WISCI II score was compared with each participant's level of injury and

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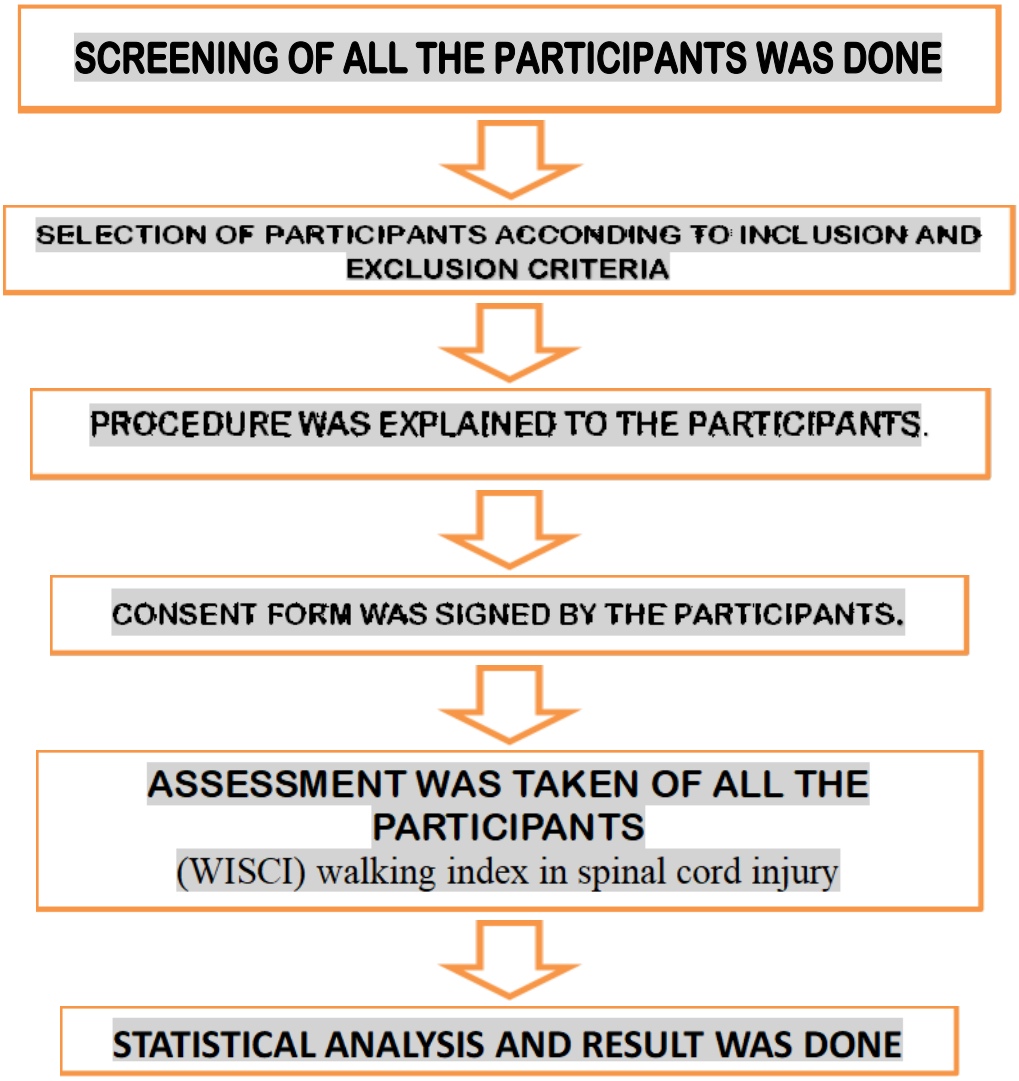
ASIA score. The ranking of scale is based on the severity of the impairment and not on functional independence in the environment.

FLOWCHART

Procedure:



RESULT

DEMOGRAPHICS -A total of 20 participants were selected according to selection criteria.

TABLE 1: MEAN AND STANDARD DEVIATION SCORE

It shows the mean value and standard deviation of Age, and WISCI II SCALE

	MEAN	STANDARD DEVIATION
AGE	27.63	8.41
WISCI II	6.45	5.52

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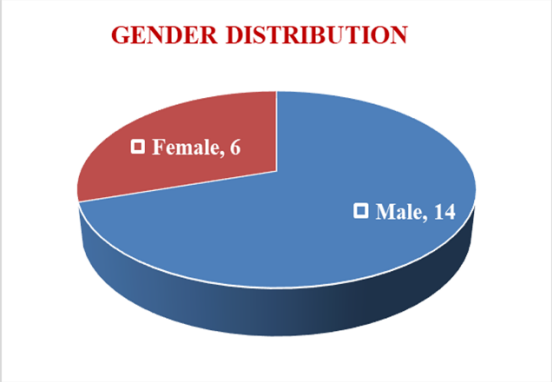

Fig 1: Gender distribution among participant

This study included a total of 20 participants out of which 27.43% (14) of the participants were males and 27.83% (6) were females as shown in chart 1. All of this participant are Spinal Cord Injury patients.

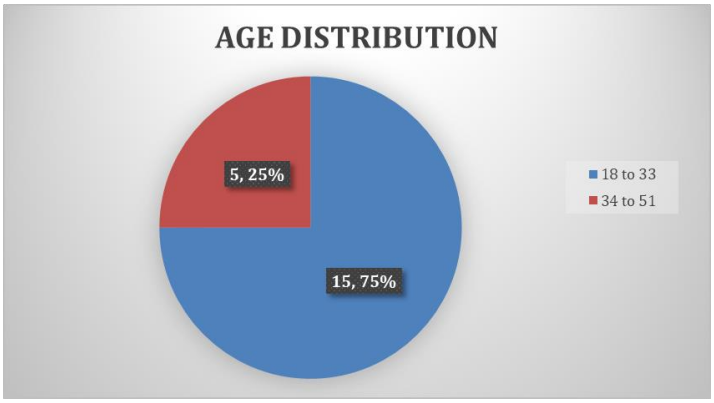

Fig 2: Age distribution among participants.

Demographic distribution of participants

Demographic characteristics	
AGE	**PARTICIPANTS**
18-33 YEARS	15
34-51 YEARS	5

This study included a total of 20 participants out of which 75% (15) of the participants were between 18 to 33 years, 5% (5 participants) were between 34-51years as shown in fig.2.

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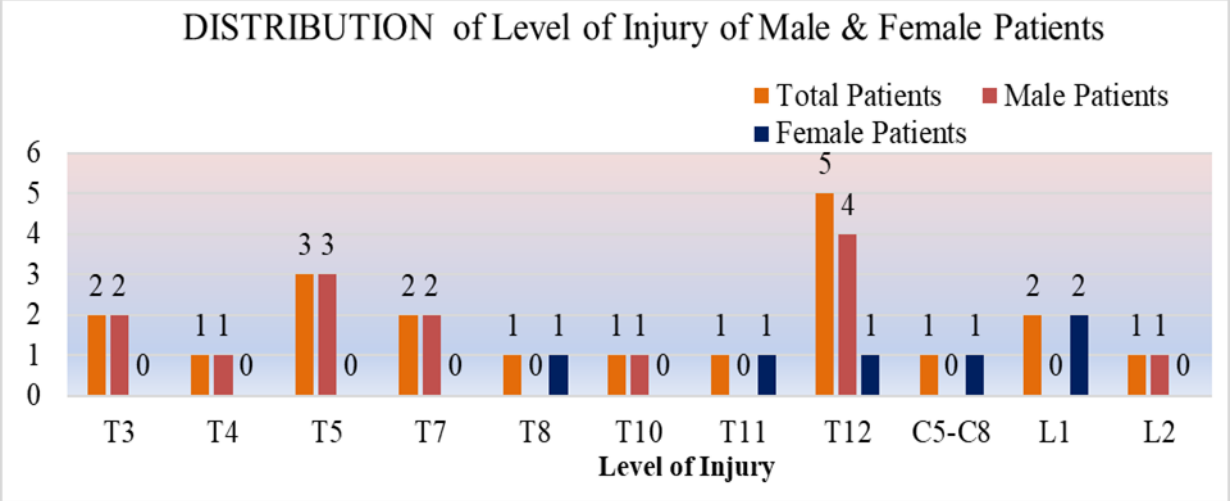

Fig 3: LEVEL OF INJURY Distribution Among Participants

Tabular representation of LEVEL OF INJURY

Level of Injury	Total Patients	Male Patients	Female Patients
T3	2	2	0
T4	1	1	0
T5	3	3	0
T7	2	2	0
T8	1	0	1
T10	1	1	0
T11	1	0	1
T12	5	4	1
C5-C8	1	0	1
L1	2	0	2
L2	1	1	0

This study included a total of 20 participants which were further categorized according to LEVEL OF INJURY.

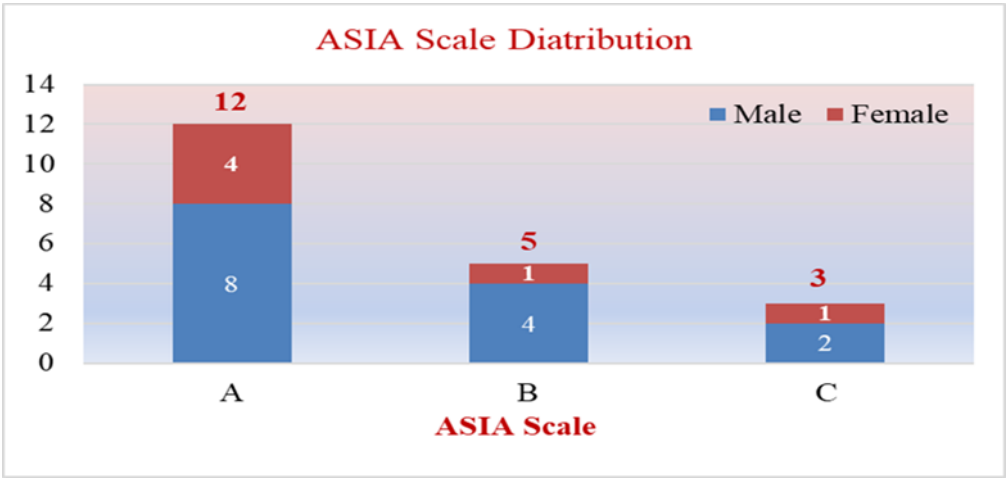

Fig 4: Distribution of participants according to ASIA SCALE

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Tabular representation of DISTRIBUTION OF ASIA SCALE

ASIA Scale	Male	Female
A	8	4
B	4	1
C	2	1

This study included a total of 20 participants which were further categorized according to their ASIA SCALE

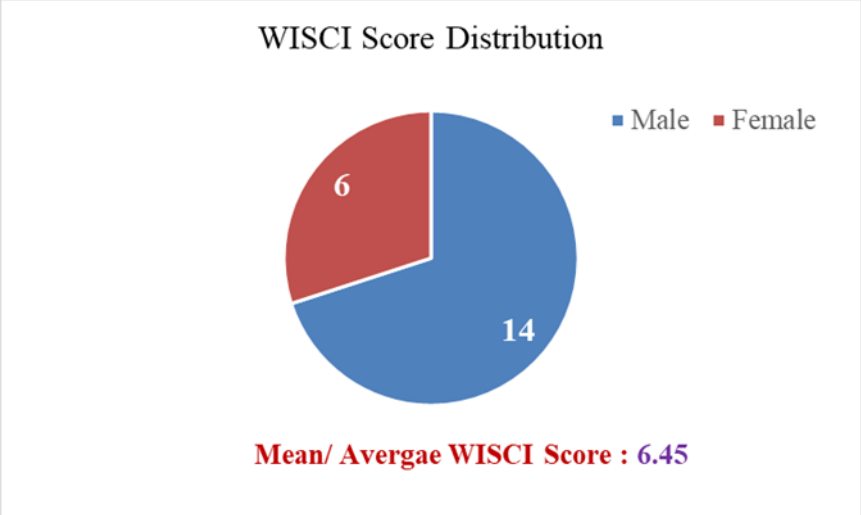

Fig 5: Distribution of participants according to their WISCI II

Tabular representation of WISCI II Score for ASIA A, B, C

Patient Sr. No	WISCI-II Score for Asia Scale A
1	6
4	5
5	1
6	3
8	9
10	3
13	3
14	3
15	15
16	3
19	9
20	0
Patient Sr. No	**WISCI-II Score for Asia Scale B**
9	16
11	20
12	3
17	3
18	3
Patient Sr. No	**WISCI-II Score for Asia Scale C**
2	12
3	3
7	9

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WISCI II was used as an outcome measure to assess if the participants had walking index after the injury and rehabilitation. The test was done by asking the participant weather he or she is walking with braces, parallel bar, orthosis, with or without assistance for 30m distance. The above chart shows the WISCI II score for ASIA A , WISCI II Score for ASIA B , WISCI II Score for ASIA C.

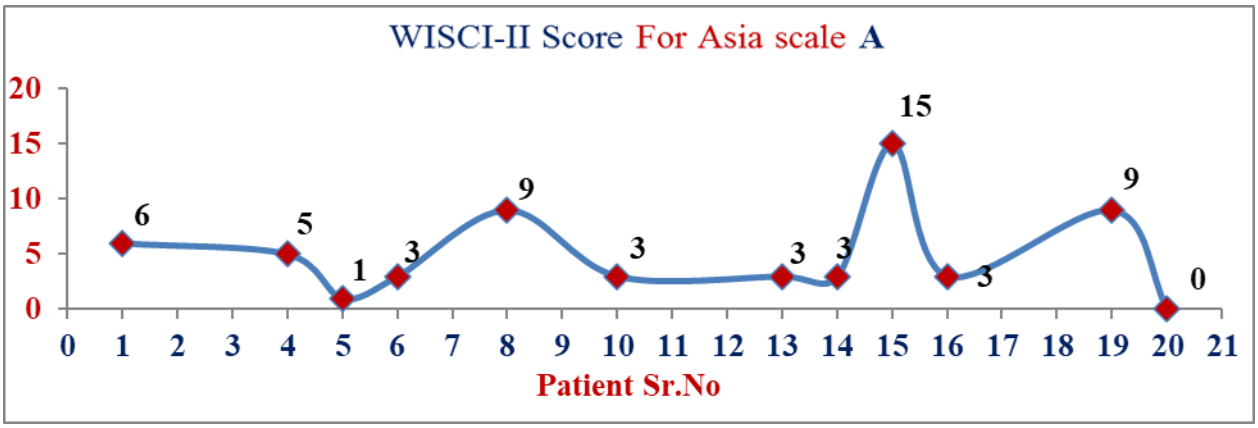

Fig 6: Distribution of participants according to their WISCI II for ASIA

SCALE A

This study included a total of 20 participants in which average WISCI II score for ASIA SCALE A was (5) (SD = 4.19) which is patients Ambulates in parallel bars, with no braces and no physical assistance, 10 meters, admitted to tertiary hospital in western Maharashtra.

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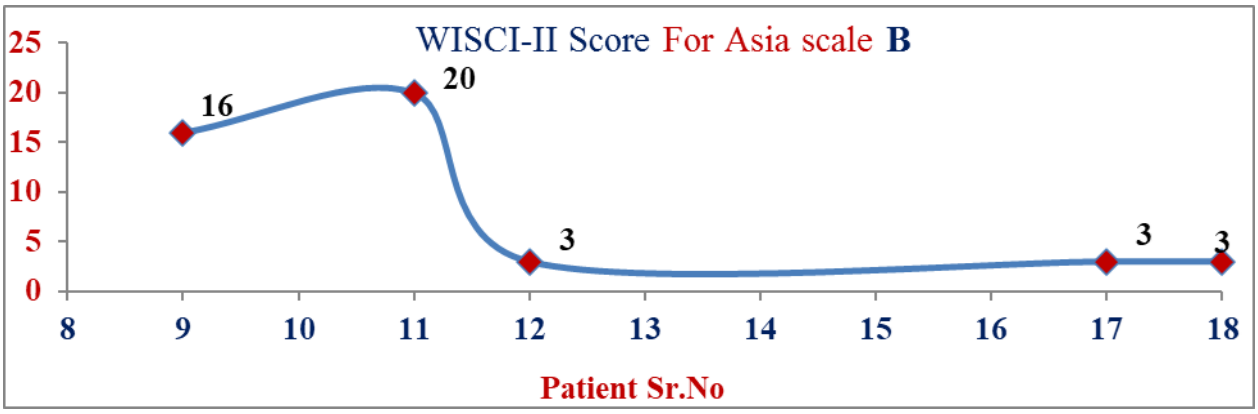

Fig 7: Distribution of participants according to their WISCI II for ASIA

SCALEB

This study included a total of 20 participants in which average WISCI II score for ASIA SCALE B was (9) (SD = 8.33) which is patients Ambulates with walker, with braces and no physical assistance, 10 meters, admitted to tertiary hospital in western Maharashtra.

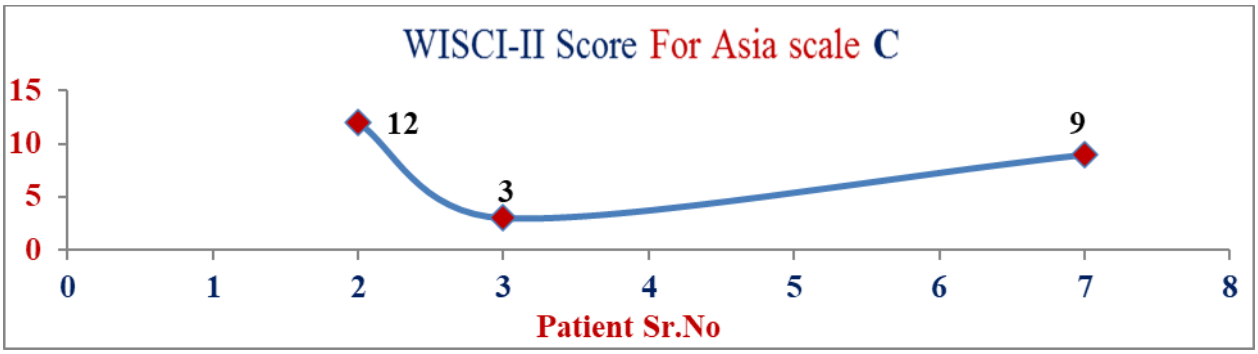

Fig 8: Distribution of participants according to their WISCI II for ASIA

SCALE C

This study included a total of 20 participants in which average WISCI II score for ASIA SCALE C was (8) (SD = 4.58) which is patients Ambulates with walker, no braces and physical assistance of one person, 10 meters, admitted to tertiary hospital in western Maharashtra.

DISCUSSION

The current study was conducted on walking index in spinal cord injury patients admitted to tertiary hospital in western Maharashtra. Most muscles in the limbs receive innervation from more than one

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spinal nerve root, and are hence comprised of multiple myotomes. For lower limb L2 is hip flexion whereas prime movers (agonist) for hip flexion are psoas major muscle and iliacus muscle.

L3 is knee extension, where knee extensors play an essential role in human movement. The one agonist muscle that extends the knee is the massive quadriceps. The quadriceps femoris consists of four individual muscles, three of the heads arise from the femur, the vastus intermedius, vastus medialis, and vastus lateralis. The fourth head, rectus femoris, arises from the hip bone. All four heads converge on the quadriceps tendon. They form the main bulk of the thigh, and collectively are one of the most powerful muscles in the body. L4 is ankle dorsiflexion, L5 is big toe extension, S1 is ankle plantarflexion, and S2 knee flexion,

Physical limitation for walking secondary to impairment is defined at the person level and indicates the ability of a person to walk after spinal cord injury. The development of this assessment index required a rank ordering along a dimension of impairment, from the level of most severe impairment (0) to least severe impairment (20) based on the use of devices, braces and physical assistance of one or more persons. The order of the levels suggests each successive level is a less impaired level than the former. The ranking of severity is based on the severity or the impairment and not on functional independence in the environment.

One notable result is that a considerable percentage of participants were assisted, WISCI II Level from (0) to (20) based on the use of the result. Participants Selection was done who are capable of standing and walking in parallel bars. Only a reciprocal gait (without the use of mechanical device i.e ARGO) is to be considered in scoring the WISCI II. Most often ASIA Impairment Scale (AIS) grade A below T10 and AIS B, C, and D subjects qualify (Ditunno 2004). AIS A subjects with a higher injury level were included in studies that use the WISCI II but typically they would function on initial assessment at the 0 level.

According to the inclusion criteria participants from age 18 above were included. Total 20 participants were included out of which 14 were male and 6 were female. As per the report WISCI II score for ASIA A were 12, then WISCI II for ASIA B were 5 and WISCI II score for ASIA C were 3. While these findings provide valuable insights into the assessment of walking index in spinal cord injury patients admitted to tertiary hospital in western Maharashtra.

A study done by Priyaranjan provides valuable insights into Walking Ability in Patients with Chronic Spinal Cord Injury. To study the walking ability in patients with spinal cord injury using the Ten-meter walk test and Walking Index for Spinal cord injury II (WISCI) scale was done and was correlated with respect to the neurological level of injury and the ASIA Impairment Scale. This study was the prospective observational cross-sectional study conducted over a period of 2 years in a tertiary-level hospital in Northern India. Walking ability in patients with chronic spinal cord injury was assessed using the WISCI II scale and a ten-meter walk test. Walking ability was correlated with the neurological level of injury and the AIS category of patients. Similarly in our study Walking ability was correlated with the neurological level of injury and the AIS category of patients admitted to tertiary hospital in western Maharashtra.

Çiğdem Çinar studied the Effect of robotic-assisted gait training on functional status, walking and quality of life in complete spinal cord injury. His purpose of this study was to investigate the effect of robotic-assisted gait training (RAGT) on functional status and the quality of life in patients with

subacute complete spinal cord injury (SCI). Evaluations were performed using the Walking Index SCI II (WISCI II) for ambulation, Functional Independence Measure (FIM) for functional status and Short Form 36 (SF-36) for the quality of life at the beginning and end of rehabilitation. However, no significant inter-group difference was noted in pre- and post-treatment FIM and WISCI II change scores. However, on the contrary our study showed no similar significance but evaluation used was WISCI II which is similar in our study for ambulation for patients admitted to tertiary hospital in western Maharashtra.

The Walking Index for Spinal Cord Injury (WISCI) is a scale that measures the type and amount of assistance (in terms of requirements of assistive devices, or human helpers) required by a person with spinal cord injury (SCI) for walking. It is an ordinal scale which rates people with SCI from being unable to walk to independent walking and designed to indicate the grades of impairment occurring after SCI and their relationship to the function of walking.

CONCLUSION

The present study concludes strong relation between WISCI II and ASIA A, B, C for patients admitted to tertiary hospital in western Maharashtra**.** Mean Average WISCI II score for ASIA A is (5) which is aambulates in parallel bars, with no braces and no physical assistance, for 10 meters. Mean Average WISCI II score for ASIA B is (9) ambulates with walker, with braces and no physical assistance, for 10 meters. Mean Average WISCI II score for ASIA C is (8) which is ambulates with walker, no braces and physical assistance of one person, for 10 meters for patients admitted to tertiary hospital in western Maharashtra.

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