

Effect of Task Specific Exercise Program in Improving Balance for Patients Between T6-T12 Spinal Cord Injuries - A Review Study

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Abstract: ***Aim:** To investigate the evidence on the effect of task-specific exercise programs in improving balance for patients between t6-t12 spinal cord injuries. **Methodology:** A comprehensive search on PUB med, google scholar, and Cochrane library, using keywords like spinal cord injury T6 & below level, balance training, task-specific training, trunk control, standing balance by using AND, OR. Randomized control trials and systematic meta-analysis were taken, published in English between 2008-2022, and reviewed. **Results:** 23 studies were identified through database searching, and eight articles were selected according to inclusion criteria. The result of this review provides evidence that task-specific exercise program is effective for balance in spinal cord injuries. **Conclusion:** Based on studies analyzed in the review, task-specific training improves balance, muscle strength, and coordination in spinal cord injury patients through specific tasks.*

Keywords: Spinal cord injury T6 & below level, Balance training, Task-specific training, Trunk control, Standing balance

1. Introduction

Spinal cord injury (SCI) is a serious medical condition often resulting in severe morbidity and permanent disability. In SCI, axons of nerves passing through the spinal cord are disrupted, leading to loss of motor & sensory function below the level of injury, which results in severe morbidity & permanent disability. Injury is usually the result of significant trauma, and primary injury is often irreversible. (1)

The incidence of spinal cord injury is between 10 and 80 cases/million/year, in that half of the people are aged under 30 years. Males are more affected when compared to females. Only 15% of SCI are affected by females. Over 55% of all SCI are cervical; the remaining thoracic, lumbar, and sacral are equally distributed. C5 is the most common level of injury, followed by C4, C6, and T12. (2)

The most common causes of spinal cord injuries are road traffic accidents, gunshot injuries, knife injuries, falls & sports injuries, direct trauma to the spinal cord, compression (fractured vertebrae), masses (epidural hematoma/abscess) & less commonly compromised blood flow. (3)

SCI damages not only the spinal cord but also independence & physical function and leads to complications; like neurogenic bladder & bowel, urinary tract infections, pressure ulcers, orthostatic hypotension, and fractures. It also damages deep vein thrombosis, spasticity, heterotrophic ossifications, contractures, autonomic dysreflexia, pulmonary & cardiovascular problems, and depressive disorders, which leads to comprise in patient life expectancy & quality of life. (3)

T6-T12 Injuries Symptoms: (2)

Usually, people between t6-t12 level injuries have good upper limb control; based on the level of injury (higher/lower thoracic), they have partial/complete paralysis of the trunk. But people between T6-T12 have weak/paralyzed intercostals, abdominals, and total paralysis of lower limbs. Most of them are wheelchair dependent, and some can walk a short distance with the help of braces.

How balance is affected in SCI: (4)

- Usually, balance/postural stability maintenance is dependent on the continuous integration of somatosensory, visual & vestibular inputs, their processing, and targeted motor responses.
- Sudden loss of sensory inputs from body segments and loss of voluntary motor control below the neurological level of spinal cord injury cause compromised/loss of balance, postural sway, decreased precision, and delayed response to external perturbation in spinal cord injury patients.

Task-specific exercises:

Task-specific training is a term that has evolved from movement science and motor skill learning, where patients practice context-specific motor tasks and receive some form of feedback. Task-specific training focuses on functional studies rather than impairment which helps to improve performance in operational tasks through goal-directed practice and repetition. (5)

Task-specific exercises focus on: (6)

- Maintaining antigravity posture
- Anticipatory postural control during voluntary self-initiated movements.
- Reactive postural control during unexpected perturbation

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Sitting unsupported is very important for spinal cord injury patients (which is affected due to trunk muscle paralysis) because many activities of daily living are performed in this position. Task-specific exercise programs improve balance through intensive & repetitive practice of purposeful activities. (7)

During task-specific training, the neuromuscular system is activated below the level of injury by the repetitive and progressive approach to the desired task. Through this activity, dependent plasticity develops, which helps in functional reorganization and helps to improve balance. (8)

Inclusion criteria:

- Patients with T6-T12 level of Spinal cord injuries.
- Patients with incomplete spinal cord injuries.
- Spinal cord injury for any reason (trauma, tumors, infection, etc.)
- Age group -20 to 35 years (most common age).

Exclusion criteria

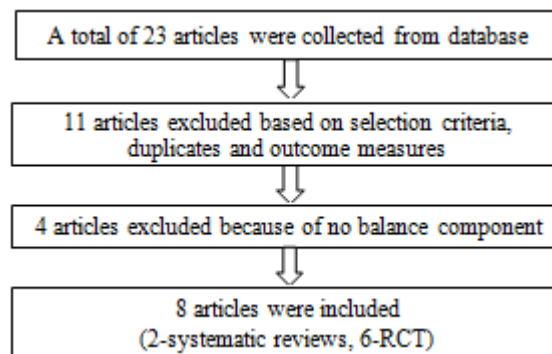
- Spinal cord injuries with any associated injuries.
- Mentally unstable patients.
- Patients with brain insult.
- Patients who are not able to follow commands.
- Patients who are not cooperative

2. Methodology

Source: A comprehensive search on PubMed, google scholar, and Cochrane, using keywords like spinal cord injury T6 & below level, balance training, task-specific training, trunk control, and standing balance.

Study selection: randomized control trials and systematic meta-analysis were taken, which fulfilled the criteria like studies published in English between 2008-2022.

Objective: The study aims to determine the effectiveness of task-specific exercise programs in improving balance for patients with T6 & below spinal cord injuries.



3. Review of Literature

S. No.	Author, year	Title	Methodology	Results
1	Cynthia M. tse, amandaE. chisholm, 2018. (6)	Effectiveness of task-specific rehabilitation interventions for improving independent sitting and standing function in spinal cord injuries.	The systematic review consists of 19 articles: three-rct, two prospective controlled trials, one cross-over study, nine pre-post studies, and four prospective cohort studies. Participants over 16 years with sci, regardless of type and method of injury, are included. Outcome measure: PEDro scale	Some articles stated that Task-specific exercise benefits sitting and standing balance. Some studies said that there is a small or negligible effect on balance.
2	Beverly French, Thomas LH, Jacqueline coupe, 2016. (9)	Repetitive task training for improving functional ability after stroke	A systematic review had 18 years old stroke patients. Outcome measures are upper limb function/reach test, sitting balance/reach test, standing balance-timed up and test, walking distance, and speed, and Berg balance scale. Treatment involves reaching activities, sit-to-stand, bending &reaching tasks for 2 to 4 weeks. Outcome measures: upper limb function/reach test, sitting balance/reach test, timed up, and test.	There is a little improvement in hand& arm function, walking &balance after repetitive task training.
3	Margaret K. Y. mak, christina, 2008. (10)	Cued task-specific training is better than exercises in improving sit-to-stand in patients with Parkinson's disease	The randomized control study had 52 participants divided into three groups audio-visual (Av) task-specific training (19), the experimental group (19), control group (14). AV Group has cued sit-to-stand task-specific training for 20 minutes, three times/week; the experimental group has mobility and stretching exercises for flexors &extensors of trunk, hip, knee, and ankles, followed by sit-to-stand practice for 45 minutes, two times/week. The control group has no treatment. Outcome measures: VICON motion analysis system	There is a significant improvement in the AV group in decreasing sit-to-stand completion time compared to the experimental and control groups.
4	Seo HS, Lee JH, 2014. (11)	Effect of task-specific exercise program on balance, mobility &muscle strength in the elderly	Thirty participants are taken having 65 years of age and grouped into falling and non-falling groups. People who experienced falls over two times in the past six months were included in the falling group. Intervention includes task-specific exercise programs having three stages. Outcome measures: K-ABC and POMA (Korean version of the Activities-Specific Balance Confidence Scale and Performance-Oriented Mobility Assessment)	The increase in muscle strength was less in the falling group than in the non-falling group. This article said that task-specific exercises enhance lower extremity muscle strength and balance in elders who experience falls.
5	Boswell-Ruys,	Training unsupported	Randomized control study having 30 participants having	The training group shows

	LA Harvey, 2009. (7)	sitting in people with chronic spinal cord injuries	spinal cord injury for at least one year. Every 15 members participated in a training group and a control group. Interventions are unsupported sitting position with hips and knees flexed to 90 degrees & feet on the floor, tasks that involve moving the upper body over & outside the base of support for 1 hour 3 times/week for six weeks. The control group has no treatment; only the training group receives treatment. Outcome measure: Canadian Occupational Performance Measure (COPM), tests of Upper Body Sway, T-shirt test.	moderate improvement in sitting balance in spinal cord injuries.
6	Choi JH, Kim BR, Han EY, Kim SM, 2015. (12)	The effect of dual-task training on balance and cognition in patients with subacute post-stroke	RCT consists of 20 participants (12 males & 8 females). The dual-task group has conventional physiotherapy for 30 minutes/day for four weeks and dual-task training. The control group has traditional therapy and balance training using a balance board 30 minutes/per day for five days/week for four weeks. Outcome measure: Berg Balance Scale for balance ability	Participants who had dual-task training showed improved balance ability compared to balance training in patients with subacute stroke.
7	MohamedE. khallaf, 2020. (13)	Effect of task-specific training on trunk control & balance in patients with subacute stroke	Randomized control study: 34 participants are categorized into two groups: the study group (17) receiving task-specific training and the control group (17) undergoing conventional therapy. The treatment session is 60 minutes, three times /per week for ten weeks. Outcome measure: trunk impairment scale (TIS), postural assessment scale (PAS), and functional reach test (FRT)	The study group shows more improvement with task-specific training compared to the conventional therapy receiving control group.
8	Halvarsson A, Franzen E, Stahle A, 2015. (14)	Balance training with multi-task exercises improves fall-related self-efficacy, gait, balance performance & physical function in older adults with osteoporosis	Randomized control study, 96 participants are taken having 66-87 years grouped into three groups, the training group (34) had only balance training, the training group with physical activity (31) had balance training along with physical activity, and the control group (31) has no treatment at the end has balance training for three times/week for 12 weeks & physical activity for 30 minutes, three times/week. Outcome measures: one leg test & modified figure of 8 test.	Each group shows improvement in balance and lower extremity physical function compared to the control group. So it is effective for improving balance and fall-related issues.

4. Conclusions

Based on studies analyzed in the review, I concluded that task-specific training improves balance, muscle strength, and coordination in spinal cord injury patients through specific tasks. Task-specific training is a core element of many interventions like motor relearning/movement sciences approaches or to force the use of the limb in daily activities, as in the constraint-induced movement therapy (CIMT) approaches. Equipment or virtual environments may also facilitate the movement or learning environment. Focus on functional tasks rather than impairment helps to improve performance. Repetitive functional task practice helps activate the neuromuscular system below the level of injury through the repetitive and progressive practice of the desired task. It also helps in gaining activity-dependent plasticity and helps to improve functional reorganization and improve balance.

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