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Impact of Core Stability Training Combined with Ems to Enhance Balance and Transfer Technique in Post-Dengue Spinal Cord Injury Patient - A Case Report

Dr. Shubham Vinay Gajare[1], Dr. Komal Gunjal[2]

[1]PG Student, Dr. APJ Abdul Kalam College of Physiotherapy, Loni, Ahmednagar, Maharashtra, India
Corresponding Author Email: *shubhamphysio8249[at]gmail.com*

[2]Associate Professor Neuro-physiotherapy, Dr. APJ Abdul Kalam College of Physiotherapy, Loni, Ahmednagar, Maharashtra, India
Email: *komal.physio[at]rediffmail.com*

Abstract: ***Purpose**: Purpose of this study is to check impact of core stability training combined with EMS to enhance balance and transfer technique in post-dengue spinal cord injury patient. **Relevance**: Spinal cord lesions associated with dengue should be considered in patients from endemic regions. Spinal cord involvement may occur between two days to more than two weeks after the first symptoms of infection. **Participants**: A single case study of 46-year-old male with a history of SCI since 6 months. **Methods**: A single case study of SCI with bilateral lower limb Paralysis with right Upper limb Weakness. **Analysis**: Analysis was done on the basis of interpretation provided by the individual scale used for the assessment. **Results**: The values of FIST increased from 12 to 48 and score of TAI 3.0 improved from 5 to 8 for both Part 1 and 2. **Conclusion**: Considerable improvement was seen in balance and Transfer training. It was observed that the integrated physiotherapy protocol has helped in improving the patient with transvers myelitis. **Implications**: The findings suggest that this combined approach may significantly improve functional mobility and overall rehabilitation outcomes. It suggests that such interventions may be integral in clinical practice.*

Keywords: EMS, FIST, TAI 3.0, SCI

1. Introduction

Spinal cord injury (SCI) is a severe and life-altering condition that can result from various causes, including traumatic events, infections, or diseases such as dengue fever, which may lead to neurological deficits and impair physical function.

Spinal cord lesions associated with dengue should be considered in patients from endemic regions. Although dengue fever is fraught with common complications like bleeding problems, electrolyte abnormalities, renal failure, and other systemic complications, spinal and neurologic complications like encephalopathy, acute disseminated encephalomyelitis, encephalitis, Guillain-Barré syndrome, and transverse myelitis have also been reported, particularly at the time of dengue epidemics. Dengue infection can range from subclinical to symptomatic with clinical dengue diseases such as dengue fever, dengue hemorrhagic fever (DHF), dengue encephalitis, and expanded dengue syndrome (EDS).

Spontaneous spinal hematomas with or without associated etiologic factors have been reported to some extent in literature, but spinal hematomas following dengue fever have been rarely reported.[2] Both intradural and extradural hematomas can occur after dengue fever. Prognosis regarding recovery of weakness or establishment of bladder/bowel control following spontaneous spinal hematomas is usually poor.

Plasma leakage and intrinsic coagulopathy are the main pathophysiological changes involved in DHF. Development of active bleeding with moderate thrombocytopenia and normal clotting profile may be explained by platelet functional defects which are known to occur during dengue infection.

In particular, patients with SCI are prone to impaired balance and reduced functional movements, including the ability to transfer from one surface to another (e.g., from a wheelchair to a bed). This impairment can be due to a combination of muscular weakness, loss of postural control, and neurological deficits.

Core stability plays a vital role in enhancing postural control, balance, and functional mobility, which are crucial for performing transfer techniques. The core musculature is essential in maintaining spinal alignment and enabling coordinated movement patterns.

EMS is one such adjunctive therapy that has been studied for its ability to stimulate muscle contractions through electrical impulses. EMS is believed to have beneficial effects on muscle strength, endurance, and functional mobility, especially in patients with reduced voluntary muscle control. When combined with traditional core stability training, EMS may provide synergistic benefits by further activating dormant or weakened muscles, facilitating improved trunk control and functional movement, particularly in balance and transfer techniques.

Need of the Study

Spinal cord injury (SCI) following dengue fever, though uncommon, can lead to severe impairments in trunk stability,

balance, and transfer ability, significantly limiting functional independence. While core stability training is known to enhance postural control, and Electrical Muscle Stimulation (EMS) has shown potential in improving neuromuscular activation in patients with impaired voluntary control, there is a lack of evidence on their combined application in post-dengue SCI rehabilitation. Existing protocols often rely solely on conventional strengthening, which may be insufficient to achieve optimal trunk activation and functional transfers in this population. Therefore, this study is needed to explore whether integrating core stability exercises with EMS can provide superior improvements in balance and transfer technique, offering a novel and clinically applicable approach for enhancing independence in post-dengue SCI patients.

2. Case Study

A 37-year-old male presented with on-and-off fever (102ºF) for four days and generalized weakness in both upper and lower limbs (UL<LL). All necessary investigations were performed in hospital. On evaluation, the patient was diagnosed with dengue fever with thrombocytopenia. For which he was admitted for 3 days in the duration of which he received 4 units of Random donor platelets (RDP). After 2 days patient developed left arm and back pain which did not resolved even after providing medication. But he experienced severe back pain along with progressive weakness and numbness in both lower limbs with urinary retention. After which he was investigated with an MRI of cervical spine and WSS which revealed an epidural hematoma from C3 to D7 with significant cord compression. On 16th July, he underwent emergency laminectomy and evacuation of the epidural hematoma. After which he had been refered for Physiotherapy.

Upon Examination,
Sensation loss from L1 (Grade 0) and Light touch altered from T9 to L1 (Grade 1)
Muscle tone reduced in bilateral lower limb.
Deep tendon reflexes reduced in bilateral lower limbs.
Manual muscle testing for lower limb was reduced (Grade 1)
Dynamic sitting/standing balance was affected which was assessed by Function in sitting test pre and post treatment.
Self transfer was affected which was assessed by Transfer Assessment Instrument 3.0 pre and post treatment.


T1 Sagittal image (Cervical)


T2 Sagittal image (WSS)

Protocol

Phases	Exercise	Duration	Volume	Frequency
PHASE 1 (Week 1–2)	1. EMS-SF: Surge interval 2 / Surge duration 4	12 min		Monday–Saturday
	2. Conventional treatment • PROM for B/L lower limbs • Joint compression for LL joints • Self-Stretching (TA, Hamstring) • Bed mobility • Core Strengthening Ex. (Abdominal curls / Lateral obliques)	5-10 min	10 Reps*3 Sets 5reps*20sec hold*3set 10reps*3sets 3reps each side 10reps*2sets	
	3. Core stability training • Spinal twists • Heel touch • Push Ball side to side • Roll a car on table	5 min each	10 reps × 2 sets	
	4. Transfer Training with maximal assistance	5 min	5 reps × 2 sets each side	
PHASE 2 (Week 3–4)	1. EMS-SF: Surge interval 2 / Surge duration 4	12 min		Monday–Saturday
	2. Conventional treatment • PROM for B/L lower limbs • Standing by using frame • Self-Stretching (TA, Hamstring)	5-15 min	10 Reps*3 Sets 10reps*3sets 3reps each side	

	• Bed mobility • Core strengthening Ex. (Abdominal curls / Lateral obliques / Pelvic bridging / Back extensor exercise)		10reps*10sec Hold*3sets	
	3. Core stability Training • Multidirectional reachouts beyond BOS with wedge support • Multidirectional Ball catch and throw with wedge support • Pullover side-side with theraband • Task Specific training	5 min each	10 reps × 2 sets each side	
	4. Transfer Training with minimum support (Slideboard)	5 min	5 reps × 2 sets each side	
PHASES	EXERCISE	Duration	VOLUME	Frequency
PHASE 3 (Week 5–6)	1. EMS-SF: Surge interval 2 / Surge duration 4	12 min		Monday–Saturday
	2. Conventional treatment • PROM for B/L lower limbs • Standing with KAFO in Parallel bar • Self-Stretching (TA, Hamstring) • Bed mobility • Core Strengthening Ex. (Abdominal curls / Lateral obliques / Pelvic bridging / Back extensor exercise)	5-10 min	10 reps × 3 sets 5 reps × 20 sec hold × 3 sets 10reps*3sets 3reps each side 10reps*10sec Hold*3sets	
	3. Core stability training • Multidirectional reachouts on swiss ball • Punching on Pillow • Multidirectional ball catch and throw without support • Balancing on Horizontal wobble board	5 min each	10 reps × 2 sets × each side	
	4. Transfer Training without assistant	5 min	5 reps × 2 sets × each side	

Progression

Figure 1 and 2: Abdominal Curls

Progression

Figure 3 and 4: Transfer Training

Progression


Figure 5 and 6: Ball Catch and Throw


Figure 7 and 8: Pressure Biofeedback using Aneroid Sphygmomanometer

Figure 9: Multidirectional reachouts on swiss ball

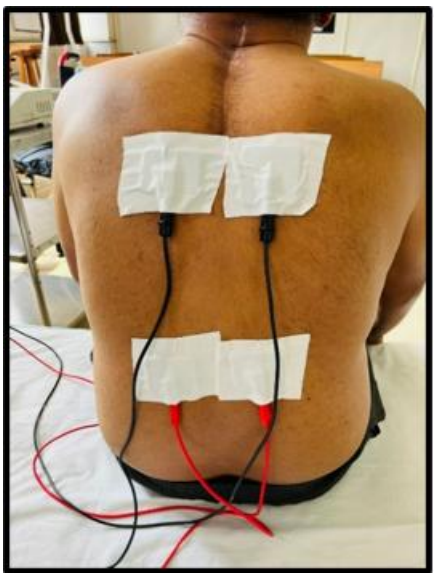

Figure 10: EMS for Paraspinals

Outcome Measure

Outcome Measures	Pre- Test	Post- Test
Function in sitting test	12	48
Transfer Assessment Instrument 3.0	5 (Part 1 and 2)	8 (Part 1 and 2)

3. Result

As per the chart no.1 the score of FIST improved from 12 to 48 and chart no. 2 the score of TAI 3.0 was improved by 5 to 8. As significant improvement was observed.

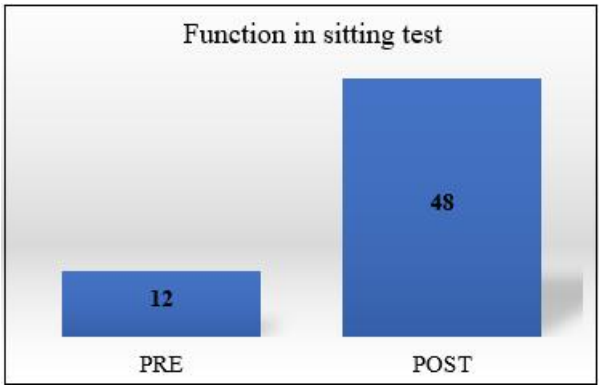

Chart 1

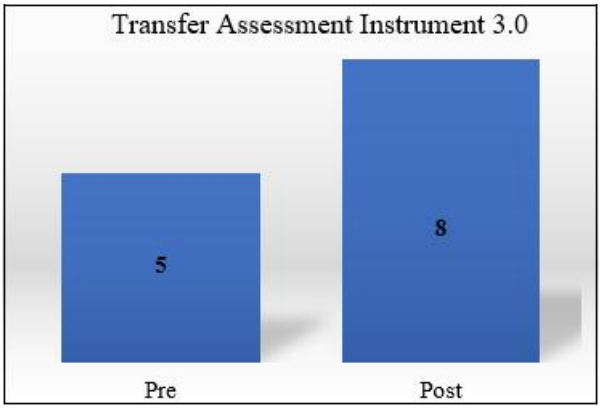

Chart 2

4. Discussion

This case demonstrates that the combination of Core Stability Training (CST) and Electrical Muscle Stimulation (EMS) led to meaningful improvements in balance and transfer ability in a patient with post-dengue spinal cord injury (SCI). Dengue-associated SCI is a rare but functionally devastating complication, often resulting in impaired trunk control and mobility limitations. Rehabilitation strategies for such patients are poorly documented, highlighting the clinical relevance of this report.

Following a structured CST+EMS intervention, the patient showed remarkable gains in sitting balance, as evidenced by the Function in Sitting Test (FIST) score improving from 12 (pre-test) to 48 (post-test). This represents a shift from severely impaired sitting function to near-functional independence, reflecting enhanced static and dynamic postural control. These findings align with previous studies showing that core stabilization training improves trunk endurance, balance, and functional reach in individuals with SCI. Maffiuletti et al. (2011) observed that EMS, when combined with traditional strength training, significantly enhanced muscle strength and endurance, even in individuals with neurological impairments such as SCI.

Moreover, transfer performance, assessed using the Transfer Assessment Instrument (TAI 3.0), improved from 5 to 8 points (Part 1 and 2). This indicates enhanced movement sequencing, weight-shift control, and safety during transfers. Previous literature on NMES-assisted trunk activation has shown similar benefits in improving reach, trunk extension moments, and sitting stability, supporting the synergistic role of EMS in enhancing motor output during functional transitions. The study by Sloot and van der Woude (2014) emphasized the importance of balance training in SCI rehabilitation, highlighting that improvements in balance are essential for enhancing the patient's ability to perform daily functional tasks, including transfers.

The mechanistic basis for these improvements may involve increased neuromuscular recruitment via EMS, particularly of partially denervated or inhibited trunk muscles, combined with improved anticipatory postural adjustments via CST. The integration of task-specific transfer practice likely facilitated motor learning and carryover to daily function.

Compared to conventional rehabilitation alone, this combined approach appears to provide greater functional efficiency, particularly in cases where voluntary trunk activation is insufficient. While the single-case design limits generalizability, the magnitude of change across both objective measures suggests that CST+EMS may serve as a promising rehabilitation strategy for post-infectious SCI.

5. Conclusion

The integration of EMS with core stability exercises appears to facilitate muscle activation and enhance the effectiveness of rehabilitation, enabling the patient to perform essential movements like transferring from one surface to another more effectively. While the outcomes observed in this case are promising, further research with larger sample sizes and more robust study designs is needed to validate these findings and establish standardized protocols.

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