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Title: PROGRESSIVE SENSORIMOTOR CONTROL TRAINING ON PROPRIOCEPTION, NEUROMUSCULAR FUNCTION, BALANCE AND GAIT PARAMETERS IN PATIENTS WITH DIABETIC NEUROPATHY

Keywords: motor nerve function, electromyography, static balance, dynamic balance, spatiotemporal parameters

ABSTRACT

OBJECTIVES: To measure the changes in the sensory function, electrophysiological parameters (nerve conduction studies and EMG activity of lower limb muscles), balance measures and spatiotemporal parameters of gait after sensorimotor training in patients with DPN.

METHODS: Thirty seven subjects were recruited on the basis of eligibility criteria. The patients allocated to the intervention group received sensorimotor training, diabetes and foot care education; and control group received diabetes and foot care education only. The sensorimotor training consist of 10 different types of exercises and conducted thrice a week for eight weeks. Each session was comprised of 10 min of warm-up, followed by 50-60 min of exercise, followed by 5-10 min of cool down. Diabetes and foot care education was conducted once in two weeks for 30 min. The study design was a two arm; parallel group randomized controlled trial with single blinding (blinding of outcome assesser). Outcome measures are Michigan neuropathy screening instrument (MNSI) score (questionnaire and assessment) and vibration perception threshold, proprioception (front, back, left, right), nerve conduction studies of peroneal and tibial nerve, EMG activity of tibialis anterior, medial gastrocnemius, vastus lateralis and multifidus muscles during eyes open and eyes closed postural task and treadmill walking, COP range (front, back, left, right), COP sway (front-back, left-right) with visual feedback and without visual feedback conditions, one leg stance (OLS), functional reach test (FRT), time up and go test (TUG) and berg balance scale (BBS), reaction time (front, back, left, right), and spatiotemporal parameters of gait.

RESULTS: Time×group interaction was found to be significant for MNSI questionnaire (p = 0.008) and physical assessment (p = 0.008), and proprioception front (p = 0.038), back (p = 0.043), and left (p = 0.014) direction and group effect was found to be significant only for proprioception in front ($p = 0.038$) direction. Time×group interaction was found to be significant only in conduction velocity of peroneal nerve ($p = 0.023$) and latency of tibial nerve ($p = 0.03$).

MVIC of medial gastrocnemius ($p = 0.001$) and multifidus ($p = 0.004$) showed significant time×group interaction During eyes open standing position, time×group interaction was significantly in the muscle activity of tibialis anterior ($p = 0.012$), where as medial gastrocnemius ($p = 0.004$), and multifidus ($p \leq 0.006$) showed significant time×group interaction in both eyes open and eyes closed standing. During treadmill walking group effect and time×group interaction was found to be significant only for the multifidus activity ($p = 0.003$ and $p = 0.004$ respectively).

Group effect was found to be significant only during eyes closed OLS in right leg ($p = 0.05$), whereas time×group interaction effect was found in eyes open OLS in right leg ($p = 0.006$) and eyes closed OLS in left leg ($p = 0.042$). COP range showed significant time effect in all directions (Front: $p = 0.001$; back: $p < 0.001$; left: $p = 0.001$; right: $p = 0.001$), group effect in front ($p = 0.028$), left ($p = 0.028$) and right direction ($p = 0.05$), and time ×group interaction in front ($p = 0.028$) and back ($p = 0.045$) direction. FRT, TUG and BBS showed significant time×group interaction ($p = 0.033$, $p = 0.011$ and $p = 0.001$ respectively) whereas group effect was found to be significant for FRT ($p = 0.041$) and TUG ($p = 0.001$).

Time×group interaction showed significant effect for velocity at both paces (at self paced: p = 0.018; at maximal paced: p = 0.014) whereas time×group interaction was found to be significant for stride length (p = 0.011) at self paced, and cadence (p = 0.049) and gait cycle (p = 0.05) at maximal paced. Double limb support was found to be significant group effect (p = 0.012) and time×group interaction (p = 0.012) at self-paced walking. Double limb support at maximal paced showed only significant group effect (p = 0.047).

CONCLUSIONS: Specific progressive sensorimotor training helps in improving clinical symptoms of neuropathy, enhances proprioceptive sensation and has capability to partial regeneration or restoration of nerve function which is a novel finding and has not been reported earlier. Due to better sensory feedback, sensorimotor exercises provide beneficial changes in the activity of muscles around the ankle joint and multifidus during postural task and walking being reported for the first time. Enhanced proprioceptive sensation and motor response improves static, dynamic and functional balance measures. Also improves spatiotemporal parameters of gait at self-paced as well as maximal paced walking.