Original Research

Role of Balance Training in Bilateral Foot Drop Following Guillain-Barre Syndrome: Pretest- Posttest Research Design

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Abstract

Guillain-Barre syndrome (GBS) is a debilitating condition characterized by acute or sub-acute autoimmune inflammation affecting the peripheral nervous system. One of its most common residual defects is bilateral foot drop, significantly impairing balance, and functional independence. This article investigates the efficacy of balance training in patients with bilateral foot drop post-GBS. The study, conducted on 18 patients, aimed to assess the impact of balance exercises, including Swiss ball and wobble board exercises, over three weeks. Baseline assessments were conducted using the Berg Balance Scale, Functional Independence Measure, and Hughes GBS Disability Scale. Results showed significant improvements in balance, functional independence, and disability scores post-intervention. GBS typically presents with pain, weakness, paresthesia, and decreased reflexes, leading to various functional limitations. Rehabilitation strategies must address these challenges early on, emphasizing posture, range of motion, and muscle strength to prevent contractures and improve function. Correcting foot drop is crucial for restoring functional capacity and independence. Balance is a key aspect of functional recovery in GBS patients, as it affects mobility and reduces the risk of falls. Balance training targets proprioception, muscle strength, and coordination, facilitating improvements in postural control and gait. The study's findings suggest that balance training effectively enhances outcomes for individuals with bilateral foot drop post-GBS. However, it is essential to consider the self-limiting nature of the disease and the potential for spontaneous improvement over time. Long-term follow-up studies are warranted to evaluate the sustained benefits of balance training and the natural course of recovery in GBS patients. The article underscores the multidisciplinary approach required for GBS rehabilitation, involving physiotherapy, neurology, and other healthcare professionals. By addressing the complex impairments associated with GBS, tailored rehabilitation programs can optimize functional outcomes and improve the quality of life for affected individuals.

Keywords: Guillain-Barre syndrome, balance training, bilateral foot drop, functional independence

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Introduction

Guillain-Barre syndrome is an acute or sub-acute autoimmune, inflammatory demyelinating[2] condition with radiating features[3], involving the peripheral nervous system. It leads to axonal damage[1] following infection or stimulation of immune system[4] and progresses rapidly with reaching severity within 4 weeks. The disease is infrequent, affecting 0.81- 1.89 per 1,00,000 persons per year[5]. The incidence is proportional to the age and increases by 20% for every 10 year increase in age [6], with 40 years as mean age of onset, infrequently affecting children and men getting 1.5 times more affected than women (ratio- 3:2)[4]. The variants of GBS are classified into demyelinating and axonal types with axonal variant including AMAN (acute motor axonal neuropathy), AMSAN (acute motor sensory axonal neuropathy), MFS (miller fisher syndrome) and the demyelinating variant including AIDP (acute demyelinating polyneuropathy)[7]. Patients with GBS present with pain[3], followed by weakness in the bilateral limbs which is usually ascending, paresthesia or dysesthesias[5], decreased or absent deep tendon reflexes in the affected limbs, cranial nerve involvement, balance and gait disorders. 60% of people have mild residual deficits predominantly in lower limbs for as long as 2 years post GBS making the recovery incomplete [10].The residual deficits include bilateral foot drop (30%), limb weakness (8%), paresthesia's (38%), unsteadiness of gait (37%), painful hands or feet (24%), severe fatigue (22%), are flexia (5%), psychological problems and reduction in leisure activities (44%)[11].

Distal weakness in lower limbs is observed as the most common residual deficit following GBS resulting in foot drop which is usually bilateral[3] as GBS affects both sides of the body characterized by weakness in dorsiflexion. This is due to severe wasting of anterior tibialis muscle[8,9] by damage of common peroneal nerve in the anterior portion of the leg and demyelination of axons [12,13]. This position impairs balance by shifting the body & center of mass to the less affected side, causing a disruption in symmetrical weight shifting in response to external movement. In addition to increasing lower extremity stiffness, a decline in balance ability disrupts independent walking, exacerbating the sense of chronic disability [7]. The recovery pattern in GBS is usually from proximal to distal with foot muscles improving at last.

Correction of foot drop is required for improving functional capacity, social rejuvenation, and gait velocity [15]. Early rehabilitation will emphasise posture and range of motion, especially in cases of paralysis. Exercises that increase range of motion and static bracing are essential for preventing muscle contractures. Careful positioning will support this programme and help in the same [14]. Recovery from foot drops is essential for effective functioning and independence of patients. Therefore, this study is directed towards role of balance training in bilateral foot drop following GBS through balance training over generalized interventions.

Materials and Methods

The study conducted at the Department of Physiotherapy NIMS, Hyderabad, employed a prospective one-group pretest-post-test design to assess the effectiveness of balance training on individuals with bilateral foot drop following Guillain-Barré Syndrome (GBS). Eighteen patients meeting the inclusion criteria, including age between 15 to 60 years, and diagnosed with bilateral foot drop following GBS, were recruited through convenient sampling after obtaining ethical clearance. Each participant was provided with a comprehensive description of the study and gave informed consent before inclusion. Baseline assessments were conducted using standardized scales, including the Berg Balance Scale, Functional Independence Measure (FIM), and Hughes GBS Disability Scale, to establish the initial condition of the participants. Only one group underwent the intervention, which consisted of balance training exercises utilizing Swiss balls and balance boards.

The pretest observations of the variables were made using the aforementioned outcome measures before the commencement of the treatment. Following the implementation of the treatment, post-test assessments were conducted to evaluate the effects of balance training on balance, functional independence, and disability in the participants. The exercise protocol encompassed various activities such as sitting to standing, transfers, standing unsupported with eyes closed, reaching forward,

turning, and core stabilization exercises, tailored specifically for individuals with bilateral foot drop.

Throughout the study, each patient was followed up for three weeks, with reassessment in the final week to monitor progress and ascertain the sustained effects of the intervention. The utilization of a one-group pretest-post-test design allowed for a comprehensive examination of the impact of balance training on individuals with bilateral foot drop following GBS, providing valuable insights for rehabilitation strategies in this population.

Exercise Protocol

Sitting to standing
Standing unsupported
Transfers
Standing unsupported with eyes closed
Standing unsupported with feet together
Reaching forward with outstretched arm while standing
Pick up object from the floor from a standing position
Turning to look behind over right and left shoulders while standing
Turn 360 degrees
Place alternate foot on step or stool while standing unsupported
Standing unsupported one foot in front
Seated calf stretch
Exercises for bilateral foot drop
Wobble board exercises
Core stabilization exercises

Findings/Results:

The study investigated the efficacy of balance training in improving functional outcomes for individuals with bilateral foot drop post-GBS. The findings showcased significant enhancements in balance, functional independence, and disability scores from baseline to the third week post-intervention. This improvement indicates the promising potential of balance training as an intervention strategy for this population. The mean age of participants, at 31.6 years, sheds light on the demographic profile of the study group. Moreover, a higher prevalence of GBS among males was noted, emphasizing a potential gender-specific susceptibility to this condition. The methodology employed meticulous data collection and analysis procedures. The initial data collection on day 1 during the first visit allowed for the establishment of baseline parameters. These baseline values were crucial for gauging the effectiveness of the intervention over time. By recording averages and calculating standard deviations and standard errors, the study ensured robustness in its statistical analysis. The correlations between outcome measures and participant demographics, such as age and gender, were thoroughly examined using Microsoft Excel and GraphPad Prism software. Furthermore, statistical tests like paired t-test, Wilcoxon signed-rank test, unpaired t-test, Mann-Whitney U test, and Karl Pearson's correlation coefficient test were employed appropriately to analyze the data. The utilization of these tests allowed for a comprehensive understanding of the intervention's impact and its relationship with participant characteristics. Overall, the study's findings underscore the effectiveness of balance training as a rehabilitation intervention for individuals with bilateral foot drop post-GBS, offering hope for improved functional outcomes and quality of life for affected individuals.

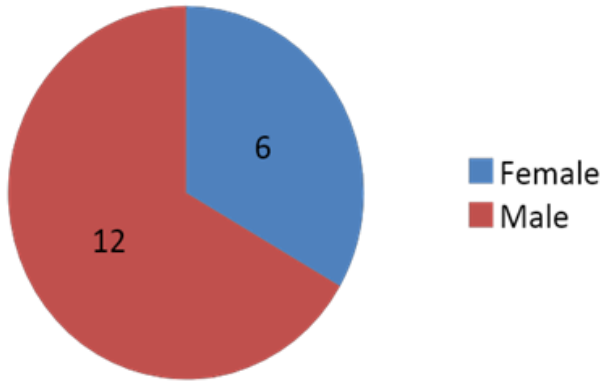

Figure 1: Gender-based results

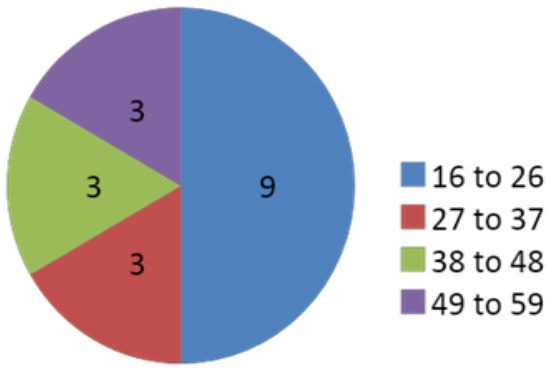

Figure 2: Age requirements

Explanation: The age requirements are 16 years minimum and 59 years maximum. The age distribution exhibits a mean of 31.6 ± 13.39 years. The age range of the subjects included in the data was 15 to 60 years, as the mean age of commencement was 40 years, and the maximum number of subjects were between the ages of 16 and 26. GBS is more prevalent among males compared to females.

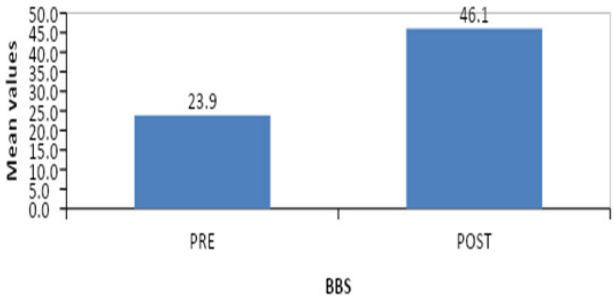

Figure 3: pre-and post-parameters

Explanation: From the first day of the study until the end of the third week, there was a statistically significant difference between the pre and post values for the BBS parameter. This difference was found in all components.

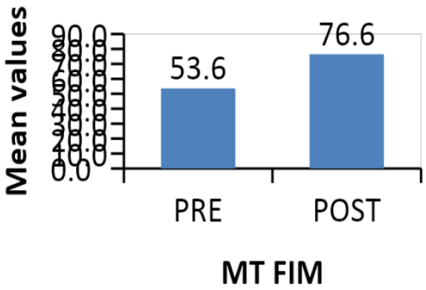

Figure 4: pre-and post-values of FIM

Explanation: There is a statistically significant difference between the pre and post parameters of the motor component of FIM, as indicated by the fact that the mean ± standard deviation value of the pre and post values of FIM are 53.6 and 76.6 respectively, and the P value is less than 0.001.

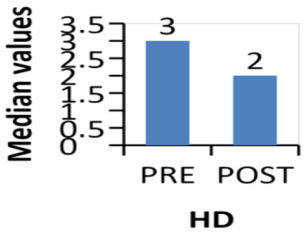

Figure 5: Comparison of the ankle dorsiflexion parameter's pre- and post-results

Discussion

The study's findings underscore the pivotal role of balance training in ameliorating balance deficits, enhancing functional independence, and mitigating disability among patients grappling with bilateral foot drop post Guillain-Barré syndrome (GBS). Notably, the observed enhancements could be attributed to the self-limiting trajectory of GBS, with the majority of patients experiencing recovery within 200 days on average. However, up to two years post-GBS onset, residual impairments persist in 60% of cases, particularly affecting the lower limbs. This suggests a complex interplay of factors influencing the trajectory of recovery beyond the acute phase.

Contrary to conventional wisdom, the severity of the initial injury may not be the sole determinant of GBS outcomes. Instead, the capacity for healing emerges as a critical factor shaping long-term recovery. Despite the heterogeneity in patients' demographics, the study found consistent improvements in balance, functional independence, and disability scores, indicating that these outcomes were independent of age and gender. This underscores the need for a nuanced understanding of the underlying mechanisms driving GBS recovery, beyond simple demographic factors.

The multifaceted nature of GBS recovery is further elucidated when considering the sensory and motor dimensions. The sensory system's contribution to balance improvement underscores the importance of holistic assessment and treatment approaches involving both neurologists and physiotherapists. Additionally, the concept of central learning and peripheral training effects suggests a dynamic interplay between neurological plasticity and targeted physical interventions, potentially amplifying the efficacy of balance training regimens.

Central to the discussion is the pivotal role of the ankle joint in facilitating balance and gait control. Beyond its mechanical support, the ankle serves as a crucial nexus for sensory feedback, constantly modulating postural adjustments during movement. The study's emphasis on ankle muscle strength and range of motion (ROM) underscores the intricate relationship between musculoskeletal integrity and balance control. By targeting ankle strength and

ROM, balance training interventions may catalyze cascading improvements in postural stability and functional mobility.

Interestingly, while the study focused on participants with bilateral foot drop, the primary objective was to enhance overall balance rather than solely addressing foot drop severity. This strategic shift reflects a broader understanding of the interconnectedness between musculoskeletal impairments and functional outcomes. Indeed, previous literature has linked diminished ankle muscle strength to compromised balance, further underscoring the rationale for prioritizing balance-focused interventions.

The implications of these findings extend beyond the confines of the study, signaling the need for a comprehensive and longitudinal approach to GBS management. By embracing a holistic perspective that encompasses both acute interventions and long-term rehabilitation strategies, clinicians can optimize outcomes and mitigate the enduring impact of GBS-related disabilities. Moreover, the study's emphasis on the self-limiting nature of GBS prompts further inquiry into the dynamic interplay between disease trajectory and rehabilitative interventions, offering fertile ground for future research endeavors.

In summary, the study underscores the transformative potential of balance training in mitigating the functional repercussions of GBS-related bilateral foot drop. By unraveling the intricate interplay of sensory, motor, and musculoskeletal factors, the findings pave the way for a more nuanced and effective approach to GBS rehabilitation. Moving forward, longitudinal research endeavors are warranted to elucidate the enduring impact of balance interventions and refine therapeutic strategies aimed at optimizing long-term functional outcomes for individuals affected by GBS.

Conclusion

The findings of this study shed light on the effectiveness of balance training as a crucial intervention for individuals grappling with bilateral foot drop post-GBS (Guillain-Barré Syndrome). GBS, known for its self-limiting nature, often resolves within a few years post-discharge, yet its impact on mobility can be profound. This study highlights that, while the disease may naturally regress, targeted interventions like balance training can significantly expedite the recovery process, leading to notable enhancements in balance, functional independence, and reduction in disability. The three-week timeframe examined in the trial illuminates a pivotal window where balance training can exert substantial benefits. During this period, patients experienced remarkable progress in their balance capabilities, functional independence, and reduction in disability levels. Notably, despite the increase in ankle dorsiflexor strength observed during the trial, it didn't correlate significantly with the measured outcomes. This raises intriguing questions about the underlying mechanisms driving these improvements, hinting at potential complexities yet to be fully understood. Moreover, the study's findings refute any influence of demographic factors such as age, gender, or BMI on the observed outcomes, further emphasizing the pivotal role of the disease trajectory itself and its capacity for healing over time. This suggests that while exercise interventions like balance training play a crucial role, the disease's intrinsic dynamics also contribute significantly to the overall recovery process. Thus, the study highlights the need for comprehensive, long-term follow-up research to elucidate the intricate interplay between disease progression, rehabilitation interventions, and patient outcomes. By delving deeper into these complexities, future studies can refine therapeutic approaches and optimize outcomes for individuals grappling with bilateral foot drop post-GBS.

Conflict of Interest: The authors, B Mayuri Chandra, Naveen Kumar Balne, and Lakshmana Prasad Gadde, declare no conflicts of interest related to this research. They have no financial or personal relationships that could bias their work or influence their interpretation of the results.

Source of Funding: The study was conducted within the Department of Physiotherapy at NIMS, Hyderabad, without financial support from any external sources. Therefore, the research was conducted independently, without any influence from external funding agencies.

Ethical Clearance: The study protocol was reviewed and approved by the ethics committee to ensure compliance with ethical standards. Informed consent was obtained from all participants, and measures were taken to protect their privacy and confidentiality throughout the study. By addressing conflict of interest, disclosing the source of funding, and obtaining ethical clearance, the authors demonstrate transparency and adherence to ethical standards in conducting medical research. These measures help to ensure the integrity and credibility of the study findings

Ethical clearance details: Ref No.EC/ NIMS/2948/2022 Dated: 30.03.2022

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