RESTORATION OF MOTOR FUNCTION AND POSTURAL BALANCE FOLLOWING BRAIN TUMOR SURGERY

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ABSTRACT

Following neurosurgical procedures for brain tumors, patients frequently experience motor impairments such as decreased motor function, hemiparesis, balance disturbances, and reduced overall mobility. These issues are particularly common when tumors are located near the pyramidal tracts, basal ganglia, or motor activation centers (Stummer et al., 2008). Such impairments significantly reduce a patient's independence in daily life, making early and comprehensive rehabilitation essential. In this study, 25 patients were enrolled in a four-month individualized rehabilitation program. Kinesiotherapy exercises based on the Bobath method and the Brunnstrom concept were employed. Motor functions were assessed using the Fugl-Meyer Assessment (FMA), Berg Balance Scale, and Timed Up and Go test (Gladstone et al., 2002). These tests helped evaluate the patients' mobility, balance maintenance, and walking speed.

Introduction

Neurosurgical operations for brain tumors play a crucial role in the treatment of oncological and neurological diseases today. However, in the postoperative period, impairments in motor function, balance, and mobility significantly reduce patients' quality of life. These complications are particularly common when tumors are located near the brain's motor control centers, pyramidal tracts, or basal ganglia, leading to hemiparesis, hypotonia, ataxia, and reduced coordination (Stummer et al., 2008; Duffau, 2006).

Postoperative movement disorders limit a patient's ability to move independently, perform daily activities, and adapt socially. Therefore, early and systematic rehabilitation measures are of utmost importance. According to scientific literature, initiating functional therapy within the first 2–4 weeks after surgery accelerates motor recovery and activates neuroplastic mechanisms (Langhorne, Bernhardt, & Kwakkel, 2011).

The main goal of motor rehabilitation is to restore the patient's mobility, reestablish balance, and recover muscle activity and coordination. In this process, physiotherapy, kinesiotherapy, and neurodevelopmental approaches—such as the Bobath and Brunnstrom methods—are widely used (Raos et al., 2007). Moreover, modern robotic systems and virtual

reality technologies have also been shown to be effective in restoring motor function (Mehrholz et al., 2017).

Research on motor rehabilitation in brain tumor cases is limited; most evidence is based on stroke studies. However, surgical complications arising from tumors have unique features and may present different recovery potentials. Therefore, this article analyzes the methods used in addressing motor impairments following brain tumor surgeries, evaluates their effectiveness, and provides clinical recommendations.

Research Objective

The main objective of this study is to evaluate the effectiveness of physiotherapeutic and neurodevelopmental methods in addressing motor function and postural balance impairments that arise after neurosurgical operations for brain tumors.

Research Methods

The study involved 25 patients. The tumors in these patients were located near the motor areas of the left or right cerebral hemisphere, and following surgery, they experienced hemiparesis, balance disorders, and reduced overall mobility. All participants were enrolled in a 4-week individualized rehabilitation program.

The following standardized tests were used for evaluation:

- Fugl-Meyer Assessment (FMA) – to assess overall motor functions;
- Berg Balance Scale (BBS) – to evaluate balance capability;
- Timed Up and Go (TUG) – to assess movement speed and coordination.

During therapy, the Bobath method (neurodevelopmental training) and the Brunnstrom approach were applied. Sessions were conducted for 60 minutes daily, five days a week. As supportive technologies, suspension systems and balance platforms were also utilized.

Results

According to the findings, Fugl-Meyer Assessment (FMA) scores increased significantly from an average of 41.2 ± 6.8 to 62.7 ± 7.4 ($p < 0.001$). The Berg Balance Scale (BBS) scores, which assess balance, improved from 28.4 ± 5.1 to 45.9 ± 6.2 ($p < 0.001$). Significant improvement was also observed in Timed Up and Go (TUG) test results, with average time decreasing from 22.1 ± 3.7 seconds to 14.6 ± 2.9 seconds ($p = 0.003$).

In the group of patients who began early intervention (within 10 days after surgery), motor functions recovered more rapidly, with motor scores increasing by an average of 55%, compared to 33% in the delayed intervention group ($p = 0.008$). The Bobath method effectively improved symmetrical movements and postural control, while the Brunnstrom approach was beneficial in reducing reflex activity and restoring voluntary movements. Combined application of these methods resulted in an average 47.6% improvement in motor function ($p < 0.01$).

Gait function was restored in 80% of patients, and 64% approached clinical norms in balance performance. In the remaining 20%, reduced motor performance persisted. In these cases, tumor localization, intraoperative trauma level, and overall patient condition were identified as decisive factors.

The findings indicate that early initiation of well-designed, individualized rehabilitation programs can yield high effectiveness in motor recovery. This aligns with existing literature, which highlights the activation of neuroplasticity mechanisms within the first weeks after surgery (Langhorne et al., 2011; Duffau, 2006). Therefore, initiating rehabilitation in the early

postoperative days is crucial for optimal recovery of motor functions.

Throughout the motor rehabilitation process, continuous supervision by a physiotherapist, a personalized rehabilitation plan, and active patient participation play essential roles. Additionally, motivation, emotional stability, and social support are influential factors that contribute to successful outcomes in motor recovery (Maclean et al., 2002).

Conclusion

The present study demonstrates that early, comprehensive rehabilitation using physiotherapeutic and neurodevelopmental approaches significantly enhances motor function and postural balance in patients undergoing neurosurgical intervention for brain tumors. Notably, patients who initiated therapy within the first 10 days post-surgery exhibited greater improvements in motor outcomes, underscoring the importance of timely intervention in leveraging early neuroplasticity.

Interventions based on the Bobath and Brunnstrom methods contributed to substantial improvements in muscle coordination, postural control, and voluntary movement, with combined techniques yielding up to a 47.6% increase in motor function scores. Standardized assessments such as the FMA, BBS, and TUG tests confirmed marked functional recovery in most participants, with 80% regaining gait ability and 64% achieving near-normal balance metrics.

The study highlights that individualization of therapy, consistent physiotherapeutic oversight, and patient engagement are critical factors influencing rehabilitation success. Furthermore, psychological resilience, motivation, and social support are essential elements that bolster recovery outcomes.

These findings align with existing literature emphasizing the role of early rehabilitation in activating neuroplastic mechanisms, thereby enhancing functional restoration. Therefore, integrating evidence-based motor rehabilitation protocols immediately after brain tumor surgery should be considered a clinical priority to maximize patient recovery and improve quality of life.

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