Role of Dynamic Neuromuscular Stabilization (DNS) on Functional Mobility in Occupational Therapy: A Scoping Review

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Abstract:
Background: Dynamic Neuromuscular Stabilization (DNS) has emerged as a promising technique in rehabilitation sciences, with potential applications in occupational therapy practice, particularly for improving functional mobility. This comprehensive examination explores the intersection of DNS techniques with occupational therapy interventions targeting functional mobility across various populations.
Objective: To map the existing literature on the use of DNS in OT and evaluate its impact on functional mobility across populations.
Methods: A search was conducted using multiple databases to assess the impact of DNS in functional mobility in occupational therapy following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) statement.
Results: A keyword search yielded 253 articles of which 6 articles were included in the present review according to the inclusion and exclusion criteria.
Conclusion: DNS shows potential to enhance functional mobility in populations served by OT. Further research is needed to establish DNS as a formal component of OT interventions and to assess its long-term effects.

Keywords – dynamic neuromuscular stabilization, occupational therapy, functional mobility

I. INTRODUCTION

Dynamic Neuromuscular Stabilization (DNS) has emerged as a promising technique in rehabilitation sciences, with potential applications in occupational therapy practice, particularly for improving functional mobility. This comprehensive examination explores the intersection of DNS techniques with occupational therapy interventions targeting functional mobility across various populations.

Understanding DNS and Functional Mobility

Dynamic Neuromuscular Stabilization or "DNS," is a rehabilitation approach developed based on the principles of developmental kinesiology and reflex-mediated core stabilization concepts. DNS focuses on facilitating core stabilizers—primarily the diaphragm, obliques, and transverse abdominis—utilizing ontogenic patterns that are particularly beneficial for individuals with reduced somatosensory function or impaired movement awareness. The technique involves analysing the quality of stability and movement to restore the integrated spinal stabilization system through specialized functional exercises.(1)

Based on the scientific concepts of developmental kinesiology (DK), DNS is a manual and rehabilitative strategy to optimize the movement system. In the field of sports rehabilitation and performance, DNS is rapidly gaining recognition and acceptance for both injury prevention and the recovery from musculoskeletal overuse injuries.(2)

Anatomical and biomechanical perspectives, as well as the impact of external forces (i.e., loading) operating on the spine, are frequently used to assess the genesis of musculoskeletal pain, particularly back pain. But the assessment of the forces generated by the patient's own muscles is frequently absent. Muscle stabilization is a vital and important postural function that is reliant on the level of central nervous system (CNS) control. Kolar's dynamic neuromuscular stabilization (DNS) method is a novel and distinctive way to illustrate the significance of the movement system's neurophysiological underpinnings. During the first year of life, the DNS includes developmental kinesiology principles that establish optimal posture, breathing patterns, and functional joint centering from a "neurodevelopmental" perspective. DNS offers a crucial collection of functional tests that evaluate the spinal and joint stabilizers' level of functional stability and help identify the "key link" causing dysfunction. The ontogenetic global postural-locomotor patterns provide the basis of the therapy strategy. Optimizing the internal forces of the muscles working on each segment of the spine and/or other joint is the main objective of treatment. In order to promote optimal coordination among all stabilizing muscles, patient education and involvement are essential components of the DNS therapy paradigm. (3)

Functional mobility, within the occupational therapy framework, is defined as "moving from one position to another during performance of everyday activities," encompassing bed mobility, wheelchair mobility, transfers, functional ambulation, and transportation of objects. It represents an essential component of Activities of Daily Living (ADLs) and Instrumental Activities of Daily Living (IADLs), as most daily activities require movement to be completed.(4) Functional mobility is a core component of independence in daily living, making its enhancement a priority in occupational therapy. Dynamic Neuromuscular Stabilization (DNS) utilizes the principles of developmental kinesiology to activate and coordinate deep stabilizing systems of the spine and trunk.

Given occupational therapists' holistic focus, DNS could offer novel avenues for improving functional mobility, posture, and performance in everyday activities. (5)

Studies have shown that nearly 80% of sports injuries are linked with the musculoskeletal system and mainly affect the lower extremity (Patel & Nelson, 2000). The increased injuries to the lower extremity are probably due to the fact that the lower extremity bears the weight both in static and dynamic positions. There is a higher risk of musculoskeletal injuries in women compared to men and the elderly compared to young people (De Loes, 1995; Louw, Manilall, & Grimmer, 2008). Nevertheless, both genders at all ages may become prone to the injuries. Over 70% of musculoskeletal injuries are caused intrinsically (Boden, Dean, Feagin, & Garrett, 2000), i.e. they are mainly caused by internal factors. Researchers studying musculoskeletal injuries believe that one of the major factors behind intrinsic injuries is "functional movement dysfunction", a neuromuscular condition that results from "Dynamic Postural Instability".(5) Core strength is essential for improving body balance and postural control during actions like landing and contact. Core strengthening is a word used to describe control over the muscles necessary to preserve functional stability around the lumbar spine. To produce spinal stability, the abdominal, paraspinal, hip girdle, gluteal and other muscles work together. Core strengthening has become a popular rehabilitation technique.(6)

One of the primary objectives of the DNS approach is to improve precise muscle coordination by placing the subjects in various developmental positions while achieving a functionally central position for the supported joints and all segments. Additionally, the DNS approach emphasizes the importance of combining spinal stabilization and breathing patterns during daily activities.

II. OBJECTIVE

Impact of Dynamic Neuromuscular Stabilization on Functional Mobility in Occupational Therapy: A Scoping To explore the extent, range, and nature of literature on the application of DNS in OT, with a focus on its effects on functional mobility.

III. METHODOLOGY

A literature search was conducted using Google Scholar, scopus, PubMed, Cochrane library, and BMC databases. Keywords used for the search were as follows; "dynamic neuromuscular stabilization" OR "DNS", "occupational therapy", and "functional mobility". The articles included were in the English language only, (Fig. 1). Articles registered for conference papers, and abstracts were excluded. Inclusion Criteria: - Interventions using DNS techniques. - Populations relevant to OT (e.g., neurological, orthopedic, pediatric). - Outcomes involving mobility, posture, or adls. Exclusion Criteria: - Studies without functional outcomes. - DNS used solely for sports performance enhancement.

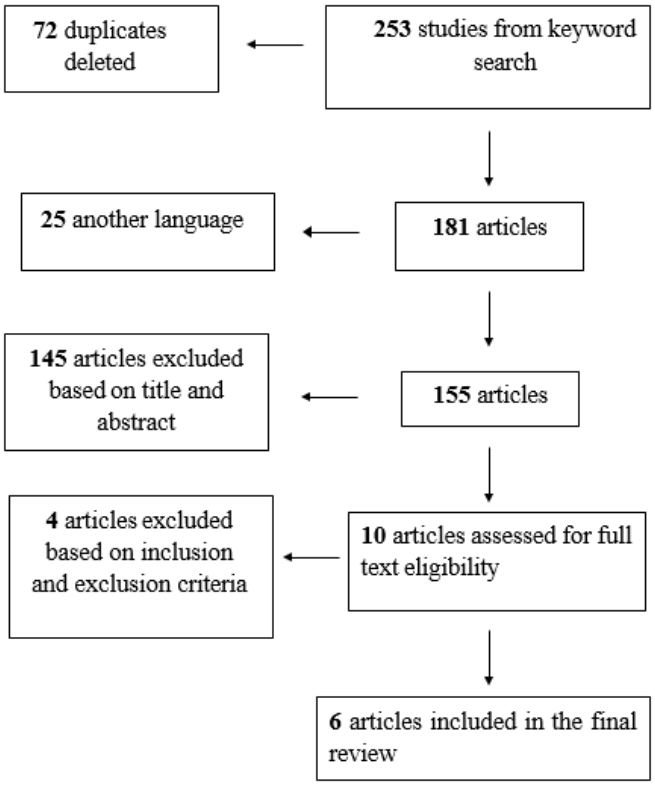

Figure 1 Flow chart of methodology

IV. EVIDENCE SUPPORTING DNS FOR FUNCTIONAL MOBILITY

Neurological Conditions

Research has demonstrated promising results for DNS interventions across various neurological conditions:

- Stroke Rehabilitation: Studies have shown that DNS techniques can significantly improve balance and quality of life in stroke patients. An 8-week DNS protocol resulted in significant improvements in balance measurements using the Berg Balance Scale (BBS) and quality of life assessments using the 36-Item Short Form Survey (SF-36) compared to control groups. Additionally, DNS has shown positive effects on anticipatory postural adjustment time, which is crucial for functional mobility.(1)
- Multiple Sclerosis (MS): DNS exercises have demonstrated significant improvements in balance, postural stability, walking ability, and fall rates in individuals with MS. Compared to conventional core stabilization exercises, DNS techniques showed superior outcomes in BBS scores, postural stability, activities-specific balance confidence, Timed-Up-Go (TUG) test, and Multiple Sclerosis Walking Scale-12. This suggests DNS may be particularly effective for MS patients by emphasizing integrated spinal stabilization, precise muscle activation, timing, and coordination.(1)
- Alzheimer's Disease (AD): Quasi-experimental studies have indicated that patients with AD experienced significant improvements in balance and gait parameters following 8 weeks of DNS exercises compared to control

groups(1). These improvements directly translate to enhanced functional mobility for daily activities.

- Cerebral Palsy (CP): DNS rehabilitation protocols have led to significant improvements in muscle thickness and activation, balance, and walking abilities in CP patients, as evidenced by both case studies and experimental research.(1)

Overweight and Obese Populations

A randomized controlled trial investigating DNS techniques in overweight and obese individuals found improvements in functional capacity(7). Given that excess weight can compromise functional mobility, these findings suggest DNS may be valuable for addressing mobility limitations in this population.

General Functional Movement Improvements

A study involving female students demonstrated that DNS training improved functional movements more effectively than traditional physical fitness training. The research showed significant improvements across five functional movement tests, with particularly strong results in the Y-Balance test, which assesses dynamic balance—a critical component of functional mobility.(5)

Integration of DNS in Occupational Therapy Practice

Occupational therapy's role in functional mobility is to help patients improve their mobility through interventions that enhance ADL performance(4). The integration of DNS techniques into occupational therapy practice aligns well with this goal, as DNS emphasizes the restoration of fundamental movement patterns that support functional activities.

V. CLINICAL APPLICATIONS

DNS can be incorporated into occupational therapy interventions targeting:

1. Bed Mobility: For patients in acute care or inpatient settings with limited mobility tolerance, DNS principles can enhance interventions focused on rolling bed-level and transitioning from supine to side-lying to sitting edge of bed for ADLs.(4)
2. Bathroom Transfer Training: DNS techniques can support the core stabilization needed for toilet/shower/tub transfers, complementing adaptive equipment education.(4)
3. Wheelchair Mobility: Core stabilization through DNS may improve seated balance and upper extremity function needed for efficient wheelchair propulsion.(4)
4. Functional Ambulation: DNS can enhance the quality of movement during walking activities by improving core stability and coordination.

VI. GOAL SETTING FOR DNS-ENHANCED FUNCTIONAL MOBILITY

Occupational therapists can incorporate DNS principles into SMART (specific, measurable, achievable, relevant, and time-bound) goals for functional mobility.(4) These goals should address specific mobility challenges while considering the patient's individual needs and meaningful activities.

VII. FUTURE DIRECTIONS AND RESEARCH NEEDS

While evidence supports the efficacy of DNS for improving functional mobility across various populations, several gaps in the literature remain:

1. More high-quality evidence with longer follow-up periods is needed to understand the long-term effects of DNS interventions better.(1)
2. Research specifically examining the integration of DNS within occupational therapy practice is too limited, suggesting a need for studies directly addressing this intersection.
3. As noted in the research, the progression coefficient for DNS interventions declined as functional movements became more specific, suggesting that combining fundamental DNS training with specific task training might be more effective for highly specific functional activities.(5)
4. Develop OT-specific DNS intervention protocols. - Conduct long-term studies on DNS in occupational settings. - Promote interdisciplinary training for OTs in DNS methods.

VIII. DISCUSSION

The findings suggest DNS improves biomechanical efficiency and motor control, essential for functional mobility. Despite promising results, its formal integration into OT remains limited. Studies often lacked occupationally grounded assessments or the involvement of OTs in delivering the intervention. There's a need for practice-based evidence and interprofessional collaboration.

Table 1Traditional intervention V/S DNS

Aspect	DNS	Other Interventions (e.g., NDT, PNF, WBV)
Core Stabilization	Strong emphasis on activating deep core muscles (diaphragm, transversus abdominis, pelvic floor) through developmental movement patterns; enhances intra-abdominal pressure for spinal stability(8),(2),(10)	NDT focuses on facilitating normal movement patterns and postural tone via central nervous system training; PNF emphasizes proprioceptive neuromuscular facilitation for muscle activation; WBV mainly targets muscle activation through vibration stimuli,(9),(10)

Functional Mobility Impact	Improves posture, balance, coordination, and motor control by restoring ideal stabilization patterns; shown to enhance gait, balance, and trunk control in neurological populations and healthy individuals(8),(9),(10)	NDT and PNF also improve trunk control and gait but may not target deep core stabilization as specifically as DNS; WBV shows minimal improvements in postural stability compared to DNS. (8),(9)
Effectiveness Evidence	Studies report medium to large improvements in postural stability, balance, muscle strength, endurance, and flexibility; benefits sustained at follow-ups.(8),(11),(10)	NDT effective in improving gross motor function and balance in cerebral palsy; PNF improves muscle activation patterns; however, some studies suggest DNS may produce superior gains in core stability and functional movement,(9),(10)
Approach and Methodology	Exercises replicate developmental stages (lying to crawling to standing), promoting natural movement patterns and CNS activation. (8),(2)	Other methods may use task-oriented activities (NDT) or specific muscle facilitation techniques (PNF) without the same developmental progression emphasis,(9),(10)
Population Suitability	Effective across diverse populations including neurological disorders (stroke, CP, MS), intellectual disabilities, athletes, and healthy individuals. (8),(9),(10)	NDT and PNF widely used in neurological rehabilitation; WBV more common in fitness and musculoskeletal rehab,(9),(10)

IX. LIMITATIONS

Limited OT-specific studies. Small sample sizes in many included studies. - Heterogeneity in intervention protocols and outcome measures.

These limitations underscore the need for:

- Larger RCTs comparing DNS to conventional therapies in diverse populations
- Standardized, occupation-focused outcome measures tailored to DNS mechanisms
- Longitudinal studies assessing functional mobility maintenance post-intervention
- Improved methodological rigor (e.g., blinding protocols) in future trials

Despite these constraints, DNS remains a valuable tool for enhancing core stability and movement patterns critical to functional mobility. Occupational therapists should consider these limitations when selecting interventions and contribute to addressing evidence gaps through practice-based research.

X. CONCLUSION

Dynamic Neuromuscular Stabilization offers a promising approach for enhancing functional mobility interventions within occupational therapy practice. By focusing on core stabilization through developmental patterns, DNS addresses fundamental movement components that support daily activities. Evidence suggests DNS can improve balance, coordination, and functional movement across various populations, including those with neurological conditions, which directly translates to enhanced functional mobility for ADLs and IADLs.

As occupational therapy continues to evolve in its approach to functional mobility, the integration of DNS techniques represents an evidence-informed strategy that aligns with the profession's focus on meaningful occupation and function. Further research specifically examining DNS within occupational therapy contexts will help refine best practices for implementation. Dynamic Neuromuscular Stabilization holds potential as a therapeutic tool in OT for improving functional mobility. Expanding its evidence base within OT frameworks may support its adoption into mainstream practice

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