

## CASE REPORT

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## PHYSICAL THERAPY MANAGEMENT OF A PATIENT WITH NON-SURGICAL IDIOPATHIC NORMAL PRESSURE HYDROCEPHALUS

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## ABSTRACT

**Background:** The disease, Idiopathic Normal Pressure Hydrocephalus (iNPH), affects the ventricles of the brain, which causes an increase in cerebrospinal fluid pressure and presents with a triad of symptoms: dementia, gait, and urinary disturbances. These symptoms are often reversible with treatment via a surgical shunting procedure; however, not all patients are candidates for this intervention. The purpose of this case report was to examine the benefits of physical therapy treatment for a patient who was not a candidate for surgery.

**Case Summary:** 77-year-old male with a triad of iNPH symptoms and MRI confirmation of diagnosis. 7-month history of progressive decline to the full onset of disease. Non-surgical candidate due to osteoarthritis and cervical flexion posture. PT intervention included gait training with new assistive devices, range of motion (ROM), home exercise prescription development and teaching, body weight supported treadmill training (BWSTT), and forced use techniques such as therapist paced recumbent ergometry.

**Outcome Measures:** The patient was seen for 23 visits in an outpatient physical therapy setting, which improved his cervical ROM, and functional assistance level for walking and transfers, until final visits in an episode of care.

**Conclusion:** Physical Therapy intervention may have reduced patient decline in functional areas addressed by therapy. However, the patient continued to decline in ADLs not addressed by therapy. Additional research is needed to evaluate the efficacy of earlier intervention following diagnosis and physical therapy to address patients who are non-surgical candidates with iNPH.

**Keywords:** Physical Therapy, Idiopathic Normal Pressure Hydrocephalus, Rehabilitation, Intervention, Non-Surgical candidate.

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## INTRODUCTION

Idiopathic normal pressure hydrocephalus (iNPH) is a disorder causing enlargement of the ventricles of the brain. iNPH classically presents with a triad of impairments, including dementia, gait, and urinary disturbance [1]. A combination of these signs and radiological examination of the ventricles is used to confirm a diagnosis of iNPH [2]. Cerebrospinal fluid (CSF) shunting procedures have led to significant improvement in approximately 60% of patients with iNPH [3] and has been the gold standard of care for this population. Options are more limited for those patients who are not candidates for a shunt procedure. To date, there is no peer-reviewed literature outlining physical therapy treatment for individuals who are not candidates for surgical treatment of this condition. The purpose of this case is to describe the physical therapy interventions and outcomes for a patient with iNPH without shunting.

### Patient Information

The patient was a 77-year-old male who presented with a 7-month history of progressing functional decline until the full triad of NPH symptoms achieved. Patient with the one-month onset of aphasia and difficulty communicating with family. Due to changes in gait and balance, the patient had utilized a small-based quad cane for several months. The medical diagnosis was confirmed with MRI findings. The patient was a non-surgical candidate for shunt placement due to severe osteoarthritis and cervical spine flexion postures.

### Physical Examination

Physical therapy examination using range of motion (ROM), manual muscle testing (MMT), Timed Up and Go (TUG), 10 Meter Walk Test revealed decreased cervical spine ROM, postural instability, global weakness, poor gait mechanics, and a decline in dynamic balance. The patient's noted activity limitations included: sleeping, household walking, poor conversational gaze, and limited activities of daily living (ADL). The patient could not tolerate prolonged supine postures due to cervical ROM impairments and subsequent poor sleeping tolerance. These limitations led to restricted social relationships. The patient exhibited positive environmental factors of an accessible home and good family support. The negative personal factors were: advanced age, flat affect, and poor cognition..

### Diagnosis and assessment

Physical Therapy diagnosis was reduced cervical spine range of motion, poor muscle performance, and limited functional activities associated with Normal Pressure Hydrocephalus. Physical Therapy prognosis was guarded as a response to anticipated functional decline until dependence for all mobility and activities of daily living (ADLs) was achieved.

**Table 1: ICF Clinical Findings**

Idiopathic Normal Pressure Hydrocephalus		
<b>Impairments:</b> Decreased cervical AROM Postural Instability Decline dynamic balance Poor gait mechanics Global weakness	<b>Activity limitations:</b> Sleeping Household walking Poor Conversational Gaze ADL independence	<b>Participation Restrictions:</b> Restricted social relationships
<b>Environmental Factors:</b> Family support Accessible home		<b>Personal Factors:</b> Older age Flat affect Poor cognition

### Interventions

Outpatient physical therapy interventions were delivered 2x/week for 12 consecutive weeks. Initially, interventions included gait training with new assistive devices, therapeutic exercise tasks for ROM, for improved joint mobility and improved postures, home exercise prescription development and teaching, and forced use techniques including therapist paced recumbent ergometry and body weight supported treadmill training.

Due to a family report of increasing episodes of loss of balance and excessive cervical flexion, the patient was trained in the use of a walker for improved upper extremity support and anterior visual scanning. Initial attempts at using two-wheeled and four-wheeled walkers were unsuccessful due to poor device management, including the patient's festinating gait and difficulty independently stopping the device once anterior walking was initiated. Following a short training period, using a U-step walker (Skokie, Illinois, USA) mitigated these issues and allowed for independent navigation.

Therapy interventions were adjusted and tailored to meet the patient's changing needs. For example, therapy interventions began with the patient performing tall kneeling and quadruped tasks. Still, following declining tolerance in these activities, therapy interventions were adjusted to supine tasks with similar therapeutic emphases and adjusted postures. Additionally, as noted above, the patient's poor cervical ROM affected his duration and quality of sleep. To improve ROM, manual therapy techniques (contract-relax, and strain, counter-strain) for increased cervical rotation/extension were augmented with active and active-assisted strengthening tasks performed in supine, prone, and quadruped positions. Tactile and visual cues were used to enhance cervical spine and trunk excursions from the midline. These interventions were performed during each of the initial eleven sessions until the patient could return to and maintain supine sleeping positions. Manual techniques were performed 3-5 repetitions within 8-10 minutes until the full available range of motion was consistently achieved.

Home exercise prescription (HEP) was also developed for improved strength and ROM, to reduce symptoms progression, fostering greater independence, and decreasing caregiver demand. Trained daily tasks included gait with the U-Step walker in the home, resisted scapular retraction, seated cycling, and sleeping in supine. The

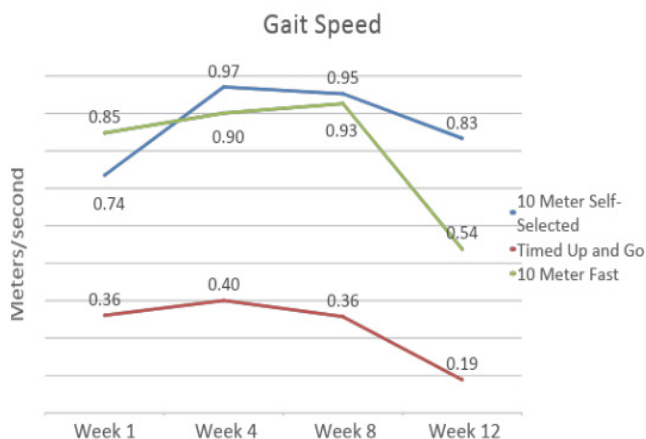
HEP was performed daily with family assistance. Tasks included 2-3 bouts of U-Step gait 50-100 feet in the home, resisted scapular retraction 3x10 repetitions with green and blue theraband, seated cycling for 10 minutes at level 1 resistance and supine sleeping position.

For improved neuroplasticity, forced use exercise via therapist paced recumbent ergometry and bodyweight supported treadmill training were utilized [4]. SciFit recumbent ergometry (Tulsa, Oklahoma, USA) with parameters of 10-minute bouts with minimal to moderate cues to maintain rates of approximately 100 steps/minute were performed. Initial parameters for body weight supported treadmill training included 2-3 bouts of 5-8 minutes at rates of 0.8-1.2 miles per hour (mph). Peak treadmill training was achieved by the 7<sup>th</sup> visit with the patient performing three bouts of 7 minutes at 2.0 mph, and variable intensities of 2-3 bouts at 1.5 mph supporting 20-60% body weight for the remaining 18 visits. The patient required manual assistance for cervical extension (to within 10 degrees of neutral) 50-70% of the time and minimal assistance for increased bilateral hip extension, progressing from 70% to 10% of the time, during body weight supported treadmill training (BWSTT).

### Outcome measures

The patient showed progression in several functional measures such as gait speed and spinal ROM (See graph 1, Table 1). Most notable was an increase of over 0.2 meters per second in the patient's self-selected 10-meter walk test speed. The patient's family reported improved sleeping. Initially, the patient could complete sitting to stand transfers with contact-guard assistance only. Still, the fifth visit began to require tactile cues for improved hand and foot placement to maintain independence. By the ninth visit, this assistance level increased to moderate tactile cues to initiate transitions to standing. Finally, the 19<sup>th</sup> visit patient required maximal cues to initiate movement and minimal assistance, with a further decline to maximal assistance to initiate and moderate assistance to complete the transition to standing by the final visit. The patient required maximal assistance for supine to quadruped transfers throughout this episode of care.

**Graph 1: Outcome Gait Function**



**Table 2: Progression of Passive Range of Motion for cervical mobility**

	Week 1	Week 4	Week 8	Week 11
<b>Cervical</b>				
Flexion (resting)	58	60	60	65
Forward Flexion	60	70	70	70
Extension	2	12	22	50
R Rotation	38	63	63	49
L Rotation	45	65	65	54
R side bending	20	16	18	11
L side bending	12	22	25	13

\*Values expressed in degrees.

### DISCUSSION

Functional tasks addressed by physical therapy were improved or maintained. Manual therapy techniques maximized the patient's cervical ROM. By the seventh visit, the patient was able to transition from sleeping in a recliner to supine in bed, thus improving his average sleeping time from 2-4 hours/night to 8-10 hours/night. Interestingly, the patient's passive cervical ROM (bilateral rotation and side bending) declined during the patient's final assessment. This is thought to have occurred secondary to decreased active cervical mobility and increasing resting postures in full cervical flexion, with the patient's chin resting on his chest during the final four weeks of this episode of care.

With the introduction of the U-Step Walker, the patient could continue to ambulate with minimal assistance, as compared to maximal assistance without the device. The patient reports that these improvements reduced the burden of care and improved his quality of life.

However, over time independence with Activities of Daily Living (ADL) declined, requiring increased caregiver assistance. For example, the family reports the patient required increased assistance with self-feeding tasks by the eleventh visit. Unfortunately, no standardized measure of the quality of life or other reliable subjective assessment of ADL function was performed throughout the episode of care. The family's retrospective report is informative, but it is not definitive, and therefore difficult to apply to other cases. The patient demonstrated a need for increased assistance at home. He showed Fair lower extremity strength as noted by the assistance level to complete the transition from sitting to standing but required greater assistance over time to initiate transfers. Based on this decline, transfer status appeared to be a better indicator of patient functional decline than walking status alone.

Due to the patient's poor cognition and aphasic status, self-report measures could not be performed, but the patient could participate in standardized function measures. Based on standardized testing performed, both the TUG test and the 10-meter walk test (self-selected velocities) detected declining functional status better than family report alone. These changes were noted by the fourth week of treatment, whereas the 10-meter walk test (fast) did not identify this change until the eighth week of treatment. As noted above,

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his orthopedic response to treatment was likewise effective (see Table 1).

Additional research is needed to know if the patient's change in functional status was due to physical therapy interventions only or merely a natural progression of iNHP without surgical intervention.

### **CONCLUSION**

Physical Therapy may have contributed to functional improvements in a patient with iNHP. The patient demonstrated improved self-selected gait speed, increased cervical spine ROM, and gait independence with the U-Step Walker. The patient also noted a subjective improvement in duration and quality of sleep due to improved cervical ROM and returned to supine sleeping postures. More research is needed to assess the value of physical therapy intervention in this population.

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