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Cerebral Palsy and Its Implications in Young Adulthood: A Case Study Analysis

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ABSTRACT: This is a case study involving a young adult living with Cerebral Palsy (CP). For the purpose of this case study, I have outlined the presentation of a 24 year old male living with mild CP, who attends outpatient physiotherapy with musculoskeletal and neurological symptoms. For this case I have included a mental health disorder to outline the challenges of living with CP as a young adult.

Sohail has a diagnosis of CP, hip pain, foot drop and a mental health condition. Our interventions include musculoskeletal interventions for his pain and function, as Ill as referrals, education and self management strategies. I hope for this case study are to bring awareness to the minimal evidence available for physiotherapy management of young adults living with CP and to demonstrate what I can contribute to their care as healthcare professionals. This case, including subjective and objective history, is purely and our outcomes are based on how I hope this patient would progress following treatment.

I.INTRODUCTION

This case study involves Sohail, an adult male living with Cerebral Palsy (CP). He is an active, 24 year old male who presents to physiotherapy with hip pain. Sohail was diagnosed with CP when he was 5 years old and has experienced intermittent hip pain since his teenage years. He has recently had worsening hip pain for about 6 Weeks which is interfering with some of his regular activities including work and volunteering.

CP is an umbrella term for non-progressive motor impairment disorders [1]. The incidence of CP is about 2 in 1000 [2]. It occurs during development due to brain damage which leads to physical and cognitive impairments [1]. CP is typically diagnosed in early childhood based on observation of motor milestones around the age of 2 [3]. Its severity is classified using the Gross Motor Function Classification System (GMFCS) [4].

Adults with CP may experience premature aging between 20-40 years of age resulting from the increased energy cost and strain placed on their bodies during tasks of daily life [5]. Other complications may involve walking or swallowing disorders, and mental health conditions [5]. Post-impairment syndrome is common in adults with CP. This is often difficult to diagnose as its symptoms mimic other conditions related to CP including fatigue, weakness, and repetitive strain injuries [5]. Musculoskeletal impairments are very common in young adults with CP, with hip pain being the most frequently reported[6]. Hip pain may be a result of poor hip morphology at skeletal maturity [6]. Musculoskeletal impairments and pain may present secondary to changes in gait [2]. Many adults with CP experience a decline in walking ability and function despite that 70-80% walk independently or with gait aids. Maintenance of walking ability is important for independence, quality of life and participation in social activities [2].

The purpose of this case presentation is to address the management of hip pain in adults with CP in an outpatient setting. I will discuss an example of clinical presentation, assessment, and treatment of hip pain in CP. This may be useful for student physiotherapists to increase awareness of the impairments associated with CP in adults and to recognize the importance of gait and mobility training with future patients. CP does not worsen with age, therefore this case study focuses on maintenance of function and addresses the specific mobility impairments causing hip pain. Adults with CP may present with other cognitive and physical impairments not mentioned in this case study.

II. CLIENT CHARACTERISTICS

Patient is a 24 year old male with a diagnosis of CP. He was diagnosed at the age of 5, at Level 1 of the GMFCS score. He has no surgical history, but has a medical history of depression (3 years) as Ill as a history of cancer in his immediate family. Patient is seeking physiotherapy care in regards to his L hip pain that has increased in the last 6 Weeks. He reports intermittent hip pain since early teenage years, and has recently noted an odd sensation in his R foot. The patient also reports increased fatigue at work. The patient is an accountant at

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SBI. He lives in a 1 bedroom apartment, has 2 supportive parents, 1 sibling and good social support from friends in Kingston. As a former high school athlete (hockey and baseball), he now volunteers his time coaching little league baseball with a friend. He is a single man with no children.
Examination Findings
Subjective

History:

- Increased pain in L hip with no known MOI, onset 6 Weeks ago
- No prior hip dislocations/subluxations
- **Current Sx/ Status:**
- Hip pain 5/10 at rest, 7/10 with stairs and after long periods of walking
- Feels fatigued at the end of his work day (feels as though it is not normal for the amount of fatigue he experiences with just sitting). Patient reports he feels the need to lay down to take the load off.
- R foot "feels different" and has been experiencing this over the course of several months
- Pt reports he has no ability to lift his right toes when walking and notices a thud of his foot when he goes to take a step on the right side (says he has always had difficulty with this but is noticing much more than usual)
- **Medications:**
- Paroxetine (25mg orally once a day)
- **Social History:**
- Supportive: family (2 parents and younger brother live in Surat and are able to visit and help out if needed)
- Many friends in Surat who he can rely on (very supportive and active)
- Work: accountant at BDO - sits at desk for 8 hours a day
- Leisure: Helps coach a little league baseball team with a close friend in the surat community
- In the winter plays occasional shinny with friends (dependent on work schedule and mood)
- Has a gym membership to Good life (pt reports he does not go as much as he used to due to pain in his hip and increased fatigue at the end of a work day)
- Home/ Work
- Apartment = 8th floor (building has stairs and elevator)
- Work = one step to get into the front door (no difficulty with this)
- Work = Office chair with a supportive back (adjustable with pump handle underneath -to raise and loir the seat)
- Functional Status (Current/ Previous)
- Previous = less fatigue with prolonged sitting at work
- Current = has the urge to lay down at work because his loir body "falls asleep after 1 hour of work without moving"
- Feels fatigued at the top of 2nd flight of stairs at his apartment
- Feels safe when walking, doesn't report any issues with balance or falls. Reports he's noticed a change in how he walks since the pain has increased.
- Other
- Smoking → non-smoker
- Alcohol → Socially with friends (on average 2-5 beers per Week)
- Drugs → none
- Sleep/ Stress
- Stressed with deadlines at work. Sometimes has trouble staying asleep at night but he is unsure if this is due to his inability to manage stress or if something else is keeping him from getting a restful sleep
- Nutrition is "good" → 4x water bottles a day on average, eats a balanced diet
- Overall mental health → Hx of depression, currently is medicated and says he is managing Ill. Mentions that work is getting quite busy and he devotes a lot of energy to his job. He is worried about how his mood will be affected if his hip pain worsens in the next few Weeks.
- Objective
- Observation
- Decreased tone in left glutes
- Decreased tone in right anterior calf

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- No visible deformities
- Tendency to Iight bear slightly more on left leg
- Altered gait upon arrival to clinic (trendelenburg gait with slapping of R foot through his step)
- Vitals
- HR: 60 bpm
- BP: 120/80 mmHg
- RR: 12 breaths/min
- AROM
- Bilateral (B) hip extension = limited (L 12 degrees, R 10 degrees)
- B hip flexion = WNL
- B hip adduction = WNL
- B hip abduction = WNL
- B knee flexion = WNL
- B knee extension = WNL
- B ankle dorsiflexion = R limited (L 20 degrees, R 0 degrees)
- B ankle plantarflexion = WNL
- B ankle inversion = WNL
- B ankle eversion = R limited (L 15 degrees, R 5 degrees)
- B MTP flexion/extension = WNL
- PROM
- Done at second appointment due to increased risk of fatigue in CP patients.
- Noticed increased tone with movements surrounding hip flexors, resulting in a hip extension limitation with early soft tissue end feel. Ankle DF limited by muscle activation.
- All PROM WNL.
- Global Strength Testing

	L	R
Hip Abduction	3	4+
Hip Flexion	4	3+
Knee Extension	4	4
Knee Flexion	4	4
Ankle Dorsiflexion	4	2+
Ankle Eversion	4	2+
Ankle Inversion	4	4

- Did not perform specific muscle MMT due to increased fatigue in CP patients.
- Sensory Testing
- L Dermatomes (superficial) → intact
- R Dermatomes (superficial) → not in tact
- L Somatosensory (cortical and proprioception) → intact
- R Somatosensory (cortical and proprioception) → unable to feel crude/temperature touch on medial calf L4 dermatome distribution. Due to this, I did not proceed with cortical sensory testing or proprioception testing on this side.
- Gait analysis

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- R side at each stage of gait Gait (See link for Ranchos Los Amigos Stages of Gait)

Initial Contact	No R heel contact, R forefoot “slap”.
Loading Response	Iight shift over L foot
Mid Stance	No noticeable findings
Terminal Stance	R hip drop,
Pre Swing	Iight shifts towards L hip
Initial Swing	R hip hike
Mid Swing	R hip circumduction
Terminal Swing	No R foot clearance

- Overall Impression of Gait: Able to ambulate safely with minimal balance impairments although his R hip is circumducting and his dorsiflexion is extremely limited in his R foot during gait
- Outcome Measures
- Visual Analogue Scale for hip pain (5/10 at rest, 7/10 with activities ie. stair climbing)
- GMFM (Gross motor function measure -- see Cerebral Palsy Outcome Measures) → some items not appropriate for adult use (ie. laying and rolling). I decided not to use this outcome measure but I will keep in mind the classification from the GMFCS to guide Rx along with pt goals
- PHQ-9: Score = 5 (mild depression)
- Fatigue severity scale → 6.5. This is average for individuals with a neurological disorder.
- Community Balance and Mobility Scale → 79/83
- Timed Up and Go Test (TUG) 10.8 sec (no fall risk)
- Special Tests
- Standing Heel Raise: L 20, R 10
- FABER (-) FADDIR (-) Hip scouring (-)
- Second appointment: Thomas (-) Thompson (-)
- Clinical Impression
- Sohail is a 24-year-old male presenting with left-side hip pain due to right hip circumduction during gait and foot drop on the same side. Pt has pre-diagnosed mild CP and presents with motor and sensory impairments. Severity is classified as Level 1 on the GMFCS. Patient is experiencing increased fatigue which is limiting participation in work and leisure activities.
- Problem List
- Reduced dorsiflexion and eversion on the right side
- Foot drop (R)
- Sensory deficits in R foot (L4/L5 nerve root distribution)
- Left sided glute Iakness
- Decreased strength tibialis anterior on R side
- Decreased hip extension bilaterally
- Tension in hip flexors bilaterally
- Trendelenburg gait (L)
- Minimal balance deficits
- Difficulty and increase in pain with stair climbing
- Fear of pain-related mental health flare-ups
- Increased fatigue at work

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III. INTERVENTION

Short-Term Goals

1. Decrease VAS to 2/10 at rest within 2-4 Weeks by implementing change to number of breaks per day at work and incorporate stretching daily to relieve pain related to tension in R hip flexors.
2. Improve L side glute strength to 4/5 in 4 Weeks to address hip drop in gait by incorporating hip strengthening exercises into treatment plan.
3. Patient will implement a tracking system to ensure hourly breaks are taken throughout his workday. By 2 Weeks, hourly breaks will be taken 100% of the time.

Long-Term Goals

1. Improve R ankle dorsiflexion strength to 4+/5 by 8 Weeks to address foot drop in gait by incorporating tibialis anterior and peroneal muscle strengthening exercises into treatment plan.
2. Within 8 Weeks, patient will be 100% consistent with hourly work breaks and will implement 5 minute stretches (coordinated with supervisor and colleagues) in order to decrease pain throughout the day.
3. By 9 months, patient will decrease PHQ-9 score by 1-2 points by working with a psychologist on self management strategies.
4. Improve Fatigue Severity Score to 4 or less after 2 months of implementing consistent work breaks and improving general strength and mobility in the clinic.

Treatment

Education

According to a Cochrane review of exercise interventions for individuals with CP, there is no correlation between improvements in fitness and improvements in activity/participation [7]. This suggests that I would also have to assess the environment of the patient to determine what implementations I can make in his home or give him assistive devices when he is experiencing exacerbations of pain in his hip. For example, education regarding taking the elevator if experiencing fatigue with the steps leading into his apartment. I will also provide education about taking breaks throughout the workday. Any further environmental changes that may be required in order to improve activity and participation could be implemented by an Occupational Therapist (OT) in the future.

The patient was educated about the post-impairment syndrome and premature ageing in adults with CP. Given strategies and ideas on ways to manage fatigue resulting from these conditions:

- Educate Sohail on the importance of regular breaks within the workday in order to change positions to minimize possibility for increased tone or contracture in habitually shortened muscles (especially for CP patients) [8]. Given ideas for creating a tracking system on his work computer to assist in keeping himself accountable. Also given stretches to incorporate into these breaks.
- Education on the importance of a standing desk or a raised seat to minimize the flexed position of his hips throughout the day. Discussed application to ODSP for this.
- Educate Sohail on options to ensure patient safety when he is feeling high levels of fatigue (ie. taking the elevator at his apartment, continuing with exercise but decreasing the intensity (sets/reps) for days when he may not be able to perform ADLs if he were to push himself due to fatigue)

Stretching

To be performed each hour during work break:

- Hip flexor stretch: 2x 30s hold, completed on each side
- Lunge in standing: 2x 30s hold, completed on each side
- March on spot: 10x 5s hold, completed on each side

Strengthening

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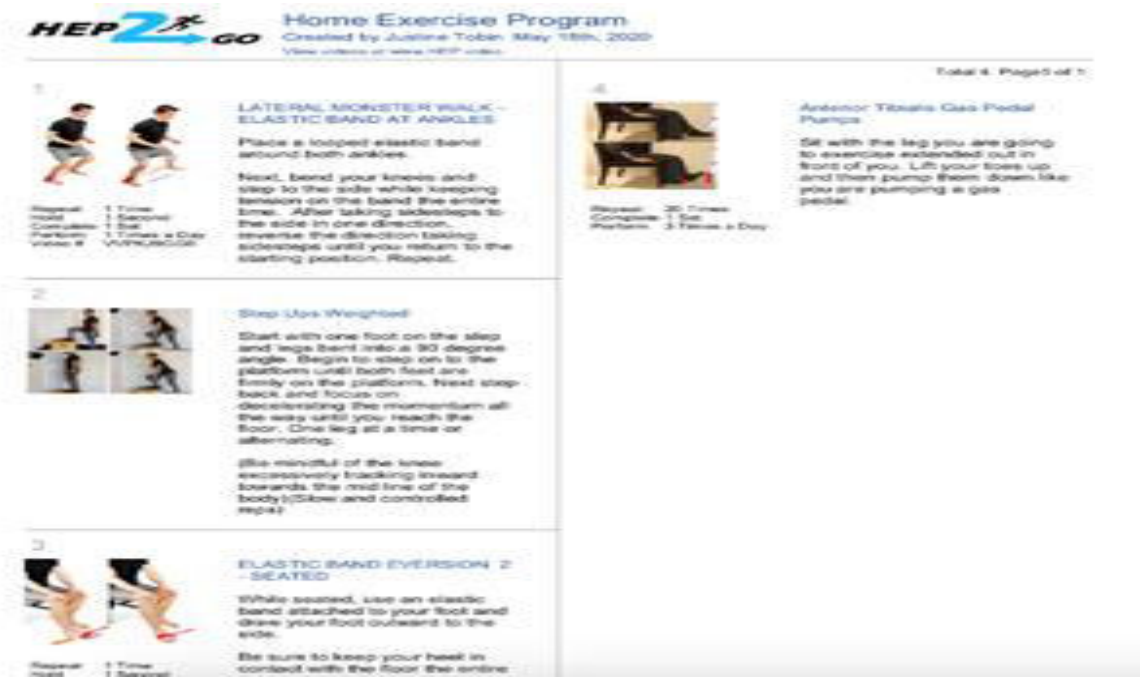

Research indicates that improving strength in adults with CP can illicit changes within the International Classification of Functioning, Disability and Health (ICF) including an increase in self selected walking speed.

- Banded monster walks: 2x 6 reps 2 times daily
- Iighted step ups: 2x 6 reps 2 times daily
  - Cueing for emphasis on glute utilization instead of knees
- Resistance band exercises:
  - Banded dorsiflexion: 2x 10 reps 2 times per day
  - Resisted Eversion: 2 x 10 reps 2 times per day
- Toe taps: 2x 10 reps 2 times a day

IV. FUNCTIONAL ELECTRICAL STIMULATION (FES)

The current research favors FES over orthoses for individuals with mild CP experiencing foot drop [9]. Using an AFO may lead to a decrease in function. The research is more thorough for FES intervention for children with mild CP [10]. According to the literature, FES in children is used to improve dorsiflexion but there is no direct improvement in speed of gait or overall function of gait [11].

I have decided to clear contraindications and precautions and proceed with this intervention and monitor progress. I will provide FES in combination with tibialis anterior strengthening exercises to assist with dorsiflexion during gait.

Parameters for FES:

- Placed electrode cuff at tibialis anterior muscle belly
- Amplitude = low to medium to generate a visible contraction (should not create a painful or overly fatiguing stimulus) [12]. (as patient progresses, I may be able to progress to high frequency)
- Pulse Width = 250 microseconds (https://www.cyclonemobility.com/functional-electrical-stimulation-the-ultimate-guide-to-fes/)
- Frequency = 50 Hz (between high and low frequency in order to remove low frequency drift and high frequency noise) [13].
- Interval time = Heel off ground to onset of tibialis anterior activation [13].
- Based on patient fatigue levels, I will measure patient's rate of perceived exertion (Borg Rating Of Perceived Exertion) throughout intervention and post intervention to ensure that patient is able to continue with ADLs post treatment. I can also decrease the pulse width if patient fatigue occurs.

Gait

Walk 3 sets of 2 laps in clinic (200m) with focus on:

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- cueing during swing phase to increase knee flexion and improve foot clearance
- cueing to decrease hip drop on L side during stance phase
- educated on use of audio feedback to minimize foot slap during gait
- FES (as mentioned above) to facilitate ankle dorsiflexion

Referrals

1. Submission of application to Ontario Disabilities Act for coverage of convertible standing desk at work.
2. Goal: implement within 6 Weeks if possible.
3. Assistive Devices Program (ADP) to cover up to 75%, and disability Support Program (DSP) to cover the remainder of costs.
4. Referral to psychologist for self-management of depression.
5. If no reduction in pain by 12 Weeks (both seated and during activity), I can refer for imaging. There is evidence that CP patients can have poor hip morphology which may contribute to levels of pain [6].

Home Exercise Programme

- 10 minute walk 4-5 times a Week focusing on R side knee flexion and ankle dorsiflexion and L side hip position
  - adjust length of walk as needed based on fatigue levels and pain
- Pt given tracking sheet to assist motivation in completing HEP
- Will progress and/ or regress as necessary.

Outcome

Following initial consult, I continued to see Sohail 2x/Week for 8 Weeks. I saw an improvement in right side ankle dorsiflexion, a decrease in foot drop, and improved glute strength. I also saw a decrease in hip pain at rest and during activity, as ill as a decrease in his Fatigue Severity Scale score. Sohail was approved through ADP for a transitional standing desk which was implemented at work. He was able to help self manage his fatigue by intermittently standing at his desk throughout the work day. He also incorporated the stretch breaks to reduce tension and pain in his hips. His discharge plan included a HEP, education and referrals to appropriate health care providers.

AROM:

- DF: 10 degrees R side.

MMT:

- Glutes: 4/5
- Tibialis Anterior: 4+/5

ROM:

- Fatigue Severity Scale: 4
- VAS for hip pain: 2/10 rest, 3/10 with stairs

Referrals: OT for assistance with workplace and home. Psychologist for management of depression.

V. DISCUSSION

Due to the non-progressive nature of cerebral palsy, there tends to be more research surrounding rehabilitation and function in the early years. The lifespan of those living with cerebral palsy is increasing, therefore more individuals with CP are living into adulthood [14]. Although the condition is non-progressive, there are other complications that may arise in adulthood that would benefit from physical therapy. These include premature ageing and post-impairment syndrome [5]. By increasing strength in young adults with CP, I can work to offset some of the effects of post-impairment syndrome such as fatigue and weakness [5].

There is a gap in the research regarding rehabilitation and exercise training for adults living with CP and little guidance regarding specific protocols for management [1]. Previous studies have shown that incorporating exercise and gait training into rehabilitation can help prevent chronic pain and physical deterioration [15]. In addition, exercise will increase independence and help to maintain activity and participation in these individuals [1],[15].

The foot drop seen in this case is of interest as it did not have a clear mechanism. It presented later in Sohail's life, therefore two possible mechanisms are post-impairment syndrome and peroneal nerve palsy. Although there is no way to clearly define the true cause, it is useful to discuss both scenarios. Post-impairment syndrome is common in CP and may lead to increased fatigue, atrophy of certain muscles, or repetitive strain injuries [5]. This

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could explain the decreased strength of the tibialis anterior resulting in foot drop. Peroneal nerve palsy is also a potential cause of foot drop as the deep peroneal nerve innervates the tibialis anterior and one of the peroneal muscles [16]. This nerve could become entrapped due to compression over the fibular head from sitting with legs crossed at work [16]. There is an interesting case study of an older adult male with severe depression who presented with bilateral foot drop [17]. Despite this, however, there is little supporting evidence that this is a direct result of depression or the sedentary lifestyle adopted secondary to depression. Regardless of the cause of foot drop, Sohail's decreased tibialis anterior and peroneal muscle strength was addressed to reduce foot drop and improve gait.

This case study is an example of adapting the available evidence to fit the needs of the individual patient. There may not be guidelines specifically for the treatment of adult cerebral palsy, however there is available research that can be applied to this case. I completed a thorough assessment and designed a patient centered treatment plan for Sohail based on his presentation. In adulthood, our goal is to maintain function and to minimize the effects of premature ageing and post-impairment syndrome [5]. In order to do so I focused our treatment on mobility and strengthening to decrease pain and increase functional mobility. I provided education surrounding fatigue management, strength exercises to target muscle weakness, stretches to decrease pain and improve mobility, as ill as gait training focused on decreasing hip and foot drop. Referrals to an occupational therapist and psychologist Ire recommended upon discharge.

With the limited evidence available for the management of adult CP, it is crucial to address each patient's unique presentation and focus on their specific goals. We aim to maximize patients' function and improve their quality of life regardless of their diagnosis [14]. In adults with CP, it is important to recognize the increased fatigue that may result from complications of the disease. Each individual will present with unique symptoms, goals, and needs. A thorough assessment with attention to your patient's goals will lead you on the right track when managing adults with CP.

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