

The Role of Medical Rehabilitation: Management of Oromotor Dysfunction (Mechanical and Kinetic Movement Dysfunction) and Speech Therapy in Children with Cerebral Palsy

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Abstract: Cerebral palsy (CP) is a non-progressive motor disorder caused by prenatal, perinatal, and postnatal factors, leading to movement and posture abnormalities. In Indonesia, around 0.60% of the total child population has CP (9 cases per 1000 live births). Speech and swallowing difficulties are common, affecting children's nutritional status and development. Speech and oral motor therapy are effective in improving speaking and oromotor dysfunction. To determine the effectiveness of oromotor and speech therapy in improving swallowing, chewing, and speech abilities in children with CP. A case study was conducted at the "Lombok Care" Children with Disabilities Foundation. Language development was assessed with the Messay Language Test, and oromotor dysfunction was evaluated using Debra C. Gangale's method. Pre and post-therapy assessments were performed to assess changes in motor and speech functions. The evaluation of 5 respondents showed an increase in speaking skills after speech therapy and swallowing skills after oromotor therapy. Both are shown to be effective in improving communication skills and oropharyngeal muscle coordination, as well as reducing the risk of aspiration. Speech and oral motor therapy are essential and effective in improving eating, swallowing, and speaking abilities in children with CP, and are an important part of holistic medical rehabilitation.

Keywords: Cerebral Palsy; Oromotor dysfunction; Speech therapy, Oral motor

Introduction

Cerebral Palsy is a collection of motor movement and postural abnormality symptoms that do not occur progressively, mostly found in children with risk factors obtained during the prenatal (period before the child is born), perinatal (period during labor) and postnatal (period after birth). The most common symptoms and signs are excessive movement and impaired motor

control. Risk factors in the prenatal period are placental and umbilical cord disorders, hypertension, and pregnancy with kidney problems, cardiovascular diseases, asthma, or diabetes mellitus, intrauterine infections (toxoplasmosis, rubella, cytomegalovirus, herpes simplex), drugs, abortion attempts, smoking, and alcohol consumptions. Perinatal risk factors are birth trauma, prematurity, and low birth weight. Postnatal risk factors are cerebral hemorrhage, infections such as

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meningitis and encephalitis that occur in the first 6 months of life, and carbon monoxide or heavy metal contamination (Vitrikas et al., 2020). The American Academy of Cerebral Palsy defines it as abnormal movement or motor function changes caused by accidents, injuries, and diseases of the nervous system abnormality (Vitrikas et al., 2020).

Cerebral palsy by Ingram and Hagberg's classification is divided into four types: spastic, athetoid, ataxic, and mixed. The new Surveillance of Cerebral Palsy in Europe classifies it into spastic, dyskinetic and ataxic forms (Sadowska et al., 2020). In the spastic type there is a damage in the corticospinal tract, in which signs and symptoms of rigid paralysis, shivering reflexes, grasping reflexes that still present (Vitrikas et al., 2020). It is estimated that 70% - 80% of cerebral palsy cases are of spastic type. The Choreo-Athetoid type has signs and symptoms of curved arms and legs, and abnormal posture, caused by a damage to the basal ganglia. Ataxic type is a spinal disorder with impaired coordination, stiff neck, and curved movements, caused by a damage to the cerebellum (Paul et al., 2022).

The prevalence of cerebral palsy in developed countries is 2-2.5 cases per 1000 live births and in developing countries 5.6 cases per 1000 live births. In Indonesia, as many as 532,130 children suffer from Cerebral palsy and 9 cases in every 1000 live births. In the United States, 10-20% of cerebral palsy is caused by post-natal diseases. Cerebral palsy is the leading cause of disability in children. Symptoms of cerebral palsy in children includes growth and development disorders, stiff body parts, only using one side of the body during activities, visual or hearing impairments, speech impairment or late speech, lack of response to tactile stimuli or pain, and seizures (Novak et al., 2020). Based on the degree of disability, cerebral palsy is divided into mild (patients can still do work and daily activities), moderate (activities require various kinds of assistance in order to take care of themselves), and severe (completely unable to do activities without the help of others). The problem that occurs in children with cerebral palsy is that children always seem to drool, have difficulty eating and swallowing, resulting in nutritional problems and difficulty speaking (Novak et al., 2020).

Examinations that can be done are motor, sensory and mental development examinations. Manifestations of motor disorders in children with cerebral palsy are spasticity, rigidity, ataxia, tremor, atonic and hypotonic, absence of primitive reflexes (in the early phase) or persistent primitive reflexes, and difficulty performing voluntary movements. Diagnosis can be made with electroencephalography (EEG) to see the electrical activity of the brain. It can also be diagnosed with the help of CT-Scan and MRI (Friedman et al., 2022). Speech

disorders occur in children with cerebral palsy ranging from 30-70%. Study by McNerney et al. found that speech and language disorders in cerebral palsy can cause developmental disorders in children (McNerney et al., 2021). One of the treatments for cerebral palsy is oromotor dysfunction management. The purpose of oromotor dysfunction management is to increase sensory awareness of the gums, increase passive movement of the lips, increase oral muscle strength, increase jaw muscle strength, increase palate muscle strength to improve or control the underlying cause of eating difficulties and to avoid or reduce the impact of swallowing (Speyer et al., 2019).

Research conducted by Marzouqah et al. found that swallowing rehabilitations with oral motor exercise has a good effect on improving swallowing function up to 59.50% (Marzouqah et al., 2021). Saconato et al. also stated that oromotor therapy is effective up to 50% in the rehabilitation of swallowing difficulties (Saconato et al., 2014). The process of eating, chewing and swallowing food is related to the physical movements made by the buccal muscles. In the mouth, food undergoes a mechanical digestion with chewing and swallowing movements. In children with cerebral palsy, mechanical and kinetic processes such as chewing and swallowing movements become imperfect due to muscle movements in the oral cavity that have dysfunction. Oromotor therapy aims to train mechanical and kinetic processes by the buccal muscles and bones in the jaw (Stipancic et al., 2021). Mechanical digestion, the process of food smoothening occurs in the mouth. Pre-swallowing assessment can be done prior to the therapy, which evaluates the result of poor oral hygiene due to the incomplete mastication process by kinetic and mechanical movements. Swallowing assessment is done by assessing food structure residues, contractions of the tongue and pharyngeal wall muscles. Swallowing is a complex neuromuscular activity coordinated in the oral phase (Singh et al., 2023). Weak velopharyngeal kinetic motion can lead to aspiration. Oromotor rehabilitation is used to train the oral phase and pharyngeal phase in patients (Speyer et al., 2019).

Oromotor rehabilitation can be done by stimulating the patient with food and assistive devices. Oromotor rehabilitation in cerebral palsy is divided into several exercise programs. Passive stimulation of oral motor muscles is done by giving a touch from left to right on the cheek, massaging the temporalis muscle and rotating it, pulling down the upper lip smoothly, directing the lower lip is from the outside to the inside, and the jaw is directed in a chewing-like movement, cleaning the tongue and by doing smiling movements. Oromotor rehabilitation can be carried out effectively three times a week for 45 minutes in 1 therapy and carried out regularly 20 times (Sant et al., 2021). Speech therapy is

one of the efforts to improve social rehabilitation in children with cerebral palsy. Speech therapy is a treatment process for people with communication behavior disorders to be able to interact with the environment. Children's language development begins with meaningless sounds or sounds and is followed by one-syllable, two-syllable language, composing simple sentences, then socializing using complex language. Myklebust divides language development into three categories. Inner language is the first aspect of language to develop, appears around 6 months. Receptive language appears at the age of 8 months, in which the person understands what others say, responds whenever their name is called, and also understands commands. Expressive language starts at the age of 1 year, in which cognitive development occurs. Abnormalities in cerebral palsy are caused by the absence of coordination of motor and speech organs, due to damage or abnormalities of the neuromotor system. Speech therapy is effective in improving the language skills of children with cerebral palsy disorder.

Speech therapy can be provided as early as possible with speech and language disorders. Swara (2014) discovered that speech therapy was very useful for children with disabilities and raised their confidence. Speech therapy helps children to be better in language and communicating with others. Communication in speech therapy is verbal communication, linguistic messages and delivery of information using language. There are several kinds speech therapies, such as the babbling method, imitation method, and the analogy method. The babbling method is a method where the child is asked to pronounce sounds randomly. The imitation method is the method of imitating syllables spoken by speech therapy. The analogy method is using basic sounds. The manipulation method is a method using speech tools such as spatulas. The diagram method is done by drawing the position of the speech organs. The visual method is done by looking at the mirror and then trying to say the letters. There are also the auditive, tactile and motor kinesthetic methods (McCoy et al., 2020). There are some innovations to aid speech therapy, such as using mobile applications to provide long-distance service. However, these applications' qualities have not been reviewed widely, and therefore it has not been possible to generalize their usage (Mariblanca et al., 2019).

The importance of this study is to fill the gap in the current understanding of how specific motor rehabilitation methods can comprehensively improve swallowing and speech function in children with cerebral palsy. While previous research has primarily focused on isolated aspects of therapy, this study seeks to provide a more holistic view by investigating a combined therapy approach. The findings have the

potential to lead to more effective and standardized treatment protocols, especially due to the high prevalence of cerebral palsy in developing countries. Improved rehabilitation outcomes could significantly improve the quality of life of children with cerebral palsy, foster greater independence, and reduce the socioeconomic burden on families and healthcare providers.

Method

This study is a case study that focuses on pediatric patients with Cerebral Palsy who underwent oromotor therapy and speech therapy. Secondary data were collected through the patient's medical records. The data collected will be analyzed for the effectiveness of medical rehabilitation, especially the role of oromotor management and speech therapy in improving the patient's condition. This study was conducted at the "Lombok Care" Children with Disabilities Foundation. For the instruments, this study uses specific measurement tools to collect data. Language development will be assessed using the Messay Language Test 2003, which is already used by pediatricians at the foundation. The effectiveness of oromotor dysfunction management will be evaluated using the method outlined by Debra C. Gangale in her book *The Source for Oral-Facial Exercises* (1993). In addition, a questionnaire will be distributed to the children's parents to collect qualitative data on their observations of their children's progress. The collected data will be analyzed to determine the effectiveness of medical rehabilitation therapy (motor and speech therapy). This analysis will focus on changes in the patient's language development and motor function, by comparing data before and after therapy. The results of the data analysis will be presented in the form of diagrams, graphs, and bar charts. These visual aids will illustrate the differences in development scores and overall improvement experienced by the patient before and after undergoing therapy.

Result and Discussion

The research was conducted at the "Lombok Care" Children with Disabilities Foundation using case studies and secondary data from medical records. There are 5 recorded cases. Several components that are assessed are the ability to express themselves when speaking, ability to understand the speech of others, ability to repeat words spoken by others, and the ability to recognize the names around them.

The graph in Figure 1 was obtained at the beginning, where the children have not been given oromotor therapy and speech therapy yet. The data is

used as a graph and initial reference that can be used to evaluate the success of a therapy performed. As a comparison, another study in Surabaya, Indonesia found a high prevalence of speech disorder in children with CP (95.6%) (Azmi et al., 2020). They found that speech disorder in CP is usually caused by an underlying dysarthria. Dysarthria is a neuromotor disorder characterized by decreased speech intelligibility due to abnormalities in speech control speed, strength, accuracy, range, tone, or duration, while the patient's ability to write and comprehend language remains intact (Jayaraman & Das, 2024). In children with mild cerebral palsy, dysarthria presents as difficulties with articulation and consonant sounds, particularly due to improper tongue placement at the front of the mouth, reduced clarity in producing fricative and affricate sounds, and challenges in articulating extreme vowel sounds. (Nugraha & Sinaga, 2023).

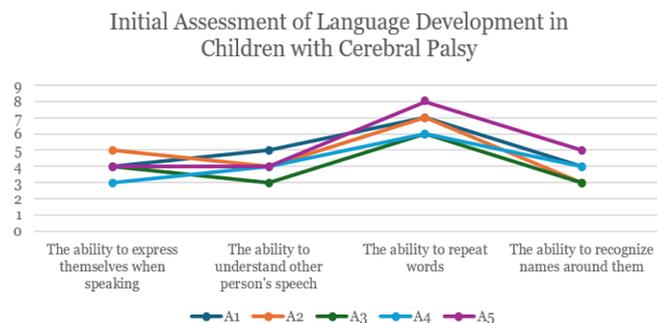


Figure 1. Initial assessment of language development in children with cerebral palsy

The graph in Figure 2 is an assessment graph of children with cerebral palsy that have received Speech Therapy. The graph shows the improvement of language skills after receiving speech therapy. The graph also states that the results of speech therapy can improve language skills. Borel et al. (2019) revealed that the purpose of speech therapy is to improve language and speech skills, especially language production, so that children can convey ideas in the form of language and be able to communicate. Setyono (2000) stated that the purpose of speech therapy is to help individuals with communication disorders, including difficulties with language, speech, voice, and rhythm/fluency, so they can interact with their environment and improve their quality of life to the fullest. Piaget explained that the structure of spoken language in children is the process of sensory-motor relationships that occur in children (Mei et al., 2020).

From birth to 18 months old, children in this process understand the world through their senses (sensory) and other movements (motor). Taqiyah (2022) explained that language is a communication process in the form of messages and feelings. Based on the

definition of the language process, through the stages of imitation (imitating language patterns or vocabulary), conditioning (habituation of words heard), and social cognition (understanding the production of a phoneme). The imitation method is one of the stages of receptive and productive language. In this sense, speech therapy helps stimulate children's language expression. An alternative method found in the literature is oromotor massage. This technique stimulates and improves speech and language development in babies aged 12-18 months. The maturation of the orofacial muscles results in children being better at speaking, chewing, and swallowing (Siregar et al., 2024).

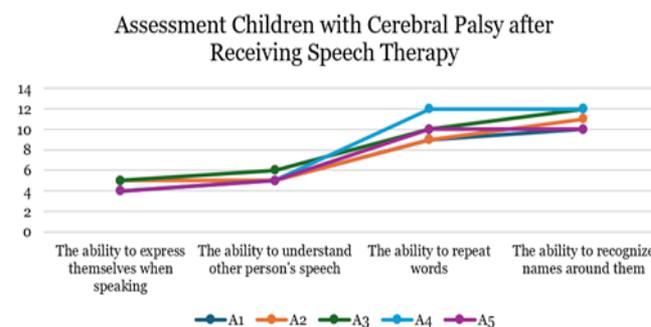


Figure 2. Assessment chart of children with cerebral palsy after receiving speech therapy

The data collection was also carried out on cerebral palsy patients with oromotor therapy. An assessment is conducted after performing the oromotor therapy to determine its effectiveness. Before the therapy, a baseline assessment is conducted (figure 3). Swallowing assessment includes examining residue levels, aspiration degree, cough reflex during aspiration, velopharyngeal movement, lingual tonsil, vocal cord movement, standing secretion, pharyngeal lateral wall muscle tone, and hypopharyngeal sensitivity. In a study done in Jakarta, Indonesia, the prevalence of oromotor dysfunction in CP is (98%) (Hafifah et al., 2017). Dysphagia is common among CP patients, and as such, many aspiration cases are found. Oromotor dysfunction is also found to correlate with recurrent pneumonia in CP patients, possibly caused by chronic aspirations (Kürtül Çakar & Cinel, 2021), which the current consensus suggest to do routine assessment of risk factors (Gibson et al., 2021). As oromotor dysfunction impairs food intake, the nutritional status of CP patients is usually lower than normal children, where a higher degree of impairment results in lower nutritional status (Dutra et al., 2019; Mouilly et al., 2022).

In Figure 4, there is an increase in the assessment score after being given oromotor therapy. Wiratningrum (2024) stated that there are phases in the swallowing process, which includes the oral phase and pharyngeal phase. Insufficiency in the velopharynx causes food to

enter the nasal cavity and pharynx resulting in aspiration. The weak velopharyngeal movement is due to lingual abnormalities. Impaired movement of the lateral wall muscles of the pharynx can cause residue and affect standing secretion. Disturbances in the pharyngeal phase led to inhibited swallowing reflexes and aspiration. As research conducted by Yosrika et al. (2024) showed, there is an increase in movement both kinetically and mechanically and an increase in the strength of swallowing muscles in patients with swallowing disorders in cerebral palsy. Based on their study, the oromotor function increased by 50% from baseline. With the management of oromotor dysfunction, the therapy can increase the intake of nutrients due to the better coordination of the oropharyngeal muscles. As a result, oromotor improvement might also lead to better nutritional status. Wardhani et al. conducted a family-based rehabilitation oromotor exercise for pediatric oral phase dysphagia and they found a consistent increase of body weight during the treatment as the dysphagia improved (Wardhani et al., 2023). Functional Chewing Training is also found to be useful in optimizing chewing, swallowing, and drooling compared to standard treatment (Banzato et al., 2022). Despite these studies, systematic review has not found sufficient evidence that supports oromotor exercises on feeding in CP patients (El Nagar et al., 2021).

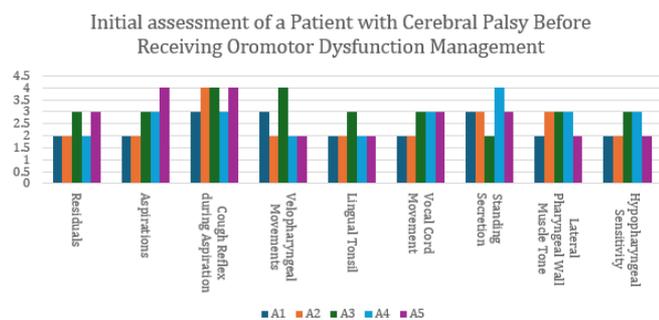


Figure 3. Initial assessment of a patient with Cerebral palsy before receiving oromotor dysfunction management

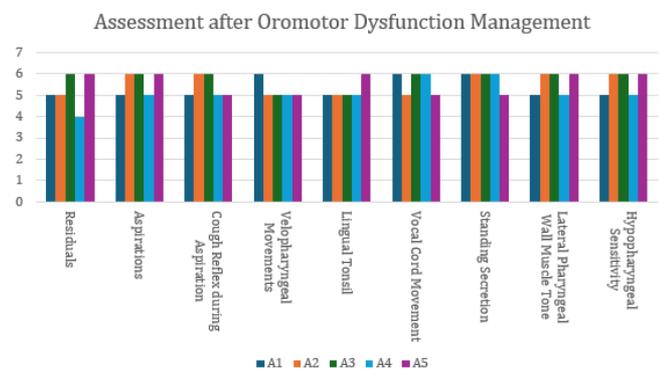


Figure 4. Assessment after oromotor dysfunction management

A study by Widman-Valencia showed better feeding and swallowing skills in CP patients after oromotor therapy compared to the non-treatment group. The therapy shows improvements in 4 out of 7 aspects: jaw mobility, tongue activity, abnormal reflexes, and breathing control (Widman-Valencia et al., 2021). Apart from having better nutritional status, oromotor therapy also shows a lower recurrence rate of respiratory diseases (Marpole et al., 2020; Widman-Valencia et al., 2021).

Conclusion

Intervention for oromotor dysfunction and speech therapy has proven to be effective in improving eating, swallowing, and speaking abilities in children with cerebral palsy.

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Author Contributions

Conceptualization, A.A.A.N.W. and N.U.; Methodology, A.A.N.W., A.D., and L.S.S.; Validation, A.A.N.W., N.U., and A.D.; Formal Analysis, A.A.A.N.W.; Investigation, A.A.A.N.W. and L.S.S.; Resources, N.U. and L.S.S.; Data Curation, A.A.A.N.W. and N.A.R.P.; Writing-Original Work, A.A.N.W.; Writing-Review and Editing, A.A.A.N.W. and N.A.P.R.; Visualization, A.A.A.N.W. and A.D. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest

We declare that we have no conflicts of interest related to the publication of this study. We have no financial or personal relationships with other people or organizations that could inappropriately influence our work.

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