

Cerebral palsy: causes and treatment alternatives, based on the evidence provided by gait analysis

Abstract

Cerebral palsy is a pathology whose origin is in the immature nervous system, its common denominator is the loss of selective motor control, accompanied by other manifestations derived from the neurological injury, such as abnormal tone, balance disorders, and proprioception, so which results in a central motor dysfunction, presenting alterations of muscles and skeleton during the development of the child. Current concepts on biomechanical mechanisms governing normal and pathological gait, have been provided by a tool known as a gait lab, that allows us to obtain a series of data and measurements objectively and accurately. The Gait analysis has allowed us to understand how and why these alterations compromise the normal ambulation, being able to present protocols of treatment much more effective and lasting

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Introduction

By definition Cerebral Palsy is a static brain injury or lesion in prenatal, perinatal, or postnatal period (up to 2 years).¹ The natural history of patients who have cerebral palsy² is one of decline in ambulatory function.

An international review³ of "The Definition and Classification of Cerebral Palsy" in 2006 defines CP as: *"A group of permanent disorders of the development of movement and posture, causing activity limitation, that are attributed to non-progressive disturbances that occurred in the developing foetal or infant brain. The motor disorders of cerebral palsy are often accompanied by disturbances of sensation, perception, cognition, communication, and behaviour, by epilepsy, and by secondary musculoskeletal problems."*

As a result, without treatment, the gait of patients who have the necessary motor skills to walk will deteriorate over time.⁴ For them, walking may become more exhausting⁵ and/or painful, and they will require more assistance to remain mobile.^{4,6}

Overview of treatments

For children who have cerebral palsy, treatments to improve or maintain walking function typically include measures to reduce high muscle tone and orthopedic surgery to correct bony deformities, balance muscles and improve joint function.⁷ Gait analysis helps guide the specific types of intervention. One of the key benefits of gait and motion analysis is the ability to accurately and quantitatively measure⁸ patients' gait patterns.⁹⁻¹¹ These data allow us to objectively identify orthopedic and neuromuscular problems¹⁰ and then use clinical expertise and guidance from existing evidence to recommend treatments.¹¹ This assessment and review of results has enabled discard surgical procedures that were useless and even harmful; allowing to know much better the problem. Gait data are also useful as a tool for assessing outcomes.¹² By measuring changes in the gait pattern after treatment, we also can gauge the efficacy of treatments in an unbiased and precise manner.¹²

Treatments for the management of high tone

Injectable medications such as botulinum toxin A or phenol are injected directly into the muscle. Botulinum toxin A temporarily weakens the muscle and reduces high muscle tone. Phenol reduces high muscle tone by acting on the nerve, not the muscle. Botulinum toxin A injections given at multiple levels (e.g., hips, knees and ankles at the same time) may require sedation or general anesthesia in the operating room (OR), but do not require overnight stays.

An intrathecal baclofen pump (ITBP) delivers a medication (baclofen) to the intrathecal space around the spinal cord via a thin catheter that extends from an implanted pump to the spine. A neurosurgeon implants the pump under the skin of the abdomen during an inpatient stay.

Selective dorsal rhizotomy (SDR) is a procedure intended to reduce spasticity,^{13,14} one type of high muscle tone. During an SDR, sensory nerve rootlets at the lumbar and sacral levels of the spinal cord are electrically stimulated to determine if they trigger a normal or an abnormal response. Those producing an abnormal response are cut, thus reducing spasticity. An inpatient stay is required for this procedure. Primordial attention in the indication of the procedure is the selection of the patient.

Corrective orthopedic surgery of the lower extremities

Orthopedic surgery is often recommended to relieve contractures and correct bone and joint misalignments.¹⁰ In children with cerebral palsy, tone management usually occurs first.

Single-event multilevel surgery (SEMLS) refers to multiple bone and soft-tissue orthopedic procedures performed at more than one level (hip, knee, ankle or foot) during one episode of anesthesia. The approach is based on the premise that for children who have cerebral palsy and other complex gait disorders, it is best to correct all deformities simultaneously to optimize and balance muscle and joint function. SEMLS reduces the need for multiple isolated admissions and repeated episodes of anesthesia. This type of procedure would not be possible without tools such as gait analysis.^{10,11}

Conclusion

The gait analysis allows the application of the scientific method: Collect facts. Organize these facts into principles or laws, Postulate hypothesis to explain the facts and laws and compare the hypothetical deduction with the experimental results. Definitely, the pathology is better understood as well as the principles that govern it, so we can apply evidence-based methods for its treatment.

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Conflicts of interest

Authors have no conflict of interest to declare.

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