The Effects of Quantitative Gait Assessment and Botulinum Toxin A on Musculoskeletal Surgery in Children with Cerebral Palsy

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THE EFFECTS OF QUANTITATIVE GAIT ASSESSMENT AND BOTULINUM TOXIN A ON MUSCULOSKELETAL SURGERY IN CHILDREN WITH CEREBRAL PALSY

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Background: The limits of nonoperative treatment for children with cerebral palsy, including physical therapy and orthotics, commonly lead to orthopaedic surgical intervention. The purpose of the present study was to evaluate the influence of gait analysis and botulinum toxin type-A injections on the timing, prevalence, and frequency of orthopaedic surgery.

Methods: We performed a retrospective review of 424 children with cerebral palsy who had been born between 1976 and 1994. The children were divided into three groups: Group 1 comprised 122 patients who were managed throughout the entire study period according to best-practice guidelines in orthopaedics, Group 2 comprised 170 patients who were similarly managed but with input from gait analysis, and Group 3 comprised 132 patients who had gait analysis and also received botulinum toxin type-A injections. We analyzed the prevalence of orthopaedic surgical procedures at different ages (three to nine years) and the time to the first surgical procedure.

Results: The progression to orthopaedic surgery was significantly different among the three groups ($p < 0.0001$). The proportion of patients who had undergone at least one surgical procedure by the age of seven years was 52% (sixty-four of 122) for Group 1, 27% (forty-six of 170) for Group 2, and 10% (thirteen of 132) for Group 3. There was a delay in surgery in Group 2 as compared with Group 1 ($p < 0.00001$ at seven, eight, and nine years of age) and a significant decrease in the prevalence of orthopaedic surgical procedures for Group 3 as compared with Group 1 ($p < 0.00001$ at four to eight years of age) and Group 2 ($p < 0.0025$ at four to nine years of age).

Conclusions: In the treatment of children who have cerebral palsy, the introduction of gait analysis increases the age of the first orthopaedic surgical procedure and botulinum toxin type-A treatment delays and reduces the frequency of surgical procedures.

Level of Evidence: Therapeutic Level III. See Instructions to Authors for a complete description of levels of evidence.

Children with cerebral palsy present with a variety of motor problems that can change with growth and development[1-4]. Primary motor problems and associated secondary problems typically cause gait disturbance. Primary motor problems are directly related to a lesion in the central nervous system and influence muscle tone (defined as a velocity-dependent increase in tonic stretch reflexes)[5,6], balance, strength, and selective motor control of different muscle groups. Secondary problems, primarily static muscle contractures and osseous deformities, develop slowly over time in response to the primary motor problems and growth[3,7,8]. Orthopaedic surgical intervention to improve gait should be postponed, if possible, until motion patterns are well established[3,8-10]. Newly developed motion patterns are characterized by inconsistency or large intrasubject variability[3]. Careful gait evaluation may define the age of consistent gait for normal children and for children with cerebral palsy[11-15]. Operative treatment before the attainment of a well-established gait pattern is associated with a higher risk of failure and relapse with less predictable results[3,8-10]. Therefore, it is generally recommended that surgical intervention to improve gait should be delayed until gait is well established as a stable motion pattern, usually between the ages of eight and ten years[11-15].

Nonoperative options for the treatment of motor problems in patients with cerebral palsy include physical and occupational therapy, orthotics, serial casting, and oral medication. Physical and occupational therapy remain corner-