

Forearm Pronation Deformity in Pediatric Cerebral Palsy: A Systematic Review of Nonsurgical and Surgical Management

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INTRODUCTION:

Forearm pronation deformity is a common upper limb impairment in children with cerebral palsy (CP). Due to spasticity of the pronator muscles, there is limited supination to achieve daily tasks, thereby reducing functional independence and quality of life. Although there are viable nonsurgical and surgical options, the optimal approach remains controversial, with limited consensus on selection criteria, treatment choice, outcome expectations, and long-term efficacy. This systematic review aimed to (1) identify clinical criteria guiding the selection of surgical versus nonsurgical treatment, (2) compare functional outcomes, (3) assess complication rates, and (4) evaluate the ability of each approach to enhance supination without sacrificing residual pronation.

METHODS:

A systematic search of MEDLINE, Embase, and Cochrane Library through June 2025 identified studies evaluating the treatment of forearm pronation deformity in children with CP. Inclusion criteria were primary clinical studies (RCTs, cohorts, case-controls) involving CP patients <21 years undergoing surgical or nonsurgical intervention for pronation deformity and reporting relevant outcomes. Exclusion criteria included adult-only studies, reviews, cadaveric or technical papers, studies lacking pronation-specific outcomes, and case series with fewer than 5 patients. Studies were assessed using PRISMA guidelines, and data were extracted on patient demographics, intervention type, outcome measures, supination/pronation range, and complications. A total of 136 articles were screened, and 28 met the inclusion criteria. Data extracted included patient demographics, intervention type, outcomes (ROM, function), follow-up duration, and complications. Given the variability in study designs, populations, and outcome measures, results were synthesized qualitatively.

RESULTS:

Treatment selection for forearm pronation deformity in children with CP is guided by the severity of the deformity, passive and active supination, functional impairment, and the prior response to nonsurgical interventions, such as botulinum toxin (BoNT-A). BoNT-A and constraint-based therapies are commonly used in younger children with dynamic deformities and retained motor control. Surgical procedures, including pronator teres rerouting, tendon transfer, or selective neurectomy, are typically reserved for patients with static or progressive deformities, limited active supination, or failed conservative care. Surgical intervention for forearm pronation deformity consistently resulted in greater and more lasting improvements in active supination and upper limb function compared to nonsurgical methods. Although treatments such as BoNT-A and therapy provided short-term benefits in select cases, surgical procedures achieved more reliable outcomes when applied in conjunction with individualized planning and appropriate patient selection. Both surgical and nonsurgical treatment approaches were associated with low complication rates. BoNT-A was generally well tolerated, with only mild and temporary side effects. Surgical procedures carried minimal risk and remained safe when performed in appropriately selected patients with structured perioperative planning. An equally important goal in treating forearm pronation deformity is improving supination without compromising residual pronation. Surgical techniques such as pronator teres transfer, selective neurectomy, and combined tendon procedures have demonstrated consistent success in achieving this balance, particularly when guided by careful preoperative assessment. In contrast, nonsurgical interventions, such as BoNT-A and constraint-based therapy, yielded only modest and temporary gains, with a limited effect on active supination and less predictable preservation of functional range.

DISCUSSION:

In summary, forearm pronation deformity in children with CP is best managed through a patient-specific approach that considers the severity of the deformity, functional goals, and the patient's prior response to therapy. While nonsurgical options may offer early or adjunctive benefit, surgical interventions remain the most effective strategy for achieving durable improvements in supination and upper limb function, particularly when preservation of residual pronation is essential. When the primary surgical goal is maximal restoration of supination and full passive supination is available preoperatively, pronator teres rerouting offers a slight advantage over other techniques. Ongoing research, with standardized outcome reporting and long-term follow-up, will be critical for refining treatment algorithms and optimizing patient selection.

SIGNIFICANCE/CLINICAL RELEVANCE:

This review supports a tailored, criteria-based approach to managing forearm pronation deformity in CP. The literature suggests that surgical correction provides the most reliable gains in supination without compromising pronation, therefore optimizing the functional use of the upper limb in affected children.