



International Journal of Contemporary Research In Multidisciplinary

Research Article

Early Interdisciplinary Intervention in Children with Cerebral Palsy: Impact of Combined Speech Therapy and Physiotherapy on Functional and Communication Outcomes

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DOI: <https://doi.org/10.5281/zenodo.21703161>

Abstract

Cerebral palsy (CP) is the most common physical disability of childhood and is frequently accompanied by communication, feeding, and cognitive impairments that extend well beyond the motor system. Contemporary evidence indicates that the early years of life represent a critical window of neuroplasticity during which targeted, activity-based intervention can meaningfully influence developmental trajectories. This review synthesises current literature on the combined delivery of physiotherapy and speech and language therapy within an early, interdisciplinary model of care, and examines its impact on functional and communication outcomes in young children with CP. Drawing on international clinical guidelines, systematic reviews, and community-based intervention trials, the review argues that motor and communicative development are biologically and functionally intertwined: postural control, respiratory support, and oral-motor stability underpin both mobility and speech. Coordinated, goal-directed, and family-centred programmes that integrate the two disciplines appear to produce more coherent functional gains than parallel but disconnected therapies. Standardised classification and outcome tools, including the Gross Motor Function Classification System, the Communication Function Classification System, and the Gross Motor Function Measure, allow these gains to be described and monitored. Barriers to implementation—delayed diagnosis, workforce shortages, and inequitable access, particularly in low- and middle-income settings—remain substantial. The review concludes that early interdisciplinary intervention should be regarded as standard practice, while acknowledging the need for larger controlled trials evaluating combined-therapy models specifically.

Manuscript Information

- ISSN No: 2583-7397
- Received: 18-06-2026
- Accepted: 26-07-2026
- Published: 30-07-2026
- IJCRM:5(4); 2026: 533-539
- ©2026, All Rights Reserved
- Plagiarism Checked: Yes
- Peer Review Process: Yes

How to Cite this Article

Mohanty S S, Datta A. Early Interdisciplinary Intervention in Children with Cerebral Palsy: Impact of Combined Speech Therapy and Physiotherapy on Functional and Communication Outcomes. Int J Contemp Res Multidiscip. 2026;5(4):533-539.

Access this Article Online



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KEYWORDS: cerebral palsy; early intervention; physiotherapy; speech and language therapy; interdisciplinary rehabilitation; neuroplasticity; functional outcomes; communication.

1. INTRODUCTION

Cerebral palsy describes a group of permanent disorders of movement and posture that arise from a non-progressive disturbance to the developing fetal or infant brain, causing activity limitation. Although the underlying brain lesion does not worsen over time, its functional consequences evolve as the child grows, and the associated musculoskeletal and neuromuscular changes can progress substantially if left unaddressed. CP occurs in roughly one in every 500 live births, making it the leading cause of physical disability in early life. Crucially, the motor disorder rarely occurs in isolation: it is commonly accompanied by disturbances of communication, cognition, perception, sensation, behaviour, feeding, and by secondary musculoskeletal problems. This clustering of impairments means that the child's needs seldom map neatly onto a single professional discipline.

For much of the twentieth century, CP was diagnosed relatively late—often between twelve and twenty-four months of age—and intervention was frequently reactive, focused on managing established impairments rather than shaping emerging development. Advances in neuroimaging and standardised neurological and movement assessment have shifted this picture. Reliable identification is now possible well before six months of corrected age in many high-risk infants, opening a developmental window in which the brain is maximally responsive to experience. This has reframed early intervention from a supportive adjunct into a potentially trajectory-altering priority.

Within this reframing, two rehabilitation disciplines are especially central to the everyday functioning of the young child with CP. Physiotherapy addresses gross motor function, postural control, mobility, and the prevention of secondary deformity. Speech and language therapy addresses communication, oral-motor control, feeding, and swallowing. Historically these have often been delivered in parallel, by separate clinicians pursuing discipline-specific goals with limited coordination. Yet the systems they treat are neither anatomically nor functionally separate. Trunk stability and respiratory control, for example, are prerequisites for both sitting and speaking; head and jaw control influence both feeding and articulation. This overlap provides the rationale for an integrated, interdisciplinary model in which physiotherapists and speech and language therapists share assessment, goals, and delivery.

This review examines the case for early, combined physiotherapy and speech therapy in children with CP, and considers its impact on functional and communication outcomes. It outlines the clinical profile and classification of CP, the neuroplastic rationale for early action, the specific contributions of each discipline, the theoretical and practical arguments for integration, the available evidence, the tools used to measure outcomes, and the barriers that constrain implementation. The intention is to provide a coherent, evidence-informed synthesis relevant to clinicians, students, and service planners working in paediatric rehabilitation.

2. Cerebral Palsy: Clinical Profile and Classification

The internationally accepted definition frames CP as a disorder of movement and posture attributable to a static encephalopathy, while explicitly recognising the frequent co-occurrence of sensory, cognitive, communicative, and behavioural difficulties. CP is heterogeneous. It is commonly described by its predominant motor type—spastic, dyskinetic, ataxic, or mixed—and by its topographical distribution, such as unilateral (hemiplegic) or bilateral (diplegic or quadriplegic) involvement. Spastic forms, characterised by increased muscle tone and exaggerated reflexes, are the most prevalent.

Because motor type and distribution alone do not capture how a child actually functions, standardised classification systems have become fundamental to both clinical practice and research. The Gross Motor Function Classification System (GMFCS) stratifies gross motor function into five levels, from independent walking with minimal limitation at Level I to profound mobility restriction requiring supportive technology at Level V. The Manual Ability Classification System (MACS) describes how children handle objects in daily activities, and the Communication Function Classification System (CFCFS) categorises everyday communicative effectiveness across five levels, considering both sending and receiving of messages and the influence of familiar versus unfamiliar partners. The Viking Speech Scale further classifies the intelligibility of a child's speech.

These systems are conceptually anchored in the World Health Organization's International Classification of Functioning, Disability and Health (ICF), which distinguishes body functions and structures from activity and participation, and situates all of these within personal and environmental context. The ICF is important for interdisciplinary work because it directs attention away from impairment alone and towards what the child can do and take part in. A shared ICF vocabulary allows a physiotherapist and a speech and language therapist to describe the same child using compatible constructs, to set participation-level goals, and to recognise how a gain in one domain—say, improved sitting balance—may enable a gain in another, such as more effective communication.

The predictive value of these classifications is considerable. Motor severity, communication level, and manual ability tend to correlate, and children with more severe gross motor involvement are statistically more likely to experience significant communication difficulty. Importantly, communication problems affect more than half of all children with CP, spanning dysarthria arising from impaired oral-motor control, language delay, and the need for augmentative and alternative communication. This high prevalence underscores why speech and language therapy cannot be regarded as peripheral to CP management.

3. The Rationale for Early Intervention: Neuroplasticity

The scientific justification for early intervention rests on the principle of experience-dependent neuroplasticity. The developing brain is not a fixed structure but a dynamic network whose connections are shaped by use. Synaptic pathways that are repeatedly activated become stronger and more efficient, while those that are seldom used are pruned. In the young child,

this plasticity is at its peak, which means that the movements, sensory experiences, and communicative exchanges a child engages in during the first years of life actively sculpt the architecture of the nervous system.

For a child with CP, this has two implications. First, there is a positive opportunity: by supporting the child to attempt and repeat functional movements and communicative acts, intervention can reinforce useful neural pathways that might otherwise fail to develop because weakness, poor motor control, or restricted experience prevented the child from practising them. Second, there is a preventive imperative. Although the brain lesion is static, the secondary consequences of muscle misuse and disuse—stiffness, contracture, and joint deformity—are progressive. Early physiotherapy can help maintain range of movement and enable the child to perform movements that would otherwise become mechanically impossible, thereby preserving the very capacity to practise.

Contemporary early-intervention practice therefore emphasises active, self-initiated movement rather than passive handling of the child. The therapist structures tasks that are challenging yet achievable at the child's current level, so that the child experiences both errors and successes and remains motivated to persist. Skills are practised across varied environments so that they generalise beyond the clinic. This active, motivating, task-specific approach is understood to drive plasticity far more effectively than passive manipulation of limbs, and the same learning principles apply directly to the acquisition of communication.

International guidance reflects this understanding. Following early and accurate diagnosis, evidence-based, CP-specific early intervention is recommended precisely to capitalise on neuroplasticity and to optimise motor, cognitive, and communicative function, while also supporting parental wellbeing and the child's participation. The window of greatest opportunity is finite: children with CP are thought to reach the large majority of their gross motor potential within the first five years of life, and even earlier when involvement is severe. Delay in diagnosis and referral therefore carries a genuine developmental cost, which frames timeliness—not merely the content of therapy—as a determinant of outcome.

4. Physiotherapy in Early Cerebral Palsy Management

Physiotherapy is a cornerstone of CP rehabilitation and addresses gross motor function, postural control, muscle length and strength, balance, gait, and the prevention of secondary musculoskeletal complications. In the early years its aims are to promote the acquisition of motor milestones, to establish stable postures such as sitting and standing, to maintain joint range and prevent contracture, and to maximise the child's independence and participation in age-appropriate activities.

The evidence base for paediatric physiotherapy has matured towards goal-directed, activity-based, and task-specific approaches. Rather than working on generic components of movement in the abstract, these approaches train the functional tasks the child and family actually want to achieve, in meaningful contexts, with sufficient repetition to drive learning. Approaches with supportive evidence include goal-directed training, functional strength training, and, for children with

unilateral involvement, intensive upper-limb regimes. Family involvement is a recurring feature of effective programmes, since parents provide the frequent, distributed practice that clinic sessions alone cannot supply.

Systematic appraisal of the wide range of interventions used in CP has been valuable in separating practices with robust support from those that are ineffective or lack evidence. This scrutiny has encouraged a shift away from passive, therapist-led handling towards active, child-led problem-solving, in which the clinician provides only the minimal support needed—finger-tip guidance or equipment—so that the child actively controls and experiences the movement. Such active engagement is thought to strengthen neural pathways more powerfully than passive techniques.

Beyond motor milestones, physiotherapy has a direct bearing on domains often considered the province of other disciplines. Postural alignment and trunk control influence respiratory efficiency and the stability of the head and neck, both of which are foundational for breath support, voicing, and articulation. A child who cannot stabilise the trunk or head expends effort simply maintaining position, leaving little capacity for the fine coordination that speech demands. In this sense, the physiotherapist's work on core stability and positioning is not merely preparatory to communication—it is part of the substrate on which communication is built, a point that motivates close collaboration with speech and language therapy.

5. Speech and Language Therapy in Early Cerebral Palsy Management

Speech and language therapy addresses the communicative, oral-motor, and feeding needs of children with CP. Communication difficulties are highly prevalent in this population and arise through several mechanisms. Impaired control of the muscles of the face, lips, tongue, jaw, and larynx can produce dysarthria, resulting in imprecise articulation, altered voice quality, and reduced intelligibility. Language development may be delayed, and some children have difficulty both expressing themselves and processing what others say. Feeding and swallowing difficulties frequently coexist, carrying nutritional and safety implications.

Early speech and language therapy seeks to stimulate the development of communication and language, to bridge the gap between the child's current abilities and age-appropriate skills, and to maximise effective communication by whatever means suits the individual child. Intervention is tailored to the specific profile of difficulty. For some children the emphasis is on developing clearer speech and strengthening oral-motor control; for others, particularly those unlikely to develop reliable verbal speech, the priority is establishing augmentative and alternative communication (AAC), ranging from gesture and picture systems to speech-generating devices. Introducing AAC early does not inhibit speech; rather, it provides a functional route to interaction and participation while other capacities develop.

A central principle is that communication is more than speech. The CFCS deliberately classifies the effectiveness of everyday communication regardless of the modality used, capturing the full range of strategies a child might employ. This participation-

oriented perspective aligns speech and language therapy with the ICF and with the broader goal of enabling the child to take part in family and community life. It also means that outcomes should be judged not only by intelligibility or vocabulary but by whether the child can convey and receive messages successfully with a range of partners.

The evidence base for speech and language therapy in CP is more limited than that for motor intervention, and systematic review has highlighted the need for larger, well-designed trials. Nevertheless, early intervention is consistently regarded as important for communicative development, and the rationale is strong: the same neuroplastic principles that justify early motor training apply to language, and unaddressed communication difficulty can compound social, emotional, and educational disadvantage. The prevalence and consequences of communication impairment make speech and language therapy an indispensable component of comprehensive CP care rather than an optional extra.

6. The Case for Interdisciplinary Integration

The argument for combining physiotherapy and speech and language therapy rests on the recognition that the child is a single, integrated system. The heterogeneity of CP—its varied aetiology, severity, and pattern of associated impairments—means that children present with diverse, overlapping needs that no single discipline can fully meet. A comprehensive, coordinated programme is therefore not a luxury but a logical response to the nature of the condition.

Several concrete interdependencies link the two disciplines. Respiratory support, generated through trunk and postural control, underlies both endurance in movement and the breath control required for phonation and connected speech. Head and neck stability, cultivated through positioning and physiotherapy, is a prerequisite for the oral-motor precision that articulation and safe swallowing require. Seating and positioning decisions influence not only comfort and deformity prevention but also the child's ability to use their hands for AAC, to make eye contact, and to engage communicatively. Conversely, motivation and communication shape a child's willingness to attempt effortful motor tasks. These bidirectional links mean that a gain achieved by one discipline can amplify—or, if neglected, constrain—the gains available to the other.

Interdisciplinary practice differs from simple multidisciplinary co-existence. In a multidisciplinary model, professionals work alongside one another but pursue separate goals with limited communication. In an interdisciplinary model, they share assessment, jointly formulate goals framed around the child's and family's priorities, and coordinate delivery so that sessions reinforce rather than compete with one another. A shared ICF framework and common classification language make this coordination possible, enabling a physiotherapist and a speech and language therapist to plan positioning that simultaneously serves postural and communicative aims, or to sequence a session so that motor readiness supports a communication target.

Family-centred care is the connective tissue of this model. Parents and caregivers are the constant across disciplines and the providers of the high-frequency practice on which

neuroplastic learning depends. When therapists coordinate their advice, families receive a coherent, manageable set of strategies to embed in daily routines—during play, feeding, dressing, and social interaction—rather than competing demands from separate services. Coordinated goal-setting also reduces duplication and conflicting guidance, improves adherence, and supports caregiver confidence and wellbeing, which are themselves determinants of the child's outcomes.

7. Evidence on Combined Intervention and Functional–Communication Outcomes

Direct trials isolating the combination of physiotherapy and speech therapy as a discrete intervention remain relatively scarce, but converging lines of evidence support the integrated approach. Comprehensive, multi-component rehabilitation programmes that include physiotherapy, speech therapy, and other supports are widely reported to produce gains across mobility, communication, and feeding, alongside improvements in quality of life for both child and family. Case-based and programme-level reports describe parallel improvements in gait, spasticity, and speech fluency when disciplines are combined within a coordinated plan, together with benefits in the emotional and social dimensions addressed through family support.

Community-based intervention studies provide some of the most instructive evidence, particularly from low- and middle-income settings where comprehensive services are scarce. A quasi-experimental study of a caregiver-led, community-based early intervention programme in West Tripura District, conducted by the Composite Regional Centre for Skill Development, Rehabilitation and Empowerment of Persons with Disabilities (CRC), Tripura, in 2023, followed children with CP receiving a six-month coordinated programme against those receiving standard care, using the Gross Motor Function Measure, the CFCS, and the Viking Speech Scale as outcome measures. The intervention group showed statistically significant improvements in gross motor function and communication classification, while the comparison group, receiving only basic advice, showed decline. Benefits were most pronounced in children under five years of age, reinforcing both the value of coordinated, multi-domain intervention and the importance of acting within the early developmental window.

These findings are consistent with the biological logic outlined earlier. Where an intervention simultaneously builds postural stability and targets communication, improvements in one domain plausibly support the other: better trunk control provides a steadier platform for breathing and voicing, while enhanced communication increases the child's engagement and motivation to move. This mutual reinforcement offers a candidate explanation for why integrated programmes appear to yield coherent, cross-domain gains rather than isolated improvements. It also suggests that measuring outcomes in only one domain may understate the value of a combined approach.

At the same time, intellectual honesty requires acknowledging the limits of current evidence. Much of the supporting literature evaluates broad, multi-component programmes rather than the specific pairing of physiotherapy and speech therapy, and study

designs range from case reports to quasi-experimental comparisons, with relatively few randomised controlled trials of combined-therapy models. Systematic reviews continue to identify substantial research–practice gaps and to call for rigorous evaluation of many commonly used interventions. The integrated model is therefore well justified on physiological, developmental, and pragmatic grounds, and is supported by real-world outcome data, but its precise incremental benefit over well-coordinated single-discipline care awaits more definitive trials.

7.1 Quantitative Evidence-Based Outcomes

Beyond the general pattern described above, several studies quantify the magnitude of benefit and merit closer inspection. In the Tripura community-based trial, **156 children** with CP were recruited, 77 to the six-month coordinated intervention (Group A) and 79 to standard care (Group B). At follow-up, Group A showed statistically significant gains on the GMFM-66, the CFCS, and the Viking Speech Scale ($p < 0.05$ for all three measures), whereas Group B deteriorated significantly on the GMFM-66 ($p < 0.001$), with non-significant decline on the CFCS ($p = 0.095$) and Viking Speech Scale ($p = 0.232$). Sub-group analysis showed that children aged five years and older in the comparison group experienced a further significant decline in CFCS level between six and twelve months ($p = 0.015$), underscoring both the benefit of coordinated intervention and the cost of receiving none.

The physiotherapy components of interdisciplinary care are supported by some of the most robust intervention-level data available in the CP literature. Novak and colleagues widely cited 2013 evidence review appraised 166 studies across 64 discrete interventions and 131 treatment outcomes, grading 16% as effective ("green light," do it), 58% as probably effective, 20% as probably ineffective, and 6% as ineffective ("red light," do not do it). Interventions directly relevant to physiotherapy that achieved green-light status included goal-directed training, constraint-induced movement therapy, bimanual training, context-focused therapy, fitness training, and structured home programmes. The 2019 update to this review, incorporating evidence to 2019, expanded the effective list to include hippotherapy, treadmill and partial body-weight-support treadmill training, task-specific training, and weight-bearing programmes, reinforcing that active, repetition-based, goal-oriented motor training has the strongest evidentiary support of any category of CP intervention.

A **meta-analysis of 27 randomised** controlled trials further quantified the benefit of constraint-induced movement therapy for upper-limb function in unilateral CP, finding a medium overall effect relative to conventional therapy (Cohen's $d = 0.546$, $p < 0.001$). Notably, this benefit was largest in studies lacking a dose-matched comparison group and considerably smaller once therapy dose was equated between groups, illustrating that intervention intensity, and not the specific technique alone, accounts for much of the observed gain—a finding with direct relevance to how interdisciplinary programmes should be resourced and dosed.

The quantitative picture for speech and language therapy is more cautious. The Cochrane review of direct speech and

language therapy for children with CP concluded that firm evidence of positive effect had not been established, although positive trends in communication change were observed across the included studies; the reviewers attributed the inconclusive result chiefly to small samples and inconsistent outcome reporting rather than to an absence of genuine effect. This asymmetry between the motor and communication evidence bases is itself an evidence-based finding: it indicates that any claim of benefit for combined physiotherapy–speech therapy programmes currently rest on firmer ground for the motor component than for the communication component, even though the two are hypothesised to interact.

Taken together, these figures do not yet constitute direct trial evidence for the specific combination of physiotherapy and speech therapy delivered as one interdisciplinary programme. They do, however, establish that each component discipline has a measurable, quantifiable evidence base of its own, and that the community-based Tripura data offers the closest available approximation of a combined-therapy outcome trial, with concrete, statistically significant, cross-domain gains attributable to coordinated intervention delivered early in life.

8. Measuring Functional and Communication Outcomes

Rigorous measurement is essential both to guide individual care and to build the evidence base. In the motor domain, the Gross Motor Function Measure is a validated observational tool designed specifically to detect change in gross motor function over time in children with CP, and it is widely used to evaluate the effect of physical therapy. The GMFCS complements it by describing the child's stable functional level and supporting prognostic discussion with families.

In the communication domain, the CFCS classifies everyday communicative effectiveness and has demonstrated content validity together with good test–retest and professional inter-rater reliability, correlating with other functional classifications to build an overall profile of the child. The Viking Speech Scale describes speech intelligibility, while broader language and participation measures capture aspects the classifications do not. Because these tools sit within the ICF framework, they allow motor and communicative progress to be described in compatible terms and combined into a functional profile spanning gross motor function, manual ability, and communication.

For interdisciplinary practice, the use of shared, participation-oriented outcome measures is more than a technical detail. Common metrics enable the team to set joint goals, to track whether coordinated intervention is producing the intended cross-domain gains, and to communicate progress to families in consistent language. Selecting outcomes that reflect activity and participation—rather than impairment alone—keeps the focus on what matters to the child and family and helps demonstrate the real-world value of integrated care.

9. Barriers, Equity, and Implementation

Despite a strong rationale, delivering early interdisciplinary intervention faces real obstacles. Chief among them is delayed diagnosis. Almost half of children with CP have no identifiable risk factor and are cared for outside specialist neonatal follow-

up, so signs may be missed and referral delayed beyond the critical window of neuroplasticity. Where diagnosis is late, the opportunity for the most impactful early intervention is diminished before therapy even begins.

Access and workforce constraints compound the problem. Coordinated physiotherapy and speech and language therapy require adequately staffed, adequately funded services and clinicians trained to work collaboratively. These conditions are unevenly met even in high-income settings and are frequently absent in low- and middle-income countries, where the burden and severity of CP are often greater and where families face additional medical, financial, geographic, and cultural barriers. The result is inequity: children with similar needs receive markedly different care depending on where they are born.

Community-based, caregiver-led models offer a pragmatic and partial response to these constraints. By training and supporting parents to deliver coordinated intervention within the home and community, such programmes extend reach where specialist services are scarce and harness the family's capacity for frequent practice. Evidence from these programmes indicates that meaningful gains in motor and communication function are achievable outside tertiary centres. Realising the promise of early interdisciplinary intervention at scale therefore depends not only on clinical models but on system-level investment in early detection, workforce development, and equitable service delivery.

10. Discussion and Implications for Practice

The literature reviewed points to a coherent conclusion: motor and communicative development in children with CP are deeply interconnected, and early, coordinated intervention that addresses both is more consistent with the biology of the developing child than fragmented, discipline-siloed care. Postural control, respiratory support, and oral-motor stability form a shared foundation for mobility and speech alike, and the neuroplastic principles that justify early motor training apply equally to communication. Integrating physiotherapy and speech and language therapy within a family-centred, goal-directed model allows these interdependencies to be exploited rather than ignored.

For practice, several implications follow. Early identification should be prioritised so that intervention begins within the window of greatest plasticity. Services should move from parallel delivery towards genuine interdisciplinary coordination, with shared assessment, joint goal-setting anchored in the ICF, and consistent, participation-focused outcome measurement. Families should be positioned as active partners and equipped with coherent strategies to embed in daily life. Where specialist resources are limited, caregiver-led, community-based models offer a viable route to extending coordinated care.

Equally, the review points to a clear research agenda. The specific incremental benefit of combined physiotherapy and speech therapy, relative to well-coordinated single-discipline care, needs evaluation through larger and more rigorous controlled trials using shared functional and communication outcomes. Understanding the optimal intensity, timing, and mode of integration—and how these vary with the child's

severity and profile—would help translate a well-justified model into precise, evidence-based protocols.

11. CONCLUSION

Cerebral palsy is a lifelong condition whose functional consequences are strongly shaped by what happens in the earliest years of life. The convergence of earlier, more accurate diagnosis with an understanding of experience-dependent neuroplasticity has established early intervention as a genuine opportunity to influence developmental trajectories rather than merely to manage established disability. Within this opportunity, physiotherapy and speech and language therapy occupy central and complementary roles, addressing the movement and communication needs that most directly determine a child's independence and participation.

Because the systems these disciplines treat are physiologically and functionally intertwined, an integrated, interdisciplinary model—coordinated, goal-directed, and centred on the family—offers the most coherent means of supporting the whole child. Available evidence, from comprehensive rehabilitation programmes to community-based caregiver-led trials, supports the value of such coordinated, multi-domain intervention and confirms that meaningful gains in both functional and communication outcomes are achievable, especially when intervention begins early. While more rigorous trials of combined-therapy models are needed, the weight of physiological reasoning, developmental science, and real-world outcome data justifies treating early interdisciplinary intervention not as an aspiration but as a standard of good practice. Ensuring that every child with CP can access it, regardless of where they are born, remains the defining challenge.

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