



GUIDELINES

Prevention of hip dislocation in severe cerebral palsy (GMFCS III-IV-V): an interdisciplinary and multi-professional Care Pathway for clinical best practice implementation

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ABSTRACT

BACKGROUND: Hip displacement (HD) and dislocation in severe Cerebral Palsy (CP) (GMFCS III, IV, V) are important causes of worsening disability and quality of life. Prevention must be started from the first months of life through screening programs and early treatments, both conservative and surgical. Evidence from Clinical Practice Guidelines also suggests the development of Care Pathways for good clinical practice. At the beginning of 2020 an interdisciplinary, multi-professional working group, composed of 26 members (including Physiatrists, Physiotherapist, Neuro-psychomotor Therapists and Orthopedists representing the respective Italian Scientific Societies) with the involvement of the FightTheStroke Foundation families' association, was set up.

AIM: The aim of the multi-professional panel was the production of evidence-based recommendations for the Care Pathway "Prevention of Hip Displacement in children and adolescents with severe CP" for best clinical practice implementation in our national context.

DESIGN: Clinical Care Pathway (Clinical Practice Guideline).

SETTING: Inpatient and outpatient.

POPULATION: Children with severe CP (GMFCS III-IV-V).

METHODS: The recommendations of this Care Pathway were developed using the American Academy for Cerebral Palsy and Developmental Medicine (AACPD) guidelines for Care Pathways development and the Grading of Recommendations Assessment Development and Evaluation (GRADE ADOLOPMENT) working group for adoption or adaption or *de novo* development of recommendations from high-quality

guidelines. In 2020 a multidisciplinary working group (WG) developed four research questions on the prevention of HD on the following topics: screening, botulinum toxin treatment, postural management and preventive soft tissue surgery. A comprehensive review of the biomedical literature was performed on each question. Guidelines, Systematic Reviews and Primary studies were retrieved through a top-down approach. References were screened according to inclusion criteria and quality was assessed by means of specific tools. A list of recommendations was then produced divided by intervention (screening programs, postural management, botulinum toxin, preventive surgery). In a series of meetings, the panel graduated recommendations using the GRADE evidence to decision frameworks.

RESULTS: Fifteen recommendations were developed: seven on screening programs, four on postural management strategies, one on botulinum toxin, and three on preventive surgery. Evidence quality was variable (from very low to moderate) and only a few strong recommendations were made.

CONCLUSIONS: In severe CP at high risk of hip dislocation, it is strongly recommended to start early hip surveillance programs. In our national context, there is a need to implement Screening programs and dedicated Network teams. We also strongly recommend a comprehensive approach shared with the families and goal-oriented by integrating the different therapeutic interventions, both conservative and not, within Screening programs.

CLINICAL REHABILITATION IMPACT: Implementing a comprehensive multi-professional approach for the prevention of hip dislocation in severe CP.

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KEY WORDS: Cerebral palsy; Hip dislocation; Prevention and control; Botulinum toxins; Posture.

Background

Preventing hip displacement (HD) in children with severe (GMFCS III, IV, V) cerebral palsy (CP) is important because as it causes postural imbalance and pain, it worsens disability by impairing function and quality of life.¹⁻⁶ Since hip subluxation precedes dislocation, its early clinical detection and monitoring are important. Prevention must be started from the first months of life through Screening programs and early treatments, both conservative and surgical. Large cohort studies⁷⁻¹⁰ and Clinical Practice Guidelines (CPGL)^{11, 12} highlight the importance of early preventive screening strategies and suggest the development of Care Pathways for good clinical practice implementation.¹¹ At the beginning of 2020, an interdisciplinary, multi-professional working group, composed of 26 members, including Physiatrists, Physiotherapists, Neuropsychomotor therapists and Orthopedists representing the respective Scientific Societies (SIMFER Italian Society of Physical Medicine and Rehabilitation and SINPIA Italian Society of Infantile and Adolescent Neuro-psychiatry, SIRN Italian Society of Neurologic Rehabilitation, AIFI Pediatric GIS – Pediatric Special Interest Group from the Italian Association of Physiotherapy, SITOP Italian Society of Pediatric Orthopedics and Traumatology) with the involvement of the FightTheStroke Foundation Families' Association, was set up and began the drafting of the Care Pathway "Prevention of hip dislocation in children with severe Cerebral Palsy". The Care Pathway development group members disclosed the absence of any existing conflict of interest and were proposed by the National Care Pathways' Committee for Rehabilitation in Cerebral Palsy,

composed of 15 Italian Scientific Societies. The scope of the Care Pathway was discussed in a series of meetings also with the involvement of families' associations. The Care Pathways' recommendations apply to children and young adults (0-18 yrs) with severe Cerebral Palsy (GMFCS III, IV, V) at risk for hip displacement and dislocation. Most existing guidelines focus on Screening programs for early detection,^{11, 12} but comprehensive CPGLs integrating different therapeutical preventive treatments are lacking. In clinical practice, preventive conservative interventions such as Postural management strategies (PM), Botulinum toxin A (BoNT-A) treatments and early preventive Surgery are commonly proposed in a combined approach. However, treatment strategies are poorly defined, and the interventions' type, timing, and dosage may vary, especially in our national context where screening programs are absent and diagnostic and therapeutic proposals are not implemented uniformly. PM is defined as all planned programs and interventions aimed at improving posture.^{11, 13} PM programs include postural aids and orthoses and may be integrated into different preventive treatment options such as physiotherapy, pharmacological agents (antispastic drugs, BoNT-A) and orthopedic Surgery.

Aim

The aim of the multi-professional working group was to develop a Care Pathway's evidence-based recommendations for the prevention and treatment of hip displacement in severe cerebral palsy in our national context and to implement good clinical practices on screening strategies and commonly proposed treatments (postural manage-

ment strategies, botulinum toxin A and early preventive surgery). The target audience includes all types of healthcare providers for whom the Care Pathway are intended, to inform their work in a healthcare setting. The primary audience consists of the intended end users of the Care Pathway and includes pediatric physiatrists, physiotherapists, orthopedists and neuropsychiatrists. Secondary audiences may include other clinician groups (pediatricians), health care or hospital administrators, and/or policymakers and families' associations.

Methods

The recommendations of this Care Pathway were developed using the AACPD guidelines for Care Pathways' development¹⁴ and the Grading of Recommendations Assessment Development and Evaluation (GRADE) evidence to decision frameworks (EtD).¹⁵ The EtD provides information on criteria that bear on guideline recommendations (health benefits, certainty of best available evidence, feasibility) and explains how the multidisciplinary working group judges the effect of this information on the final recommendation. The EtD frameworks may facilitate the adoption or adaptation of existing recommendations from high-quality Clinical Practice Guidelines or Systematic Reviews. The multidisciplinary working group (WG) structured four research questions according to PICOT (Patients, Intervention, Control, Outcome and Time) on the efficacy of Screening programs, early treatments with Botulinum toxin Type A, Postural management strategies and preventive orthopedic Surgery. Between the end of 2020 and the beginning of 2021, a comprehensive systematic search of Clinical Practice Guidelines, Systematic Reviews and Primary Studies (published from 2010 to 2020) was conducted for the four topics on the following bibliographic databases: PubMed, MEDLINE and Evidence Based Medicine Reviews (English language, abstract and full-text articles) (search strategies and PRISMA flow diagram of included and excluded studies are provided in Supplementary Digital Material 1: Supplementary Table I-IX, Supplementary Figure 1-4). First of all, we looked to high-quality CPGL to adopt or adapt existing recommendations. If the data from CPGL were judged to be incomplete or need to be updated, the search was extended to Systematic Reviews and Primary Studies (randomized controlled trials (RCTs), non-randomized studies of interventions (NRS-I) and case series or case reports). Initial screening and selection, according to the inclusion criteria, (pertinence to the PICOT framework, severe CP GMFCS

III, IV, V level, Screening strategies, Postural management, BoNT-A, preventive Surgery, age 0-18 years, x-ray hip migration percentage as outcome measure, English language publications in the last 10 years), was performed independently first on title and abstract and then on the full text by two authors. Disagreements were resolved by discussion. The quality evaluation of the selected full-text articles was assessed independently by two researchers by means of appropriate tools: AGREE II¹⁶ for Clinical Practice Guidelines (CPGL), AMSTAR 2¹⁷ for Systematic Reviews (SR) and North Ottawa Scale (NOS) for cohort and non-randomized controlled studies¹⁸ and Joanna Briggs Institute (JBI)¹⁹ checklists for uncontrolled primary studies (quality evaluation of the included studies is provided in Supplementary Digital Material 2: Supplementary Table X-XIII). For evidence evaluation of the Primary Studies included in high or moderate-quality CPGLs and SRs, the panel considered the evidence profiles and the conclusions of the authors. GRADE evidence profiles were developed for the updated primary studies retrieved. Any discrepancies in quality and evidence assessment were resolved through discussion. Following the methodology proposed by the AACPD¹⁴ and the GRADE working group (GRADE ADOLOPMENT),¹⁵ the only recommendations considered were from high-quality CPGLs evaluated with the AGREE II checklist or from SRs evaluated with the AMSTAR 2 tool. The recommendations have been adopted or adapted taking into account the criteria proposed by GRADE (ADOLOPMENT),¹⁵ (similar reference population, type of interventions and outcome measures, assessment of acceptability, feasibility of the context, taking into account different organizational and cultural systems, updating needs of the reference bibliography, certainty of evidence and methodology followed in the development of the CPGL). The decision to adopt or adapt required considering whether recommendations are credible, up-to-date, acceptable, applicable and feasible to implement given the cultural and organizational context. Where instead, it was necessary to produce *de novo* recommendations, the methodology followed was that proposed by the GRADE evidence to decision framework.¹⁵ A list of recommendations was then produced divided by the intervention (screening programs, postural management, botulinum toxin, preventive surgery) for a single outcome (hips migration percentage or Reimers Index). In a series of meetings, the panel graduated as conditional in favor (strong or weak) or conditional against (strong or weak) taking into account the following criteria: balance of effects, certainty of evidence, preferences/values of the patient and fami-

lies, feasibility, acceptability, cost-effectiveness (Supplementary Digital Material 3: Supplementary Text File 1). In case of relative uncertainty in the assessment, the team made a “conditional” recommendation for or against treatment. If the evidence is clearly for or against intervention, the recommendation was considered “strong.” On aspects considered relevant but not highlighted by the reference literature, it was also decided to consider the experts’ opinions. A consensus agreement on recommendations arising from the appraised evidence was reached by discussion. The draft of recommendations was proposed for external peer review by the panel to the National Care Pathways Committee.

The study received no funding and all participants served as volunteers.

Results

Five clinical practice guidelines^{11, 12, 20-22} and eleven systematic reviews²³⁻³³ met the inclusion criteria for the four research questions. To update the bibliography for hip displacement preventive treatments with botulinum toxin A, Postural management and preventive Surgery, a new search for Primary Studies (RCTs, NRS-Is, case series or case reports) was carried out with a time limit of 5 years. No recent RCTs were found. After the screening by two independent evaluators, two controlled not randomized studies on postural management^{34, 35} and eight uncontrolled studies (case series) on preventive surgery^{7, 10, 36-41} were included for qualitative and evidence evaluation. Evidence quality was variable (from very low to moderate) and only a few strong recommendations were made (Table I). The recommendations retrieved from high-quality clinical guidelines and the conclusions of systematic reviews included for evaluation are based primarily on observational studies and experts’ opinions. RCTs on the four topics addressed by the WG are lacking. The most relevant studies are represented by cohort studies on large populations (referring to CP registers) mainly concerning the effectiveness of Screening programs included in high-quality CPGLs.^{11, 12} Evidence from these studies was therefore upgraded as moderate. This allowed us to adopt or adapt strong recommendations from high-quality CPGL. Unfortunately, many recommendations were supported by limited evidence about Etd criteria so we developed new Etd judgments and “Adoloped” recommendations (Adoloped is an acronym from adopted if a recommendation is similar to the source CPGL or adapted if different).¹⁵ On the other hand, well-conducted studies on the effectiveness of other

therapeutic measures such as Botulinum toxin A, Postural management and preventive Surgery are lacking. Studies are often dated, mainly represented by uncontrolled studies, and case series with small and heterogeneous populations. Evidence from these studies was graded as low or very low. In agreement with the authors conclusions from CPGLs and SRs, strong recommendations cannot be made on botulinum toxin A, postural management and preventive Surgery interventions.

Fifteen recommendations (Table I) were developed: seven on screening programs (four strong in favor and three conditional in favor), four on postural management strategies (two strong in favor and two conditional in favor), one on botulinum toxin A (one conditional in favor) and three on preventive surgery (three conditional in favor) (Supplementary Digital Material 3).

Screening programs (recommendations 1-7)

Two high-quality CPGLs,^{11, 12} two moderate-quality SRs,^{23, 24} two very low-quality SRs,^{25, 26} were identified. Three Primary Studies^{7, 9, 10} of high quality and moderate certainty of the evidence included in the Systematic Reviews were also considered. The NICE CPGL¹¹ reports the large Hagglund’s cohort study,⁷ which highlights, not only after 10, years but also after 20 years from the introduction of the Screening program in Sweden, a further reduction in the incidence of dislocation from 8% in the control group to 0.5% in the screening group, further emphasizing the strength of the NICE recommendation on the effectiveness of Screening programs. The CPGL also highlights the importance of recognizing the clinical signs of possible hip migration (pain, lower limbs of different lengths, reduced abduction range of motion of the hips, increased muscle tone of peri-articular muscles, increased difficulty in perineal care or hygiene). Based only on clinical experience, hip X-ray is recommended by 24 months in children with CP if there are clinical risks of possible hip dislocation, and to repeat annually in children or young people who are in the GMFCS level III, IV or V. NICE CPGL also considers repeating the X-ray after 6 months in children and young people where the initial hip migration is greater than 30% and also in cases where the migration percentage (MP) increases by more than 10% per year. The Australian hip surveillance guideline¹² also suggests clinical screening and hip X-ray in relation to the level of GMFCS and for all levels of GMFCS, starting from 12–24 months of age. The frequency of surveillance should be increased in the presence of progression of MP (>10%/year) or risk fac-

TABLE I.—*Key recommendations for hip displacement prevention in severe Cerebral Palsy.*

Intervention	N.	Recommendations	Direction	Strength
Screening programs	1	It is recommended to perform a pelvis X-ray within 24 months of age in severe bilateral cerebral palsy	Positive	Strong
	2	It is recommended to consider the following clinical signs of suspected hip displacement and dislocation: lower limbs length difference, decreased range of motion of hip abduction, increased muscle tone of flexor-adductor muscles, alterations in sitting or standing, hygiene difficulties, hip pain, pelvic obliquity and scoliosis	Positive	Strong
	3	It is suggested to refer to specialist evaluation in presence of clinical signs of suspected hip displacement, X-ray migration percentage >30% or instable (progression >10%/yr)	Positive	Conditional
	4	It is recommended to repeat a pelvis X-ray annually in presence of a Migration percentage <30% or stable, or clinical signs of suspected displacement are absent	Positive	Strong
	5	It is recommended to repeat a pelvis X-ray after 6 months if initial Migration percentage is >30% or increases >10%/yr, presence of clinical signs of suspected hip displacement or dislocation (hip pain, pelvic obliquity and scoliosis)	Positive	Strong
	6	It is suggested to continue annual clinical and radiological surveillance until skeletal maturity is reached	Positive	Conditional
	7	It is suggested to continue annual clinical radiological screening after skeletal maturity in the presence of abnormal migration percentage (>30%), progressive scoliosis and pelvic obliquity	Positive	Conditional
Postural management	8	It is recommended a timely, individualized multidisciplinary approach, that defines objectives and the type of interventions, correct timing and dosage and that it is shared with families. Postural management programs must take into account clinical, functional, contextual factors and consider the combined use of the following interventions: Postural Aids and hip Orthosis, Physiotherapy, Botulinum toxin A and Orthopedic surgery	Positive	Strong
	9	It is recommended to provide postural management strategies for prevention of secondary deformities and to facilitate participation in daily activities and assistance. Caregivers' counselling and training and a periodic assessment of dosage, adequacy and tolerability of postural aids and orthosis must be provided.	Positive	Strong
	10	It is suggested the sitting position with abducted hips. Dynamic spasticity or retraction of adductor muscles associated with the use of postural aids and orthosis for the maintenance of the hip abducted in the sitting and upright position should be treated	Positive	Conditional
	11	It is suggested the standing position with abducted hips (1 hour a day for 5 days a week). Dynamic spasticity or retraction of adductor muscles associated with the use of postural aids and orthosis for the maintenance of the hip abducted in the sitting and upright position should be treated	Positive	Conditional
Botulinum toxin	12	It is suggested to consider early treatment with botulinum toxin A on spastic flexor-adductor hip muscles in the short-term management of hip displacement and to facilitate postural management and hygiene maneuvers	Positive	Conditional
Preventive soft tissue Surgery	13	It is suggested to involve the orthopedist in the multidisciplinary team for the evaluation of surgical indications and the choice of surgical techniques in the presence of clinical and radiological worsening and/or coxalgia	Positive	Conditional
	14	It is suggested to consider preventive surgery of soft tissues in the presence of muscle retractions (flexor-adductor and hamstring muscles) if migration percentage <50%	Positive	Conditional
	15	It is suggested that after surgery screening programs should be restarted and continued as planned	Positive	Conditional

tors such as hips at risk (MP>30%) deterioration of function, scoliosis, pelvic obliquity or lower extremities length differences, change in muscle tone with increased levels of spasticity, reduced movement (especially abduction range

of motion [ROM]), greater difficulty in perineal care/hygiene, onset or increase of hip-related pain. When clinical and/or radiographic evidence of scoliosis or pelvic obliquity is present, surveillance is required every 6 months un-

til skeletal maturity. At skeletal maturity, if the migration percentage (MP) is unstable and progressive scoliosis or significant pelvic obliquity is present, surveillance every 12 months is recommended.

Postural management (recommendations 8-11)

One high-quality CPGL,¹¹ one high-quality SR²⁷ and three very low-quality SRs²⁸⁻³⁰ and two controlled non-randomized Primary Studies of low quality and evidence^{34,35} were retrieved. Postural management programs, according to the definition proposed by the NICE guideline,¹¹ are personalized, planned over time, aimed at improving postural control, comfort of the child and prevention and reduction of the risk of appearance of deformities such as those of the hip and their evolution. These programs include a personalized combination of interventions aimed at preventing and containing hip deformities through the use of orthoses and postural aids. These programs must be agreed upon with the families. In an individualized and goal-oriented approach, planning may include postural aids for sitting and standing positions from 6 months to 12 months of age and supports for lying position (these must be carefully considered in relation to effectiveness, acceptability and tolerability). Studies on the effectiveness of postural systems for lying position²⁷ are not conclusive and these postural aids are often poorly tolerated.

Although the quality of the available evidence is low or very low, the proposed modalities and the beginning of the interventions are variable and it is not, therefore, possible to formulate strong recommendations, it seems that the sitting and standing positions with abducted hips can be useful.^{28,29}

Load is also believed to have a positive effect on hip biomechanics.³⁰

These programs should be started early from the first months of life, especially in the most compromised forms (GMFCS III, IV, V), with an individualized and integrated approach, shared with the family and possibly planned for the 24-hour day.¹¹

The teams must periodically verify the use of the orthoses and aids introduced, ensuring that they are accepted by the child and the family, appropriate to the objectives for which they were proposed, wearable and tolerated.¹¹

The standing position should be maintained for 1 hour a day for at least 5 days a week with hips abducted from 30° to 60°. Even the sitting position should be maintained for at least 5 hours a day with an aligned pelvis avoiding rotations and inclinations and keeping the hips in an abducted position. These programs should be started early, before

18 months (9-10 months according to Miller).²⁸⁻³⁰ They can be supplemented with the use of trunk orthoses and for maintaining sitting hip abduction.³⁴

Botulinum toxin A (recommendation 12)

Two high-quality CPGLs,^{11,22} one moderate-quality SR²⁴ and one very low-quality SR²⁹ were considered. Two RCTs, included in the NICE Guideline,¹¹ show that early treatment with botulinum toxin A combined with the use of hip orthosis (SWASH type), compared to standard treatment, is effective in the short-term, but does not improve the risk of dislocation in the long term or reduce the need for surgery. Botulinum toxin A can be used from 2 years of age, or earlier in selected cases, and would also seem effective in reducing pain. The high-quality CPGL of Love *et al.* 2010²² reports that BoNT-A injections of the adductors are used in more severely involved children (GMFCS IV, V) in an attempt to improve function and positioning. BoNT-A injections are also effective in the management of hip displacement in children with CP, but only in the short term. Although Botulinum toxin A does not prevent hip dislocation and surgery in the long term, there is evidence in favor of its short-term use combined with other therapeutic strategies (physiotherapy, postural aids and orthoses).²⁴ Positive results, according to the moderate quality study by Yang included in the Systematic Review of Miller,²⁹ would seem to be influenced by an early age (<3 years), a low initial MP and less functional impairment.

Preventive surgery (recommendations 13-15)

Two high-quality CPGLs,^{11,12} two low-quality SRs^{32,33} and 87,^{10,36-41} high-quality but with very low certainty of the evidence were included. For preventive Surgery, following the classical distinction proposed by Miller²⁹ for hip dislocation surgery (preventive, reconstructive and palliative surgery) in cerebral palsy, the panel considered only soft tissue surgery (release of the Adductor muscles and Iliopsoas tenotomies). The panel decided to focus mainly on this type of surgery, even if other surgical techniques proposed and used for preventive purposes were taken into consideration (such as VRDO varus de-rotation osteotomy or temporary medial hemi-epiphysiodesis of proximal femur (TMH-PF) guided growth technique³⁹⁻⁴¹).

The conclusions of the authors of the SRs and the review of the literature, consisting mainly of uncontrolled retrospective Primary Studies (with some biases for heterogeneous case series, non-uniform outcome measures

and unrepresentative for a low number of cases), do not demonstrate evidence that preventive Surgery contains hip dislocation, especially in the most disabled forms (GM-FCS V). New well-conducted controlled studies are therefore needed to evaluate its effectiveness.

Bouwhuis³² highlights how success is closely influenced by 3 factors: early age (5-6 years) for the preventive effect on secondary dysplasia, the not-too-high pre-operative Migration Percentage (MP) (threshold value 50% MP) and the level of functional impairment (best results in less compromised GMFCS III forms). However, the rates of recurrence in the short term are very high (especially if the reduction of post-operative MP is <10%) and, therefore, clinical-radiological surveillance must be continued even after surgery, together with other conservative measures. The possibility of early interception of hips at risk through Screening programs has reduced, according to Hagglund,^{7, 9} the prevalence of dislocation and the consequent use of major surgery which is related to a higher risk of complications. Early preventive Surgery could be a possibility along with reconstructive options (VDRO) and may also have the purpose of reducing secondary dysplasia⁴² and pelvic time surgery (PO pelvic osteotomy). Even VDRO compared to PO/VDRO has a high probability of recurrence, especially in the presence of acetabular dysplasia (AI >30°).

According to the NICE and the Australian CPGLs,^{11, 12} the Orthopedist should be involved early in the multidisciplinary team, especially in clinically and radiologically risky situations (clinical signs of subluxation and presence of an MP >30% and unstable MP with progression >10%/year). After surgery, hip screening must be continued.

Discussion

In severe CP at high risk of hip dislocation, it is strongly recommended to start early hip surveillance programs. Hip screening programs must be initiated from the first months of life and within 12-24 months a hip X-ray must be performed for migration percentage monitoring. In a condition of risk or instability of the hips, it must be repeated more frequently (6 months) to monitor its evolution, especially in the first years of life when progression is faster (annual migration percentage is higher in the most severe forms, peaking between 2 and 4 years of age) and risk of development of secondary dysplasia is high. A great deal of consolidated evidence of moderate quality from retrospective cohort studies,⁷⁻¹⁰ supports surveillance programs and Care Pathways production as an important resource for clinical best practice implementation.

We also strongly recommend a comprehensive approach shared with the families and goal-oriented, by integrating the different therapeutical interventions, both conservative and not, within screening programs. As suggested by Novak *et al.* 2019²⁴ “interventions in isolation have small effect sizes for preventing hip migration. In contrast, important clues arise from longitudinal population-based studies in Sweden, which have shown that comprehensive multidisciplinary intervention (including botulinum toxin, weight-bearing, motor training, and orthopedic surgery) at the right time and the right dose can prevent hip dislocation”.

Postural management, including the use of aids and orthoses, aimed at preventing hip deformities should be individual, personalized and integrated with other therapeutical strategies. PM should be articulated throughout the day and verified for dosage, tolerance and efficacy.

The wide use of postural aids for the sitting and standing position is however characterized by a great heterogeneity of the approaches and is strongly affected by the lack of evidence on efficacy from clinical studies. For this reason, the panel expressed a conditional recommendation in favor of positioning with abducted hips in the sitting and standing positions. Well-conducted controlled studies are needed to better assess the type, timing, dosage and efficacy of these interventions.

Although the isolated use of botulinum toxin A on the flexion-adductor spastic musculature of the hip does not prevent hip dislocation in the long term, the panel conditionally suggests that it can be used early, and in the short term, to slow down its evolution also in combination with other interventions.

The panel suggests that Orthopedist consultation should be requested promptly in the presence of documented clinical and radiological deterioration or hip pain. The indication for preventive Surgery (Figure 1) must arise within the multi-professional care team and must take into account several factors: the health status of the child, functional profile and its modifiability, objectives of the rehabilitation project, psycho-affective aspects, social and family context, age, needs of assistance and finally the degree of subluxation and hip dysplasia. In the absence of risk factors (muscle-tendon retractions, MP>30% or unstable) in a condition of clinical stability, conservative treatments are implemented in association with clinical-radiological monitoring. These consist of Postural Management programs (orthoses and postural aids, postural care, counseling to the family), neuromotor treatment (aimed at improving posture and gross motor function) and pharmaco-

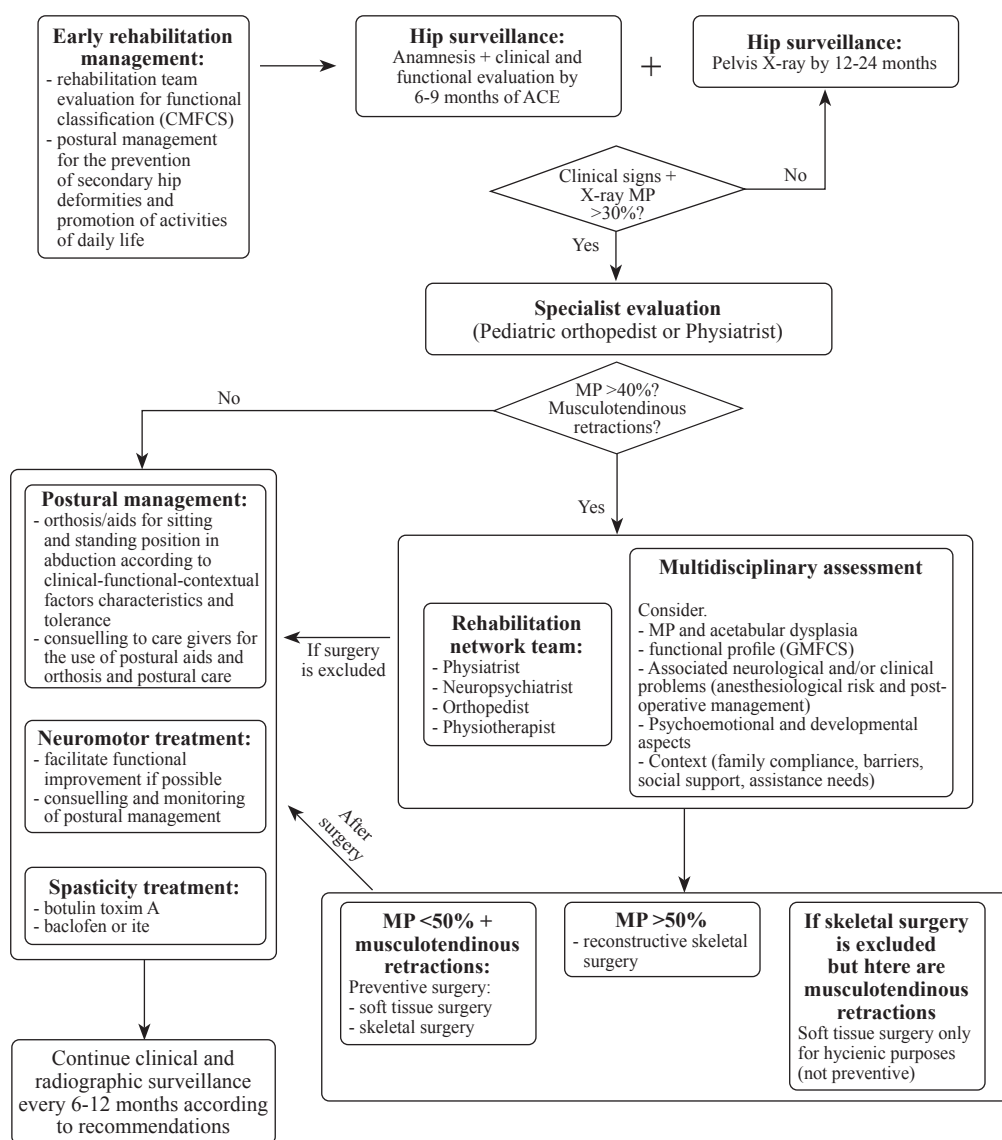


Figure 1.—Care Pathway flow chart for prevention of hip dislocation in severe cerebral palsy (GMFCS III, IV, V).

logical treatment of spasticity (Botulinum toxin A on Flexor-adductor muscles). Dynamic spasticity or retraction of adductor muscles associated with the use of postural aids and orthosis for the maintenance of the hip abducted in the sitting and upright position should be treated.

In the presence of hips at risk (MP>30% or unstable) with clinical signs of instability (MP progression, limited hip abduction, pain, pelvic obliquity), the multidisciplinary team (pediatric physiatrist, physiotherapist, orthopedist, neuropsychiatrist) evaluates the child from different clinical points of view (clinical, psycho-affective, socio-family context, function, orthopedic aspects) and collegially for-

mulates a possible indication for preventive surgery. Preventive surgery may be an option if MP is <50% and in the absence of acetabular dysplasia (AI<30°).³⁷ If, on the other hand, MP>50% and in the presence of acetabular dysplasia, reconstructive surgery is a better option. In any case, the clinical-radiological surveillance and Postural management program should be resumed after surgery.

Limitations of the study

There are limited and low-quality studies on this topic. Many trials are currently underway and recommendations may change.

Conclusions

Comprehensive and integrated preventive treatments of hip displacement in severe CP require dedicated multi-disciplinary and multi-professional network teams. These considerations imply, for the implementation of the Care Pathway in our national context, the definition of Screening programs and the establishment of dedicated Network teams, in which Pediatric Physiatrists and Physiotherapists, trained and specialized for the assessment of neurological disability, monitor the risk of hip dislocation. These professionals can refer to Pediatric Orthopedists for surgical evaluation and must be involved in post-surgical management. It is also necessary to monitor and evaluate the applicability and cost-effectiveness of the recommendations and to plan their update (5 years). Finally, further research is needed to assess the indications, effectiveness, costs and modalities of the proposed interventions.

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Conflicts of interest

The authors certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

Authors' contributions

Nicoletta Battisti has given substantial contributions to the conception and the design of the manuscript, all coauthors contribute to acquisition, analysis and interpretation of the data. All authors have participated to drafting the manuscript. Nicoletta Battisti revised it critically. All authors read and approved the final version of the manuscript.

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Supplementary data

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