Management of motor problems in cerebral palsy: A critical update for the clinician

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ABSTRACT

Currently there is no specific treatment for the brain insults leading to motor dysfunction in cerebral palsy. The available symptomatic therapeutic options place cerebral palsy among the costliest chronic childhood conditions. Therefore, it is necessary to make well-informed decisions in an effort to match cost-effectiveness with patient and family needs. This presentation aims to analyze the efficacy of rehabilitation therapy, orthoses, oral medications, botulinum toxin, intrathecal baclofen, complementary or alternative treatments and discuss guidelines for a goal oriented approach.

Despite insufficient reporting of trials, physiotherapy has shifted from traditional to goal oriented approaches, based on principles of motor learning, strength and fitness training. Correct choice and use of orthoses is stressed, yet evidence from primary studies is limited. Pharmacological treatments of spasticity (oral agents, botulinum toxin, intrathecal baclofen) may be alternatives or supplements to orthopaedic surgery. There is evidence that botulinum toxin combined with conservative treatments reduces the number of complex orthopaedic interventions. Intrathecal baclofen effectively reduces spasticity; criteria describing the ideal candidate are needed. Complementary or alternative treatment use is widespread; research needs to determine what factors make these modalities desirable and effective in cerebral palsy.

It is concluded that the introduction of new therapies facilitates an individualized management plan. Multimodal treatment is optimized with a multidisciplinary team. Outcome measurement according to the World Health Organization’s new International Classification of Functioning, Disability and Health is emphasized.

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1. Introduction

Cerebral palsy (CP) is an umbrella term covering a group of non-progressive, but often changing, motor impairment syndromes secondary to lesions or anomalies of the brain arising in the early stages of development. Recently, Bax et al. defined CP as describing a group of disorders that affect the development of movement and posture, causing activity limitation, and attributed to non-progressive disturbances that occurred in the developing fetal or infant brain; reference to activity limitations caused by CP is relevant to this discussion because treatment approaches are best examined in the context of changes in the patient’s functional status and on the ability to go through the tasks and activities of everyday life.

The motor disorders in children with CP are complex. The primary deficits include: muscle tone abnormalities, influenced by position, posture and movement; impairment of balance and coordination; decreased strength; loss of selective motor control. The secondary musculoskeletal problems are muscle contractures and bony deformities. These develop progressively in response to the primary deficits and produce further motor dysfunction and the need for orthopaedic surgery.

As of yet, there is no specific therapy for the brain insults leading to the motor problems that characterize CP; in essence the interventions that will be discussed represent management techniques, even though the term treatment is frequently re-iterated. The aims of these interventions are: (a) to minimize the development of secondary problems (contractures and deformities) by reducing or normalizing the tone, facilitating adequate stretch to muscles, and increasing the active range of motion; (b) to strengthen weak muscles; (c) to improve mobility and acquire functional motor skills; (d) to promote functional independence in the house, at school and in the community. Conservative treatments include physiotherapy (PT), occupational therapy (OT), orthoses and oral medications. Intramuscular chemodenervation with botulinum neurotoxin (BoNT) and the infrequently utilized neuromyotonic agents (alcohol, phenol) are invasive treatments that may be combined with conservative or surgical techniques, namely orthopaedic surgery, pump-infused intrathecal baclofen (ITB) administration and selective dorsal rhizotomy. Complementary or alternative treatment modalities are being increasingly discussed and sought by families especially in severely involved children with CP.

These interventions are offered in many countries, albeit without specific directions and guidelines as to their timing and sequence. Professionals select treatment strategy and assist families with making informed decisions on the implementation of these interventions without established therapeutic protocols, largely depending on availability and existing expertise in each center. In addition, it is necessary to match cost-effectiveness with patient and family needs. It is worth noting that overall, CP ranks among the costliest chronic childhood conditions.

We aim to discuss the efficacy of the commonly used interventions for the motor disorders in CP and to present available guidelines for a goal oriented management approach. A critical appraisal of the literature revealed that the “rules of evidence” that were developed in the field of epidemiology and evidence based medicine have not been systematically applied, to determine the worth or quality of several popular interventions. Common problems occurred in the design: random assignment to treatment conditions, the use of controls, the use of outside evaluators, the use of longitudinal assessments, populations being studied, outcome measures for treatment evaluation, the methods used to collect data and analyze the results. The American Academy of CP has provided a conceptual framework for critical appraisal of the literature and comparison of the interventions that have become available in the management of CP in an evidence based fashion. In practice, even though we look for good level of evidence for the interventions we prescribe, we often rely on uncontrolled evidence until better studies become available. It is interesting that the rules of evidence were more systematically applied to the newer intervention techniques rather to the more traditional ones; this probably reflects the change of attitude among the scientific community regarding research standards in the recent years.

This paper will not provide an exhaustive review of all of the management methods in CP. It is an update on the efficacy of some of the traditional techniques based on reflex and hierarchical models of motor control and on current approaches derived from theories of motor learning and skill acquisition. The evaluation of interventions used in CP, poses a challenge; it includes many health-care disciplines and involves effects at the physiological, functional, social, and behavioral levels. It is preferably studied in the framework of the World Health Organization’s new International
Classification of Functioning, Disability and Health (ICF); it aims to improve performance of functional tasks and mobility, increase participation in everyday activities, and improve quality of life in children. The ICF format facilitates organization of information on research outcomes and meaningful comparisons between interventions.6

2. Rehabilitation management

2.1. Physiotherapy and occupational therapy

The physiotherapist and occupational therapist have central roles in enhancing motor control in the child with CP. PT is the mainstay of management for the motor deficits in CP, focusing on gross motor skills and functional mobility. Positioning, sitting, transition from sitting to standing, walking with or without assistive devices and orthoses, wheelchair use and transfers, are areas that the physiotherapist works on. In most settings the physiotherapist is the “team leader” who performs therapy, plans the home program, provides the interphase with the school and recommends equipment. However, research evidence supporting the effectiveness of PT is inconclusive. Sufficiently reported trials remain infrequent; even the most adequate studies failed to report sample-size calculation, randomization, concealment of group allocation, co-interventions, and how the assessor blinding was evaluated.7 In clinical practice variations exist in methods of evaluation and in treatment decisions; these differ with age, function of the child and the family’s needs.8 Therapeutic methods, frequency and duration of service, settings and service delivery system vary. Variations in management practices combined with the lack of clear scientific evidence demonstrating the benefits of the interventions and poor reporting of available research have clinical implications7 and could well undermine the future of PT.9 Nevertheless, there is agreement that the provision of therapy services should remain a basic right for children with disabilities9,10 and cannot be based entirely on sound scientific evidence.11 One review indicated that given the complexity of the interventions employed in disabilities like CP, methodological quality is better than its reputation in PT, but certainly can improve12 and this is a widely shared view.

OT focuses on fine motor, visual-motor, and sensory processing skills needed for basic activities of daily living such as eating, dressing, grooming, toileting and bathing; it includes training in school-related skills and strategies to help children compensate for specific deficits in handwriting. Nevertheless, OT is not a standardized, quantifiable process prescribed in discrete units; programs vary in many parameters and incorporate subjective as well as objective elements while documentation of efficacy remains limited. The role of OT is currently upgraded as the emphasis has shifted from the ability to ambulate towards the achievement of functional integration. In this context long-term functional issues that are better related to cognitive and upper extremity self care skills take precedence over ambulatory skills. Regular OT focused on functional activities has been found as effective as intensive Neurodevelopmental Treatment and casting combined.13 OT home programs were effective in children with spastic hemiplegia.14 Moreover, OT enhanced functional outcome following BoNT in the upper limbs of children with CP15 and contributed to significant improvements in body structure, activity participation, and self-perception.16

2.2. Neurodevelopmental treatment (NDT) – Bobath

The most popular traditional method used for the purpose of reducing abnormal patterns of movement and posture and promoting the normal ones in order to gain maximal functional independence, is the Bobath approach, known as NDT. Based on reflex hierarchical theory, NDT aims to normalize the muscle tone, inhibit primitive and abnormal reflexes and facilitate normal movements.17 The Bobath concept has evolved over the last 50 years, and is now based on the systems approach to motor control, with neuroplasticity as the primary mechanism for neurological recovery; this evolution has been well accepted and embraced by those of us who believe in this method. However, no clear scientific evidence exists to prove the superiority of NDT over other techniques.18 A review on the effectiveness of NDT indicated that it does not confer an advantage over the alternatives with which it was compared in altering abnormal motor responses, slowing or preventing contractures, or facilitating more normal motor development or functional motor activities, nor does more intensive NDT result in greater benefit.19 Moderate evidence of effectiveness was established for prehensile hand treatment and NDT or NDT twice a week on developmental status.20

2.3. Conductive education (CE)

CE is a combined educational and therapeutic task-oriented approach for children with CP devised by Andreas Peto in Hungary as a method of intensive therapy with a different philosophy. Homogeneous groups of children with motor disorders are given education by specially trained ‘conductors’, generally in residential setting. CE is being used in countries other than Hungary.21 Major differences in outcome between CE and another intensive rehabilitation program was not demonstrated.22 A study comparing individual PT or OT with CE, showed that CE improved coordinative hand functions and activities of daily living.23 CE is sometimes included in the group of complementary therapies for CP.24 It has been reported to be used by 21% of children with CP.25

2.4. Therapeutic exercise

Several types of therapeutic exercise utilized for improving the child’s motor ability were investigated as to their effectiveness and will be further discussed.

Passive stretching, done manually or by external devices such as splints, casts or tilt-table, is offered in most spastic children to combat soft tissue tightness. There is a lack of evidence demonstrating the effectiveness and the rationale behind the stretch-based techniques in human spasticity.26,27 Manual stretching was supported by limited evidence with regards to increasing range of movements, reducing spasticity, or improving walking efficiency in children with spasticity; sustained stretching of longer duration was preferable
in improving range of movements and reducing spasticity of muscles around the targeted joints. Clinicians need to rethink the use of passive stretching in children with spasticity; the current level of evidence supporting its effectiveness remains weak.

**Static weight-bearing exercises** are commonly used in order to stimulate antagonistic muscle strength, prevent hip dislocation, improve bone mineral density, improve self-esteem, improve feeding, assist bowel and urinary functions, reduce spasticity, and improve hand function. This practice is supported by limited evidence; however, it is often recommended and regularly performed by highly motivated families.

Strength training aims to increase the power of weak antagonist muscles and of the corresponding spastic agonists; the functional benefits of strengthening in children with CP has been shown. Improvements with various modalities ranged from 19.6% with isokinetic strengthening to over 100% with training machines and free weights. Task-oriented weight-bearing strength training for children with CP was effective in increasing strength and functional performance. Others found moderate evidence of ineffectiveness on walking speed and stride length and conflicting evidence on gross motor function with strength training. We firmly believe that if strength may be enhanced, it is usually to the patient’s benefit to achieve it.

Fitness training is often added to the therapeutic exercise regimen. A program of “functional exercises,” combining aerobic and anaerobic capacity and strength training, in ambulatory children (7–18 years) significantly improved physical fitness, the intensity of activities, and quality of life. Training programs on static bicycles or treadmill were beneficial for gait and gross motor development without enhancing spasticity and abnormal movement patterns. At the same time these are more fun for the children with spastic CP than traditional treatments.

### 2.5. Other treatment options

Electrical stimulation is proposed as a useful modality in CP due to the lack of selective muscle control required for specific strengthening programs. So far, most studies lack adequate statistical power to determine the efficacy of the modality; a controlled trial concluded that more evidence was required to show the efficacy of neuromuscular electrical stimulation and threshold electrical stimulation in strengthening the quadriceps muscles in ambulatory children with diplegia who find resistive strengthening programs difficult. Others showed strength gains with neuromuscular electrical stimulation using high-force contractions and low repetitions in children with CP. Further studies are needed because the variability of the reported types of neuromuscular electrical stimulation, render comparisons difficult. This approach remains controversial.

Constraint induced therapy (CIT) involves physical constraint of the uninvolved or less affected arm in order to improve the use of the more involved hand and arm in children with hemiplegia or asymmetric upper extremity motor difficulties exhibiting developmental disregard. It is based on the learned non-use concept. It is combined with intensive behavioral training or with less intensive practice involving traditional OT approaches. Evidence for CIT in children with hemiplegia is good and is supported by several controlled trials, improved movement efficiency, performance, and perceived usage of the involved upper extremity hand and arm were shown; the effect sizes were robust; the changes were retained for 6 months. CIT was efficacious in improving movement efficiency that was not age-dependent. Moderate evidence of effectiveness was established for CIT on amount and quality of hand use. In summary, CIT seems promising. It is based on a concept that is not new but it is still experimental in hemiplegic CP; further research is essential to provide high quality support for its effectiveness and tolerability for children and families; last but not least to ensure that it is developmentally appropriate.

**Functional training and practice of functional tasks** are important parts of the rehabilitation management in CP and have gained ground as the therapeutic philosophy has shifted from traditional to goal-oriented approaches. Experienced therapists correctly point out that practicing tasks is important and not new in training in CP; achievement of functional goals was always their ultimate purpose, irrespective of preferred treatment technique.

It is beyond the scope of this paper to discuss all the techniques utilized by PT and OT in the management of CP. We conclude that an individualized approach is best adopted to meet a patient’s particular needs, depending on the availability of well-trained therapists and available resources.

### 2.6. Orthoses

This term includes all devices that by the application of external force attempt to correct abnormalities of body posture both between body segments and with respect to gravity caused mainly by spasticity. Casts, made of plaster or fiberglass, splints made of plastic for short-term use and custom-made orthoses of durable plastics for long-term use, belong to this category. Orthoses help to prevent or correct deformities, maintain the body in certain positions and/or help children overcome activity limitations, such as difficulties with standing and walking. Static orthoses support the target joints, maintain increased range of motion and prevent deformities. Dynamic orthoses not only align joints, but also assist movement or alternatively resist or stimulate movement. Correct use of orthoses is considered essential, yet the evidence from primary studies on their use in CP is limited. Upper extremity casts, splints, and orthoses, may be effective in achieving some goals; hand splints can improve grasp and casts can increase range of motion and decrease muscle tone. However, improvement in the patients’ ability to use their hands was not shown. The evidence on the effectiveness of upper extremity orthoses in children with CP is inconclusive; further well-designed research is needed. Regarding orthoses in the lower extremities, a common goal is to control ankle position. Casting improves ankle range of movement, with effects similar to those seen with BoNT. Serial casting, providing prolonged stretch with a progressive increase in muscle length, is useful when there is a pronounced static component in the patient’s spasticity. This is frequently combined with BoNT addressing the...
dynamic component of spasticity. A comparison of the efficacy of BoNT alone (three treatments), casting alone, and the combination of BoNT and casting in the management of dynamic equinus in spastic ambulatory children showed that BoNT provided no improvement in the measured parameters, while casting and BoNT/casting were effective short- and long-term.49 The effects of casting alone or in combination with BoNT, on equinus in children with CP were examined; there was little evidence that casting was superior to no casting, and no strong and consistent evidence that combining casting and BoNT was superior to using either intervention alone.50 Given that the quality of published reports varies widely,48 the evidence indicates that casting of lower limbs has a short-term effect on passive range of movement; orthoses restricting ankle plantar flexion have a favorable effect on an equinus walk, but the long-term effect is unclear. Moreover, it is difficult to determine the exact effect of the orthoses because patients usually receive many interventions concurrently.

3. Pharmacological treatments

Spasticity, one of the manifestations of the upper motor neuron syndrome, represents one of the most frequent symptoms in CP. Spasticity may be a useful substitute for deficiency of motor strength; it facilitates standing (extensor hypertonia) or provides power to voluntary contractions. It often becomes harmful leading to an aggravation of motor disability; it impairs standing or walking (due to clonus, scissoring, flexor or extensor spasms), slows voluntary movements, affects proper positioning and increases the risk of contractures and joint subluxation. Pain due to muscle spasms and difficulty in providing hygiene are additional problems.51

Spasticity reduction is considered in order to improve positioning and active function, prevent musculoskeletal complications and reduce the need for later corrective surgery or alternatively provide comfort and care. PT, oral medications, BoNT, phenol, selective posterior rhizotomy, ITB, and orthopaedic surgery are used towards this end. Drug therapy administered orally, parenterally or intrathecally is important in children suffering from spasticity. The efficacy and limitations of some pharmaceutical substances will be reviewed.

3.1. Oral medications

Benzodiazepines, baclofen, sodium dantrolene, tizanidine and other alpha-2 adrenergic agonists, gabapentin and tiagabine are the orally used medications for the control of spasticity. The mechanisms of actions are not totally understood; they probably affect the function of neurotransmitters or neuromodulators in the central and/or peripheral nervous system. The actions on the central nervous system include suppression of excitation through glutamate, increase of inhibition via GABA or glycine, or both. The only drug acting on the muscle and not in brain, sodium dantrolene, is infrequently used due to liver toxicity. Evidence on the efficacy of oral agents against spasticity is rather weak; most trials are of small size, short duration and inadequate methodologic quality.52,53 Diazepam, a post-synaptic agonist of GABA-a receptors, is the most useful oral anti-spasticity agent in CP. It is particularly helpful for the muscle stiffness and the flexor and extensor spasms that may induce pain, irritability and insomnia in spastic children. It may be combined with baclofen and may be used around the clock, even though it is preferably given at bedtime because of drowsiness. Oral baclofen, acting on GABA-b receptors, is more utilized in spasticity related to spinal cord dysfunction and less in CP. A double-blind, pilot study of oral baclofen versus placebo, showed that baclofen had an effect beyond placebo in improving goal oriented tasks, such as transfers, in children with spastic quadriplegic CP.54 Tizanidine, an alpha-2 adrenergic agent and sodium dantrolene acting on calcium channels have been used, but experience is limited in CP. Tizanidine produces a significant reduction of spasticity, but also a significant sedative effect. Gabapentin and tiagabine, antiepileptic drugs that enhance GABA activity, have been employed in spasticity;55; tiagabine was not effective in decreasing children’s spasticity or improving their function, but offered relief of painful spasms.56 In summary, spasticity management through oral agents makes sense because it is goal-directed and simple. Yet, there are few controlled data, and adverse drug reactions are common.

3.2. Intramuscular medications

These agents produce neuromuscular blockade. Phenol and alcohol are neurolytic agents and botulinum toxin causes chemodenervation.

3.2.1. Botulinum toxin

Among pharmacological treatments of spasticity, BoNT has acquired an important role. BoNT type A is the most frequently used in CP. It is injected intramuscularly and blocks the release of acetylcholine at the neuromuscular junction, causing selective, temporary muscular chemodenervation for approximately 8–12 weeks.57 BoNT use follows a protocol wherein the patient is evaluated by a multidisciplinary team, goals are established and alternative or adjunct treatments are discussed such as, casting, oral medications, ITB or surgery. The physiotherapist is centrally involved in the patient selection process, in the goal determination, in performing the baseline assessment and in the follow-up assessments that usually include outcome measures. Spasticity is the primary target in BoNT treatment, yet the muscle power and the selective motor control, i.e. the ability of the patient to isolate movement at each joint, particularly at the extremity that will be injected, are key elements that need to be documented for realistic goal-setting; the outcome is also influenced by deficits in motor planning, motor learning and balance. When BoNT is combined with orthoses and intensive PT, BoNT allows stretching and improved motion, with benefits lasting 3–6 months.58 The goals are usually functional; this is reflected in the utilized outcome measurement that includes gross motor function assessment, goal-achievement scales, measures of caregiver assistance, quality of life of the child and the family, as well as everyday activities.59 When BoNT is chosen for achieving functional goals like sitting, standing or to
improve the gait pattern, multiple muscle groups need to be treated usually in one session (multilevel treatment). The most common deformity treated with BoNT in paediatric CP is equinus foot deformity. The efficacy of BoNT in crouched gait, pelvic flexion contracture, cervical spasticity, seating difficulties, and upper extremity deformity has been shown. There is debate concerning optimum treatment with BoNT in the non-ambulatory child; yet the treatment goals in this situation are relatively concrete and focus on improving sitting potential, care, hygiene and possibly ameliorating pain. The greatest pitfalls exist in prescribing this treatment for the ambulatory spastic child; this is due to the lack of established protocols. To optimize the success of BoNT injections, a comprehensive rehabilitation program is needed: PT is intensified during the period of pharmacologic action of BoNT; serial casting may be applied to stretch shortened muscles and thus increase muscle length; new orthoses are prescribed to prevent a relapse of muscle shortening. The value of combining BoNT with serial casting for spastic equinus was emphasized.

Multilevel BoNT and comprehensive rehabilitation improved knee extension during gait, increased muscle length, and decreased spasticity in injected muscles after 6 weeks in children who walked with flexed knees. Even though BoNT has limited long-term effect, there is evidence that when this is combined with other treatment options the need for complex orthopaedic surgery is minimized. It was reported that BoNT, in combination with common conservative treatment options, resulted in a gait pattern that was less defined by secondary problems (e.g. bony deformities) at 5–10 years of age, minimizing the need for complex surgery at a later age and enhancing quality of life. The role of BoNT as part of a comprehensive treatment package has been reviewed; multimodal therapy is considered as key to achieving prolonged functional gains, with combined management techniques taking advantage of the ‘window of opportunity’ provided by the reduction in muscle tone by BoNT. Nevertheless, a review assessing the effectiveness of therapy interventions on improving outcomes in children who had received BoNT to upper or lower limb muscles concluded that there was insufficient evidence to either support or refute the use of therapy interventions after BoNT in CP. Furthermore, it was demonstrated that even though BoNT had measurable physiologic and mechanical effects in patients with spastic diplegia, these did not create enough change in the function or the family’s perception of function to register as a meaningful improvement in societal participation.

In summary, BoNT may be useful if there is dynamic spasticity causing functional impairment. Regarding BoNT treatment in the upper limb, there is no strong evidence about its effectiveness, yet it may be helpful for individual patients and for this reason it is used in clinical practice as an adjunct to the rest of the therapies. Regarding lower extremities and gait the evidence is stronger but, a standard-ized therapy regimen incorporating BoNT and other management techniques has not yet been fully defined. Divergence in the appreciation of outcomes, in conjunction with concerns about safety of the toxin, require further appraisal.

3.2.2. Phenol and alcohol injections
Reports support the use of intramuscular alcohol 45% and/or 5–7% phenol to reduce spasticity without the loss of voluntary movement or loss of sensation. These are neurolytic agents with long duration. Phenol causes chemical dissolution of the adjacent neural tissue. The duration of the neurolysis is 6 months to 1 year. It is performed under general anesthesia and it may be followed by dysaesthesias. Alcohol neurolysis is used less frequently than phenol; duration of action is shorter than phenol (2–5 months). Both treatments are used infrequently nowadays.

3.3. Intrathecal baclofen
Baclofen is a structural analog of GABA. When delivered intrathecally, unlike the oral preparation, baclofen sidesteps the blood–brain barrier; this accounts for its greater efficacy. At the level of the spinal cord it binds to the GABA b receptors, essentially substituting for insufficient levels of GABA and blocking polysynaptic and monosynaptic afferents; thus it directly reduces spasticity. The evidence about ITB in CP is promising, but treatment effect has yet to be firmly established. A review showed that ITB reduced spasticity in the lower extremities; effect on spasticity in the upper extremities was unclear; function and ease of care improved; medical complications were common, and while some were potentially serious, were manageable. The research methodology employed in three-quarters of the reviewed studies was not capable of confirming treatment effect. ITB was shown to be beneficial in dystonic CP although not in other dyssynaptic forms of CP. Further investigation is warranted for the effect of ITB in the dystonic CP, including description and assessment of dystonic CP. An improvement in the quality of the upper limb function was also shown. Improvements in positioning, transfers, dressing, toileting/hygiene and comfort were reported; cost-effectiveness of ITB was confirmed for carefully selected children with intractable spastic CP. The selection of the suitable candidate for implantation is the most important step in the process; patients need to exhibit multifocal or regional spasticity and they need to have adequate body size for the subcutaneous pump placement. Complications necessitating explantation can occur; they were more frequently associated with the diagnosis of mixed-type CP, as compared with pure spastic types, with smaller size and younger age of the children, the presence of gastrostomy tubes and non-ambulatory status; the conclusion was that criteria describing the ideal paediatric candidate for ITB are needed. The advantages of ITB over conventional multilevel surgery are its reversibility and the possibility to titrate the therapeutic response. However, infection and catheter related problems requiring surgical correction (migration, kinking) are problematic in the paediatric and adolescent age range and certain complications are associated with significant morbidity. In the opinion of some authors, ITB is indicated in the non-mobile child with severe spasticity; it offers comfort by reducing spasticity and ultimately bony deformity; it facilitates easier nursing, thus improving the quality of life of these children and their parents. In our opinion ITB is promising in children with ambulatory potential as well; in any event, technical issues have to be resolved.
4. Complementary or alternative treatment methods (CAM)

CAM refers to a group of diverse medical and health-care systems, practices, and products that are not presently considered to be part of conventional medicine. Its use is common and increasing in paediatrics, particularly for severe conditions; 20–30% of children have used one or more of them. The rates are even higher among adolescents (50–75%) and among patients with chronic, recurrent, or incurable conditions. Children with chronic disease were greater than three times more likely to use CAM, usually without paediatricians’ knowledge. Their use is widespread for children with chronic motor problems including CP. Disease progression such as this encountered in Duchenne Muscular Dystrophy had no impact on their use, but severity within the CP group did; complementing conventional medicine was the main motivation for their use. These treatments are of great interest to families of children with CP, with a usage prevalence of 56% in one study, a percentage that was consistent with usage noted in other populations of children with chronic disease such as juvenile rheumatoid arthritis, where prevalence as high as 70% was noted. Thus, it is important to evaluate current information regarding possible benefits of CAM. This will allow those devoted to maximizing the developmental potential in children with CP to help parents make informed decisions about treatments that are costly and may have side effects. Most of the information regarding these treatments is being covered through the media and is distributed and promoted through the Internet; until recently, there has been little scientific study regarding efficacy and safety. One review reported that there were different degrees of published evidence to support or refute their effectiveness. A study from the UK reported that overall, 21% of children with CP had used alternative methods at sometime, mostly CE. Others tried the Domon Delacato method, reflexology, aromatherapy or a combination. Interestingly, it is not clear what belongs to CAM; CE and electrical stimulation, discussed previously as rehabilitation techniques, are described by some as CAM.

Hippotherapy is categorized either as CAM or as a recreational treatment. Uncontrolled and controlled trials showed beneficial effects of hippotherapy on body structures and functioning. A review of 11 quantitative studies of moderate to good methodological quality demonstrated that recreational horseback riding therapy and licensed-therapist-directed hippotherapy improved gross motor function. The evidence suggested that these therapies are individually efficacious, and are indicated for gross motor rehabilitation in children with CP. Others showed that hippotherapy was effective for treating muscle symmetry in the trunk and hip and in improving gross motor function. It is one of the best liked treatments by children and parents in CP.

Hyperbaric Oxygen Therapy has been promoted for children with CP. This treatment, applied in specific medical conditions, is guided by the Undersea and Hyperbaric Medical Society, an international professional organization that sets guidelines for its ethical application and use. A controlled study demonstrated that this therapy does not make a difference to the functional capacities of children with CP. Therefore, it is not presently recommended by experts in the field because of lack of scientific evidence as to its efficacy and because it is not risk-free; children undergoing this treatment had seizures and needed ear pressure equalization tube placement.

The Adeli suit treatment has received a lot of attention. Either the Euromed Adeli Suit from Poland or similar suits that are in use in other countries provide resistance to some movements, and are purported to improve sensory feedback during movement. This treatment was compared to NDT; improvements in motor skills and their retention 9 months after treatment were not significantly different between the two treatments. This study suggested that the Adeli Suit might improve mechanical efficiency without a corresponding gain in gross motor skills, especially in children with higher levels of motor function. This treatment, like other CAM, involves increased contact time between the child and the family. The Adeli Suit program in Poland requires a family member to spend 4 weeks in close contact with their child, far away from the distractions of home and other family members. It has been demonstrated that increased parental involvement has beneficial effects in children with CP when compared to a group who received NDT. Personal experience with a similar suit (Therasuit) and intensive involvement of a trained therapist for 4 weeks, was positive in patients with GMFCS levels III and IV with weak trunks.

Studies of acupuncture are promising; more data are required before recommendations can be made. Most studies of patterning have been negative and its use cannot be recommended.

To conclude, understanding the reasons that lead families to CAM is important and will be ultimately beneficial in improving the care of children with CP. Patients and their families have a right to full disclosure of alternative treatment options and of the current knowledge regarding these therapies. For the majority of CAM further research is required to determine their efficacy in CP; this information must be presented to the families and the issue of cost-effectiveness needs to be brought up.

5. Epilogue

The management of the motor disorders that are part of CP represents a hot topic; there are unresolved questions about traditional treatments while several invasive and expensive treatments have been introduced in the last two decades. The need to evaluate these new treatments in an evidence based fashion has generated research interest in outcome measurement which has greatly influenced the entire field.

The current treatment recommendations call for a comprehensive team evaluation, after which a treatment plan is generated. The heterogeneity of CP and the variability in clinical presentation make an individualized treatment plan mandatory; the introduction of new therapies has made this easier. Selection of suitable candidates, choice of a multimodal treatment approach where the most effective and safe treatment options are offered in an integrated
fashion and systematic, objective evaluation of the functional outcome are the key elements. In addition a major shift in the therapeutic philosophy from impairment-based towards outcomes that are more satisfactory to the recipients of care rather than to the professionals, has introduced new considerations in our treatment. This approach is based on principles of motor learning, strength and fitness training and aims towards promoting activity through active training protocols and participation through lifestyle modifications, and mobility-enhancing devices.96 Regardless of treatment techniques, well-trained, flexible, open-minded and devoted therapists who adjust to what fits most to the individual patient have the best outcomes.

In the not so very distant past the treatment of the motor problems in CP was the responsibility of the paediatric orthopaedic surgeon. Today, with a plethora of conventional and alternative therapies, the families increasingly turn to the child neurologist for advice and guidance. It is thus important for our specialty to be current in the therapeutics of CP in order to make informed decisions on a strategy that will offer the best possible care and will optimize the developmental outcome of the child. The major difficulty in this process is the relative lack of guidelines for many of the interventions that will allow the paediatric neurologist to actively participate and preferably co-ordinate the care of the child with CP. It is important to recognize that our sense of treatment success regarding changes in body structure and frequently in function, is not necessarily shared by patients and families who expect enhanced societal participation. The need for outcome measurement in several domains, from the pathophysiologic to the societal level, is emphasized both in individual patients as well as within the context of research projects. Thus, it will be feasible to integrate individual clinical expertise with the best available clinical evidence from systematic research and this will ensure the optimal practice of medicine in children with CP.

REFERENCES