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**PHYSICAL REHABILITATION IN PEDIATRICS**

Study book

for independent work of students of medical faculties IV course in preparation for the practical training in the discipline "Physical rehabilitation and sports medicine."

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## Foreword

Physical medicine and rehabilitation, is a branch of medicine that aims to enhance and restore functional ability and quality of life to those with physical impairments or disabilities. A physician having completed training in this field is referred to as a physiatrist or rehabilitation medicine specialist. Physiatrists specialize in restoring optimal function of children with injuries to the muscles, bones, tissues, and nervous system. such as injuries of the brachial plexus. cerebral palsy, etc.

The major concern that PM&R deals with as a medical field is the ability of a person to function optimally within the limitations placed upon them by a disabling impairment or disease process for which there is no known cure. The emphasis is not on the full restoration to the premorbid level of function, but rather the optimization of the quality of life for those not able to achieve full restoration. Comprehensive Rehabilitation is provided by specialists in this field, who act as a facilitator, team leader, and medical expert for rehabilitation. Physical therapy helps develop the strength and range of motion children need to move through their environment easily and effectively. Physical therapy goals often include help with developmental milestones like sitting, standing, crawling and walking. Specialist of PM&R employ hippotherapy, where the movement of the horse influences or facilitates an adaptive response in the patient.

Reasons, symptoms, diagnostics, medical treatment methods, terms of rehabilitation and rehab exercises are logically considered in the given study guide. This corresponds to the academic program for the 4<sup>th</sup> - year English-speaking students of the Medical department upon studying “*Physical rehabilitation in pediatrics*”.

## **Rehabilitation for Children - How is it Different from Rehabilitation for Adults.**

According to the World Health Organization (WHO), more than 650 millions of individuals live with disabling conditions worldwide (Organisation mondiale de la santé, 2010), out of which 200 million are children. Children with disabilities can develop and achieve their full potential with assistance from the rehabilitation services. Rehabilitation for children or pediatric rehabilitation includes all the services delivered to minors, from infants to teenagers. Rehabilitation for children refers to all the services required to foster social participation of the children, and not solely to specialized interventions. For instance, according to the conceptual framework of the International Classification of Functioning, Disability and Health (ICF), the goal of pediatric rehabilitation interventions is to alleviate the effects of impaired body structures and systems; foster the development of children's capacities and their participation to various activities; as well as reinforce environmental facilitators (e.g. education to families and other caregivers and adaptation of the physical environment). Conceptual frameworks as well as approaches used in rehabilitation for children are very similar to those used in rehabilitation for adults (e.g. contextualized, collaborative/partnership and ecosystem approaches). Similarly, for both groups, services need to be accessible, holistic, interdisciplinary, organized and integrated.

As several rehabilitation approaches apply both to children and adults, there is considerable scope for therapists to treat children as small adults. In this matter, some authors consider that pediatric rehabilitation designates a medical speciality. For others, these disparities are not significant enough to make a distinction between pediatric and general rehabilitation. Both these opinions are found in clinical settings, where some therapists and managers seem to believe that pediatric rehabilitation is similar or not to rehabilitation for adults. Although existing differences may seem minimal at first, they are essential and have tremendous clinical and administrative implications (e.g. training and organization of rehabilitation services). The intent of this article is to share ideas and inspire a reflection on the peculiarities of pediatric rehabilitation. The reflection of the authors is based on a review of scientific evidence, discussions with peers and their personal clinical experience with persons with impairments. The article also takes into consideration the main disparities between children and adults: epidemiology of the causes, impairments and disabilities in children; their dependency to adults; as well as the various steps of their

development. Children with disabilities require rehabilitation services form a diverse, heterogeneous group of professionals. For instance, children in need of rehabilitation may have developmental delays, various syndromes, and aphasia or motor impairments due to cerebral palsy. The etiology of some diagnoses may be known (e.g. Down's syndrome), whereas the etiology and the risk factors for some other conditions have not been identified (e.g. motor impairments due to cerebral palsy). The primary causes and diseases giving rise to the need for rehabilitation are different for children and adults. In children, the causes of impairments and diseases are most frequently congenital, whereas they are mainly acquired in adults (e.g. strokes, traumatic brain injuries). As for prognosis, the course and functional consequences of a disease or injury in children depend upon several factors, which are often difficult to predict . The prevalence rate of the major causes and diseases affecting children is also lower than the rate observed in adults, which can result in limitations of knowledge and expertise development in areas of specialized interventions.

The clinical picture of children and their needs in terms of rehabilitation services is diverse. In addition, new health challenges have emerged. For instance, the number of infants surviving with congenital and neonatal health conditions is increasing due to improvement in perinatal medical care (e.g. motor impairments due to cerebral palsy). Other health conditions are acquired, and related to chronic diseases in children (e.g. asthma, allergies, and obesity). Moreover, the life expectancy associated with various fatal diseases has greatly increased due to advances in medicine and pharmacology (e.g. cystic fibrosis, muscular dystrophy). Consequently, the number of children in need of rehabilitation services may increase in the upcoming years, and the provision of the required services is likely to extend for a longer term. In addition, technologies and new types of interventions might increase intervention opportunities for children (e.g. use of botulinum toxin to reduce spasticity). The development of newer technology contributes to increasing pressure on rehabilitation services.

The planning of rehabilitation services for children is thus complicated and set within a long-term perspective. Services are often delivered during the first years of a child's life. The family of the child living with disabling conditions form early bonds with the rehabilitation network. The news of a diagnosis, which is usually preceded by a period of uncertainty, can generate a lot of anxiety for families. This is often a traumatic event killing the dreams of

parents and challenging the family dynamics. In response to the numerous gaps in expectations among parents regarding the diagnosis and information, several support programs are made available for use by parents, which increase the satisfaction level of families and contribute to reduce their stress.

Besides the diagnoses, the uncertainty of the prognosis may also contribute to the increased level of stress in parents. However, even when the prognosis is known, parents and therapists often wish to give children the opportunity to achieve their full potential. This is why, even though there is scientific evidence predicting the motor function level of children with cerebral palsy, therapists often work on gait training despite the negative prognostic factors for functional long-term outcome, frequently in response to the parents wishing to "try anyway". However, there is a growing concern on this matter, and therapists wonder if it would be more efficient to introduce wheelchair mobility in the early phases of the rehabilitation process. On the contrary, some adults living with disabling conditions who succeeded in resuming gait after great efforts in therapies during childhood indicate that "it was worth the try". With the emphasis on evidence-based and budget-cut practices, these efforts towards trial and errors might increasingly be questioned. However, in these reflections, it is important to not only take the sole prognosis of gait into consideration, but also the benefits of performing activities in standing position (e.g. bone mass growth and increased self-esteem). Therefore, whenever intervention guidelines are used in rehabilitation institutions, it is important to maintain a certain level of flexibility in service delivery in order to optimize the outcomes and customized it to the specific needs of the clients. Some health conditions are chronic, and therefore, rehabilitation services may be required throughout a child's life. It seems that the life expectancy for a person with disabilities is generally higher when the onset occurs during childhood as compared to adulthood. Childcare should therefore aim for optimal functioning and social participation in the short term, but also set within a long-term perspective of prevention as these domains are determining factors of the child's future health status. The complexity and duration of long-term care also leaves tremendous financial burden on the society. This raises various questions related to the organization of rehabilitation service delivery for children. For instance, when children are diagnosed or identified as having developmental delays during the first five years of life, intensive monitoring is often suggested to families. Early

intervention and enhanced services when children are very young are based on brain plasticity theories. However, it should be highlighted that in a context of budgetary restraint and limited resources, some authors question the relative importance of dedicating resources during the first years of a child's life. In doing so, the lack of resources to support children in the future various steps of his/her development are taken into account.

Development is an ongoing phenomenon for human beings of all ages, as we constantly experience changes. However, the intensity of this development is what distinguishes children from adults; acquiring new knowledge, physiological changes, and the transitions experienced by children in many life areas are rapid, frequent and significant. For instance, adults will experience occupational changes and a transition to retirement process, but their environment and social network seem generally more stable compared to children, who will experience class changes in school every year and frequently integrate many new environments (e.g. new leisure activities, new school). In addition, everything seems new to children in rehabilitation; they are learners like all other children, but they also have to face additional challenges in order to learn new skills. Early interventions services prevent children with disabilities from developing inappropriate compensatory strategies while performing activities. However, waiting lists often compromise access to services, and as a result, are most likely to affect the well-being of children.

Various developmental theories have had repercussions that are more significant on the rehabilitation of children than on adults. In this matter, the first developmental theories focused on the chronological order of learning milestones and on the central nervous system's maturation, while contemporary theories highlight the interrelation between children's neuro sensory, motor and cognitive systems, as well as the importance of contextual and environmental factors. Brain plasticity theories and early interventions are still essential, for rehabilitation care of both children and adults; however, they are also enriched by approaches increasing the emphasis on human development and social participation.

As social participation is one of the major goals of rehabilitation involving the performance of life habits depending on age, rehabilitation goals should vary according to the developmental phases experienced by children. Besides considering chronological age,



people involved in rehabilitation should consider the developmental age of children in each of their life areas (e.g. motor, cognitive and social) in order to identify the most appropriate goals and methods of intervention . Developmental age may vary significantly from one life area to another in a same child. For instance, a 5-year old child may present appropriate cognitive functions for his chronological age, but the motor abilities of a one-year-old child.

Throughout their development, children experience many transition periods (e.g. entry to day care or primary school, transition from primary to secondary school). Rehabilitation services should be organized to provide support to children and their families during these moments of transition. Therefore, the partners collaborating with the rehabilitation field may vary according to the age of the child. Many studies have been devoted to the collaboration of adult rehabilitation partners and services for adolescents.

Children in need of rehabilitation generally seem more dependent on others than adults are. Children depend on their parents in various ways. Legally, children are dependent on their parents (or on a committee) until they are a major or can be regarded as an adult—in some countries like Canada, the age of 14 years is considered as an adult for certain aspects related to consent for care. This legal dependence has various impacts on the rehabilitation field and raises ethical issues: Who can consent to care? Who makes decisions regarding rehabilitation goals? . All of this raises the following question: who is the actual client, the child or the family? As children can have different views from their parents, they should also be consulted as far as possible. The emphasis on parental priorities should be gradually reduced as children get older in order to enable them to contribute more actively in their rehabilitation process.

At the physical level, children are also dependent on their families. Their functions in various life areas (e.g. motor and social) are associated with the family dynamics within their environment. For instance, families experiencing various adjustment difficulties might provide less stimulation for children to develop. People in the children's surroundings support them throughout the various steps of their life, and that is why they need to be properly equipped and supported. Parents, most frequently the mother, are natural caregivers with significant support requirements. Adult rehabilitation also needs the involvement of

natural caregivers (often spouses) and their needs are also taken into consideration, and this results in increased collaboration with others within the children's surroundings.

Rehabilitation for children shares many similarities with adult rehabilitation. The epidemiology of the causes, impairments and disabilities is different in children and adults. In fact, children experience an "intensive" development and are dependent on adults at various levels. Furthermore, some assessment and intervention methods used in children are different from those used in adults. Intervention approaches based on play are therefore taking much part of the rehabilitation process in children. They learn and develop through playing. In adults, motivation and involvement in the rehabilitation process are mostly related to the importance of each activity. In children, pleasure is of first importance. In other words, it is easier to ask adults to accomplish an activity by explaining the goal and the way to achieve it, whereas for children, setting scenes and creating situations in which they will perform an activity is essential.

It should be noted that many assessment tools in pediatric rehabilitation are based on observation, while self-assessment questionnaires are probably easier to use with adults. In addition, it seems that the participation rate of families to rehabilitation assessments and interventions is higher for children than adults. Families can provide useful information, contribute to the treatment or ensure that recommendations are followed daily. Over the years, children become increasingly involved in their rehabilitation process. As their needs evolve and change rapidly, reassessments need to be done more frequently than in adults.

Clinical and administrative implications emerging from discrepancies between rehabilitation for children and adults should not be underestimated. For instance, people training to contribute in the rehabilitation field must be aware of the techniques and approaches that will help them to provide more efficient assessments and interventions for children, in addition to keeping an eye out for rapid changes in their life habits and environments. Similarly, people who are used to work with adult clients should be able to adjust their approaches for children as these clients present some peculiarities. As for people working with children, they should be aware of the principles underlying the peculiarities of rehabilitation for children. This enables them to specify their approaches and to keep their skills up to date according to changes at the knowledge level. As for administrators, they

must consider the particular features of children prior to implementing efficient pediatric rehabilitation services.

Early interventions are essential, as well as the provision of support to children and their family through the various life stages. At the level of service organization, the Life Needs Model is an interesting model for planning the various life stages and meeting the overall needs at the level of information, education and capacity building, both in children and family members, as well as in their communities. Based on the established goals, various types of intervention (e.g., group, individual, evaluation-consultation) are designed to meet these needs. A set of rules and procedures should be implemented to organize all these services, but also to ensure the proper operation of the rehabilitation program. These rules should be modified to match the peculiar features of rehabilitation in children in order to take their dependence on adults into consideration (e.g., participation of the child to therapies depends upon his or her family, particularly regarding regular attendance to appointments and compliance with recommendations). Finally, clinical and administrative organization of services should consider both children and family members' particular needs and features.

## PHYSICAL THERAPY of obstetric brachialplexus injury

Injuries of the brachial plexus take place during the birth process in one to four of every 1,000 births. The injuries are associated with:

- Large birth weight.
- Shoulder dystocia (the shoulders become impacted while passing through the birth canal, injuring the brachial plexus nerves)
- A difficult delivery.
- Fetal distress.

Birth order and gender have not been shown to affect the incidence of brachial plexus injuries. The most common injuries occur in the upper portion of the brachial plexus (that is, in the upper trunk which is supplied from the C5 and C6 roots of the spinal cord).

Name	Lesion Site	Motor Involvement	Sensory Involvement
Erb's	C5-6	Upper arm paralysis	Rare-minor lat. Aspect upper arm
Klumpke's	C7,8,T1	Wrist & hand paralysis	Rare-minor forearm, wrist & hand
Erb-Klumpke's	All brachial plexus	Complete upper limb flaccid paralysis	Complete upper limb

All newborns with brachial plexus injuries should begin therapy as soon as possible. Babies can develop contractures particularly in the shoulder even at a very young age. Therapy alone is usually sufficient for mild brachial plexus injuries. Therapy also is a prerequisite for successful surgery, if surgery is necessary. That will help children maintain their joint mobility, so they can use their arm when nerve recovery occurs. Patients who have experienced birth brachial plexus injuries should be seen once a month or once every six weeks during their first six months of life. Physicians and therapists need opportunities to provide close follow-up care, monitor nerve recovery and determine

whether primary nerve surgery will be necessary.

**Treatment:**

Throughout the first six months of life for an infant with a brachial plexus injury (**BPI**), therapy is the mainstay of treatment.

Exercises are intended to:

- Maintain joint mobility.
- Prevent contractures.
- Provide sensory input for sensory stimulation.

**Time of intervention:**

The rehabilitation of children with **BPI** must begin as soon as the injury is recognized in the newborn nursery during the first week of life and should continue up to age of 4 years).

Rehabilitation stages:

Stage 1 First 2 weeks.

Stage 2 From 2 weeks – 4 months.

Stage 3 From 4 months to 6 months.

Stage 4 From 6 months to 1 year.

Stage 5 From 1 year to 4 years.

Goals:

1. To educate To educate caregiver in handling, positioning, and positioning, and daily living activities
2. To Improve/ maintain Range of Motion (ROM).
3. To improve/maintain muscle strength.
4. To improve sensation (where appropriate).
5. To gain milestones and age appropriate skills.
6. To prevent joint contracture and deformities.

Assessment:

The mother or caregiver should attend all sessions to learn from the physical therapist and to implement appropriate positioning and handling techniques at home. Assessment should be completed with in the first 3 sessions with the affected arm undressed in warm environment, whether in the side lying or supine positions to eliminate gravity and to allow free movement of the arm.

**Precautions:**

1. If there are shoulder or elbow dislocations, the affected joint should be stabilized and only close kinematics exercises are used.
2. With juvenile shoulder arthritis, approximation movements should be avoided and all exercises should be within the pain free ROM.
3. Only gentle mobilization should be used, when there is soft tissue injury.
4. If there is fracture in the clavicle, start treatment after two weeks of rest, and a recent x-ray is needed to confirm the healing.
5. Treatment should be paused if the patient develops an infectious disease, open wound, or fever.
6. Thermal modalities should not be used if there is loss of sensation.

**Prognosis:** The physical therapist along with the other interdisciplinary team members makes the decision regarding the need for further medical or surgical intervention along the course of the treatment depending on the condition of the child. The prognosis of each patient depends on:

## 1. Type and site of injury

Type	Cause	Recovery
<b>Stretch neuropraxia</b>	Nerves in plexus are often compressed due to swelling or bruising from birth trauma of shoulder getting caught on the pelvic bone	Recovery potential varies for types of injuries, most recover spontaneously with a 90 -100% return of function
<b>Rupture</b>	Nerves are torn at either one or several places in the plexus	Recovery is severely limited unless surgical intervention done for the nerves to recover
<b>Avulsion</b>	Nerves are pulled from the spine cord as evidenced by a totally flaccid extremity	Recovery is severely limited and requires multiple surgeries including muscle transfer to gain function.

## 2. Cooperation of the caregiver and the child.

Treatment:

- The frequency of treatment sessions varies between patients according to the severity of the injury but each session should not exceed 45 - 60 minutes.
- When muscular contracture or tightness is present, superficial heat modalities should be used for 15 min. followed by massage or the myofascial myofascial release technique.

### Stage 1: First 2 weeks.

Goal: To educate care giver on handling, and positioning the child and activities of daily living. Instruction to the caregiver should be given at the date of admission and should be demonstrated and reviewed carefully by the physical therapist.

#### 1. Handling and positioning:

- Instruct the parent to hold the arm in supination and external rotation and place pillows or stuffed animals under the armpit and alongside the arm whether the patient is at rest or sleeping to provide a sustained stretch.
- Educate the parent to observe the patient's head and keep it in the mid line during any position and use c shape cushion. (o not let the arm dangle in space while carrying the child. The parent can keep the elbow flexed and on top of the chest but not for long periods of time. Teach parents proper way of wrapping. *Обучайте родителей правильному пеленанию.*

#### 2. Activities of daily living:

- Dressing: for dressing, start with the affected arm and for undressing start with the unaffected arm.
- Bathing and hygiene: instruct the mother to keep the armpit always dry and clean. In bathing, support the affected shoulder and scapula with one hand and wash the baby with the free hand.
- Feeding: always keep the affected arm flexed on the baby's chest while feeding him, and remind the mother to feed the baby from both sides.

3. Very gentle passive range of motion (PROM) for shoulder, elbow and wrist joints (stabilize the proximal joint and move the distal one).

### **Stage 2: From 2 weeks – 4 months.**

Goals: A) To improve ROM, sensation and muscles strength.

B) To prevent muscle tightness.

C) To gain milestones and age appropriate skills (head control, righting reactions).

1. Continue same instruction given during the first stage.
2. When muscular tightness presents, use superficial heat modalities for 15 min.
3. Gentle and slow PROM exercise should be used to increase joints flexibility, but it should be within the available PROM and 10 repetitions for each movement. To increase scapulo-humeral joint mobility, scapula must be stabilized.
4. Early motor training must be task specific guided and reinforced by the physiotherapist to encourage effective movements and to prevent any substitute movements.

Active movements and strengthening are facilitated through age appropriate developmental activities initially in gravity eliminated positions and then advanced to against gravity positions. Physiotherapist has to consider short leverage, eccentric contraction then concentric contraction when facilitating motor behavior.

5. Tactile stimulation is provided to the affected extremity by using different textured materials, vibration and brushing techniques to increase the sensory awareness of the affected arm.

6. Joint compression and weight bearing exercises are used to increase the proprioceptive input and isometric muscle contraction.

### **Stage 3: From 4 months to 6 months.**

Goals: A) To improve / maintain ROM, Sensation and Muscles strength.

B) To gain milestones and age appropriate skills (rolling, protective reactions, reaching).

C) To prevent joint contracture and deformities.

1. Continue the same program of above stages.
2. Encourage bimanual activities to prevent the neglect of the involved extremity which will lead to further complications or deformities and to prevent the learn non-use.
3. Different types of splints or tapes should be used to prevent further deformities or to initiate movements.

N.B: Watch for circulatory changes when applying splint: such as red pressure points, swelling, numbness or coldness.

4. Ball and roll therapy can also be used to increase mobility, strength, proprioceptive input, vestibular and righting reactions, balance, protective reactions and coordination.

### **Stage 4: From 6 months to 1 year.**

Goals: A) To improve/maintain ROM, Sensation and Muscles Strengthen.



B) To gain milestones and age appropriate skills (sitting, crawling, standing, walking).

C) To prevent joint contracture and deformities.

1. Continue the same program for above stages.
2. As the child grows, strength and coordination are increased by active use of the affected arm using a variety of developmentally appropriate activities and specific functional skills (Fig 12&13).
3. Although the use of electrical stimulation (ES) is controversial and it's effectiveness has not been adequately tested, it can be used if there is poor prognosis (from 6th month) with Galvanic type of ES for 15 repetitions to prevent muscle atrophy and to increase limb awareness. On the other hand, Functional Electrical Stimulation (FES) is increasingly used in neurological rehabilitation to improve mobility and upper limb function. FES is a means of producing functional movement in paralyzed muscles by the application of electrical impulses to the nerves of those muscles and it should be applied for 30 minutes daily during the treatment period. FES improves hand function, active wrist extension, weight bearing with the impaired upper limb, increases awareness and spontaneous use of the impaired limb and improves hand grasp and release abilities.

### **Stage 5: From 1 year to 4 years.**

Goals: A) To gain milestones and age appropriate skills (playing, skill and fine movements)

B) To prevent learned non-use.

C) To prevent joint contracture and deformities.

1. When muscular contracture or tightness presents, use superficial heat modalities for 15 min. followed by massage or the myofascial release technique.
2. Encourage the child to do bimanual activities by using a variety of developmental appropriate activities and specific functional skills such as throwing ball, climbing a ladder.
3. Facilitate the activities of daily living and the fine movements to increase strength and coordination of the affected arm and hand.
4. Hydrotherapy: It can be introduced at this stage to prevent muscle tightness, muscle control, improve joint ROM besides being fun for the child.

### **Complications:**

1. Scapula winging.
2. Torticollis.
3. Midline Asymmetry.
4. Postural scoliosis.
5. Limb length discrepancy.

### **Classification of Brachial Plexus Injuries according to predict outcomes (Clarke & Curtis -1995). Types of Predict Outcomes.**

#### **Type 1.**

Mild recovers within 8 weeks.

### **Type 2.**

Unpredictable prognosis in the first few weeks. Shoulder usually do not recover fully, but elbow function is satisfactory. Some children do not recover wrist & finger extension. Elbow flexion returns within first 4 weeks. Elbow extension in first 8 weeks. Limited shoulder movements between 8 – 30 weeks.

### **Type 3**

Involves upper trunk with avulsion of C7, and stretch & injury to lower plexus.

Paralysis appears complete at birth, with Horner's sign. Poor shoulder function. Recovery of shoulder may occur between 10 – 40 weeks. Elbow extension recovery 16 -20 weeks. Wrist movement between 40 – 60 weeks.

### **Type 4**

Includes avulsion of C8 & persisting Horner's sign. Significant recovery can occur of C5 & C6 function. Elbow & shoulder recovery as in type 3. Elbow extension & hand function 20 – 60 weeks.

### **Type 5**

Severe injury to all roots with severe Horner's sign. Poor prognosis. Poor wrist recovery. Very poor hand movement with no intrinsic muscle activity.

### **Indications for Surgical intervention for Brachial Plexus Injuries.**

Horner syndrome & hand function not recovering by 3 months should be operated. No biceps recovery by 3 months should be operated. Biceps recovery stopped by 6 month should be operated.

### **Types of Surgical intervention for Brachial Plexus Injuries.**

Type of Surgery	Type of Surgery	Rehabilitation Time	Weight Bearing Activities
Neurolysis (neuroplasty)	Neuroma Dissection (Neutralization)	After 1 week	After 3-4 weeks
Nerve Graft	Transplantation of a healthy nerve to replace a segment of a damaged nerve.	After 2 weeks	After 6-8 weeks
Neuroma Dissection (Neutralization)	The process of checking or counteracting the effect of any agent that produces a morbid effect.	After 4 weeks	After 8-10 weeks

### **Points to Remember:**

1. Rehabilitation program always resume after surgery with gentle PROM.
2. Do not use weights on the affected limb during the first stage of weight bearing activities.
3. Usually regeneration of nerve can be notice at 9 -12 months after surgery with a minimal movement on the affected muscles.

4. Scar massage management should be start after 4 weeks of surgery and educate the parent to perform it during the day.
5. When intercostals to musculocutaneous nerve graft done restrained the arm to the shoulder in adduction position and only allowed 45 degree of abduction for 6 weeks.

## **Cerebral Palsy**

### **What is cerebral palsy?**

Cerebral palsy (CP) is an umbrella term covering a group of nonprogressive--but, in time, often changing--motor impairment syndromes secondary to lesions or anomalies of the immature brain.<sup>1</sup> Onset usually occurs before the first birthday. CP is the most common physical disability in childhood; the incidence was stabilized in the nineties at around 2-2.5<sup>5</sup> per 1000 live births.<sup>2</sup>

Although the motor disorder is the most striking symptom, many other pediatric and neurological impairments are associated with CP, such as failure to thrive caused by feeding problems or constipation, seizures, visual and auditory impairments, mental retardation, speech impairments, such learning deficits as dyslexia and nonverbal learning disability, and behavioral impairments.

While cerebral palsy is a blanket term commonly described by loss or impairment of motor function, cerebral palsy is actually caused by brain damage.

The brain damage is caused by brain injury or abnormal development of the brain that occurs while a child's brain is still developing — before birth, during birth, or immediately after.

Cerebral palsy affects body movement, muscle control, muscle coordination, muscle tone, reflex, posture and balance. It can also impact fine motor skills, gross motor skills and oral motor functioning.

### **General management**

Treatment of children with CP requires a long-term process during growth by a multidisciplinary team, focusing on all developmental aspects of the child and planning interventions in relation to the most urgent needs of the child and the family. The long-term

goal is the optimal functioning in adulthood. The organization of the health care for children with CP is very heterogeneous within and among countries. Recently, minimal acceptable standards have been described. Pediatricians, pediatric orthopaedic surgeons, pediatric neurologists, and, rather uniquely in the Netherlands, pediatric physiatrists are involved in the multidisciplinary treatment of children with CP. The International Classification of Functioning (ICF) model (most recent version of the International Classification of Impairment Disability and Handicap, WHO, Geneva, 1999) offers a framework for a multidisciplinary, need-oriented team approach. Based on this model, the Rehabilitation Activities Profile for children (Children's RAP) has been developed. This is an instrument for team communication on the level of abilities and so avoids the use of jargon. The goals of treatment also require description of the level of abilities. Long-term (e.g., the child will walk independently without walking aids, following education in a primary school) and short-term goals (e.g., the child can sit on a chair for 60 seconds without support) need to be described in a measurable way. In this way, evaluation of the goals in the team conferences is possible, and the results of treatment are clear for all team members as well as for the parents.

### **Classification based on type of movement disorder.**

- Spastic type - there may be intermittent increased tone and pathological reflexes.
- Athetoid - this is characterised by increased activity (hyperkinesia). This has been described as 'stormy movement'.
- Ataxic type - there may be loss of orderly muscular co-ordination so that movements are performed with abnormal force, rhythm or accuracy.
- Mixed - there may be a combination of several forms.

### **Medical management**

Prognosis of movement abilities can be made in the second to third year of life and is strongly related to the kind and localization of the motor disorder and the mental status of the child. There are three main types of motor syndromes: spastic paresis, ataxic paresis, and dyskinetic paresis.

Spastic paresis is characterized by a posture- and movement-dependent tone regulation disorder. The clinical symptoms are the loss or absence of tone in lying, and increase in tone in sitting, standing, walking, or running, depending on the degree of involvement. Spastic paresis is the most common motor disorder (83%).

In patients with ataxic paresis, impairments of equilibrium and coordination are dominant. There are hypermetric movements in the extremities, and tremor and titubations can be present. Only 4% of children with CP have a mainly ataxic paresis, often with some signs of spasticity in the legs. The time course of obtaining walking ability is delayed in comparison with spastic paresis, but most children achieve walking ability, at least with a walking aid.

Dyskinetic paresis can be divided into the hyperkinetic (athetoid) type, characterized by involuntary movements, most pronounced in the face and extremities, which are present even at rest, and the dystonic type, characterized by slow powerful contractions of agonist and antagonist of movement simultaneous, locally or with total body involvement. In time, a hyperkinetic type of movement can change into a dystonic type, and combinations are also possible. The development of head and trunk balance is delayed. Some children achieve walking ability even at the age of 10 years. Dyskinetic paresis is seen in 12% of children with CP.

For the proper treatment of children with CP, the classification of the kind of motor disorder is crucial. The surgical and orthotic management in children with dyskinetic or ataxic paresis is completely different from that of children with spastic paresis. Because the spastic paresis is the most common motor syndrome, this article will focus on that motor disorder.

The motor disorder can also be classified in regard to the localization: hemiplegia is defined as a unilateral involvement (33%); diplegia as a bilateral involvement, in which only the lower extremities are involved or the lower extremities are more involved than the upper extremities (44%); quadriplegia (or tetraplegia) is defined as a bilateral involvement, in which the upper extremities are equal or more involved than the lower extremities (6%). This classification is unambiguous and easy to use in clinical practice. [Classifications using the

presence of muscle impairment of the upper extremities (paraparesis if no involvement of the upper extremities, diplegia with involvement of the upper extremities) or bulbar involvement (diplegia without bulbar involvement, quadriplegia with bulbar involvement) can cause confusion. These signs can be present only slightly, so it is difficult in clinical practice to set limits for the classification paraparesis, diplegia, and quadriplegia.] According to this classification, the functional prognosis of independent walking ability (with or without walking aids) can be set: 100% of the hemiplegic children, 85% of the diplegic children, based on the ability to put weight on the hands while prone at 18 months and a short sit at the age of 24 months, and none of the quadriplegic children will achieve independent walking ability in adulthood. The Gross Motor Function Classification System (GMFCS) is an instrument for early classification the severity of the motor disorder.

About 80-90% of the children have spastic paresis as the motor disorder. However, with regard to the impairment of muscle function, a variety of clinical symptoms can be distinguished. Several terms have been used in the literature to describe the different symptoms of spastic paresis, and the same terms are often defined differently. The term "spasticity" is often used for all kinds of motor disorders or for all signs of a spastic paresis. Because a proper description of the different symptoms is needed for selection of patients for a specific therapy, conventions about terminology are needed. The following classification is according to the actual insight.

In spastic paresis, three sets of symptoms can be distinguished: impairment of muscle activation; impairment of muscle stiffness; and impairment of muscle length.

## IMPAIRMENT OF MUSCLE ACTIVATION

Impairment of muscle activation can be divided into **deficit symptoms** and **excess symptoms**.

**Deficit symptoms** are caused by the reduction of voluntary muscle function. In the case of mild involvement, only loss of dexterity of movement, diminished ability to perform fast alternating movements and enhanced fatigability are present. In more severe involvement, the patient can perform only synergistic voluntary movements and the level of force is reduced. The lowest level of motor control is voluntary movement in a general

flexion (mostly present in the upper limbs) or extension pattern (mostly present in the lower limbs). Synergistic voluntary movements are also described as "loss of selective motor control." In spastic paresis, the influence of posture is also increased. For instance, it is much easier for most patients to bend the hip in a sitting position than in a standing position. For that reason, it is not rational to use the Medical Research Council scale for grading the force of muscles when synergies of muscle movements are present.

**Excess symptoms** reflect the presence of abnormal muscle activity. Clinically, the presence of abnormal muscle activity can be noticed either during passive joint movements, while the patient is in maximal relaxation, or while the patient is performing motor tasks.

### ***Passive Movement***

During (very) slow passive movements, muscle tone can be examined. Some patients show a raised muscle tone during a very slow passive stretch (hypertonia defined as a non-velocity-dependent resistance to passive stretch). This increased resistance could be caused by a continuous activation of the stretched muscle (tonic stretch reflex activity).

During fast passive movements, the presence of spasticity, defined as the velocity-dependent resistance to passive stretch, can be examined. If only a catch (clasp-knife symptom) can be noticed, the spasticity is mild. In more severe spasticity, a clonus in the muscle or a marked increase in resistance can be evoked. Hyperreflexia of tendon jerks, abnormal cutaneo-muscular reflexes (such as Babinski's response) are also excess symptoms.

When performing motor tasks, three other features of involuntary muscle activation can be present: mirror movements can be present in patients with a hemiplegia or asymmetric diplegia: strong voluntary contraction of a muscle on the unaffected side evokes contractions in the same muscle on the opposite side; involuntary synergies can arise during the performance of a motor task. For example, the occurrence of a flexor synergy in the arm of hemiplegic patients when walking; postural reflexes cause involuntary muscle activity during the performance of a motor task (e.g., the clawing of the toes when walking). The muscle contractions develop gradually during walking.

### ***Active (Voluntary) Movement***

During active movement, co-contraction of the antagonist is also an excess symptom. Clinically, co-contraction can sometimes be observed as a paradoxical movement. For instance, the patient is asked to extend the elbow, but a flexion movement takes place: the co-contraction of the flexors is more powerful than the contraction of the extensors of the elbow. There is no relationship between the presence of co-contraction during voluntary movement and spasticity during passive movement. The amount of co-contraction in repetitive movements of the ankle is significantly lower on the hemiplegic side than on the unaffected side.

Clinically, increased muscle stiffness (defined as hypertonia) can be observed during slow passive stretch of a muscle after maximal relaxation. It is important to choose a posture for the patient in which maximal relaxation can be achieved (i.e., lying supine, flexion-abduction-external rotation in the hip and flexion in the knee will relax the triceps surae muscle). Without electromyographic activity, hypertonia can be caused by changes in the biomechanical properties of the muscle.

The development of muscle shortening is a well-known phenomenon in clinical practice. It is unclear why muscle shortening is present in some patients and not in others. A neurological growth disturbance has been postulated.<sup>15</sup> Because muscle shortening takes place in the pattern of movement, a relation between gait pattern and muscle shortening seems probable.

The classification of impairment of muscle function in spastic paresis is summarized in . The clinical consequences of this classification are evident: treatment of spasticity can improve only functional problems caused by spasticity, not by other such impairments as postural reflexes, hypertonia, or muscle shortening. This is crucial, for instance, for selection of patients for a specific therapy, such as prescription of ankle foot orthoses or selective dorsal rhizotomy.

### **Classification of gait pattern**

In children with CP, the classification of gait pattern can be used to determine developmental risks, to forecast walking ability in time, and to define therapeutic measures,



such as orthotic treatment or surgery. For hemiplegic patients, four kinds of gait patterns are recognized. The following classification can be used for both hemiplegic and diplegic patients. Diplegic patients can show different patterns for each leg.

### ***Type 1: Insufficient Foot Lift in Swing***

In children affected only mildly, the main problem in walking is insufficient foot lift in mid-swing and forefoot landing at initial contact. In general, insufficient activity in the tibialis anterior and/or shortening of the gastrocnemius muscle is the cause of this gait pattern.

### ***Type 2: Knee (Hyper)Extension in Midstance without Heel Rise***

More severely affected children show, besides the insufficient foot lift in mid-swing, knee extension or hyperextension after initial contact instead of knee flexion, without heel rise in midstance. This is caused by a premature activation of the triceps surae muscle. The forefoot landing may be caused not only by insufficient foot lift but also by incomplete knee extension in terminal swing due to insufficient selective motor control (in terminal swing, hip flexion must be combined with a knee extension movement).

### ***Type 3: Knee (Hyper)Extension in Midstance with Heel Rise***

This gait pattern is similar to type 2, but heel rise takes place in midstance. A higher degree of abnormal activation of the triceps surae muscle is present. Prolonged activation of the vastus lateralis muscle can be present as a sign of insufficient power of the gastrocnemius muscle in terminal stance. In that case, the risk of development of a gait type 4 is present.

### ***Type 4: Knee Flexion in Midstance with Heel Rise***

In severely affected children, a gait pattern characterized by hip and knee flexion in midstance can be present. This gait pattern can be caused by strong abnormal activity (with or without muscle shortening) of the gastrocnemius and hamstring muscles or by abnormal activity of the psoas and hamstring muscles. The former situation has a better functional prognosis than the latter. These children are at high risk of developing shortening of the psoas, hamstring, and gastrocnemius muscles, and, in later stages, flexion contractures in hip

and knee joints. Because this gait pattern is very energy-consuming, deterioration in (pre)puberty can be expected.

### ***Type 5: Knee Flexion in Midstance without Heel Rise***

The worst pattern of gait is a gait pattern with flexion of the hip and knee in midstance without heel rise. Insufficient power of the gastrocnemius muscle must be present. Often, it is caused by previous gastrocnemius surgery or Achilles tendon lengthening, but it can also develop spontaneously. If a change of gait pattern in bilateral involvement, at least into type 4 gait pattern, cannot be reached, loss of walking ability can be expected in puberty.

Besides these gait patterns, foot deformation can be present (varus or valgus). Increased homolateral trunk movements or pelvic drop of the contralateral leg in midstance are signs of weakness of the hip abductors. Also, endorotation adduction motion in terminal swing can be present, in severe cases resulting in rubbing of the knees. This can be caused by shortening or abnormal activity of the medial hamstrings. Persistent adduction in stance and swing can be caused by shortened hip adductors, endorotation by increased hip anteversion and endorotation contractures. Exorotational or endorotational foot progression angles can be caused by hip rotational contractures or rotational deformities of the femur or tibia. Insufficient foot clearance in preswing can be related to insufficient hip and knee flexion or abnormal stretch reflex activity (and shortening) of the rectus femoris muscle.

All these aspects of the gait pattern must be taken into account for making a plan for improvement of gait. The task of the medical specialist is to coordinate the multidisciplinary treatment of children with CP. Setting long-term goals on the level of abilities is the major task of the team. The medical specialist must determine the functional possibilities of the child and the risks for deterioration during growth. The medical treatment should take place within a whole treatment program, taking into account all aspects of development of the child and the possibilities of its environment. It is a challenging task for teams specializing in the treatment of children with CP.

## **Treatment of Cerebral Palsy.**

Children with cerebral palsy constitute a diverse clinical group that is very different in terms of locomotor, mental, and social development. As every patient is unique, it is not possible to apply only one multipurpose method of rehabilitation. Therefore, flexibility is required in order to combine different forms and methods of medical rehabilitation (conventional and unconventional) with correctional psychological and educational work.

Therapy should not be unidirectional. Unfortunately, traditional methods of physical therapy do not always allow medical specialists to achieve the desired result. Only by integrating the various influences of different treatment modalities may the desired result be achieved. One of these multiple rehabilitation methods for patients with cerebral palsy is the Intensive Neurophysiological Rehabilitation System (INRS), also known as the Kozyavkin Method, the name of its author.

The Kozyavkin Method – the Intensive Neurophysiological Rehabilitation System (INRS) – represents a highly effective technology for treating patients with cerebral palsy, osteochondrosis, trauma complications, and organic lesions of the nervous system.

Biochemical correction of the spine and large joints constitutes a major component of our methodology; it is also combined with a complex of other therapeutic measures: reflexotherapy, remedial exercises, massage treatments, rhythmic gymnastics, mechanotherapy, and apitherapy. We have developed a program for biodynamic movement correction, using the Spiral suit, in order to form proper movement patterns.

By stimulating compensatory possibilities in the child's body and activating the plasticity of the brain, this system creates a new functional state in the child's body, giving the physical therapist the opportunity to enhance the child's motor and mental development more rapidly.



The versatile therapeutic effects of this method, which complement and potentiate each other, are aimed at achieving the main target in rehabilitation, namely, improving the patient's lifestyle. It is important to point out that this system is not an alternative to other rehabilitation methods; it only complements and substantially broadens the effectiveness of existing rehabilitation methods. Created as a result of INRS, the patient's new functional state is set against a background of normalized muscle tone, restored joint mobility, improved trophism and blood circulation, thus opening up entirely new opportunities for the child's development and improving the effectiveness of other rehabilitation methods:

The Kozyavkin Method was developed in Ukraine twenty years ago, and since then, more than 40,000 patients from 63 countries have gone through rehabilitation treatment using this system.

More than fifty families from the USA have visited Ukraine more than once, and successfully completed the course of intensive neurorehabilitation. This rehabilitation system was officially recognized in Ukraine back in 1993, and has gained wide international

recognition thanks to its effectiveness. In 1997, the Kozyavkin Method was listed among the top four most effective conservative treatments for patients with cerebral palsy in the encyclopedia edition of Children's Orthopedics, edited by the reputed German scholar, Prof. Niethard.

A statistical analysis of medical data concerning 12,256 patients, who went through the rehabilitation treatment course according to the Kozyavkin Method, confirmed the excellent performance of the system.

Normalization of muscle tone was noted in 94% of the patients, and skills in head control in the supine position in 75% of the patients; 62% of the patients, who had been incapable of sitting, mastered this skill; 19% of the patients, who had been incapable of walking, mastered assistance-free gait; after their rehabilitation course, 87% of the patients could open their spastically clenched fist.

Rehabilitation treatments according to the Kozyavkin Method are carried out in Lviv and Truskavets (Ukraine). In July 2003, along with the Elita Rehabilitation Center and the Institute for Medical Rehabilitation, the International Clinic of Rehabilitation opened in Truskavets, taking into consideration special features of rehabilitation for patients with cerebral palsy.

## **What is physical therapy?**

Physical therapy is a branch of rehabilitative health that is considered one of the most important aspects of treating children with cerebral palsy. Those with cerebral palsy experience mobility, function, posture and balance challenges of varying degrees, and physical therapy – which focuses on basic mobility such as standing, walking, climbing stairs, reaching or operating a wheelchair – is a key element in the multidisciplinary approach to increasing a child's mobility.

Physical therapy is the rehabilitation of physical impairments by training and strengthening a patient's large muscles – those in the arms, legs, and abdomen. The goal of physical therapy is to maximize functional control of the body, or increase gross motor function.

The goal of physical therapy is to help individuals:

- develop coordination;
- build strength;
- improve balance;

- maintain flexibility;
- optimize physical functioning levels;
- maximize independence.

Trained and licensed physical therapists identify mobility issues and determine the unique physical abilities and limitations of children, taking into account their age and cognitive functioning, after a diagnosis of cerebral palsy is made by a physician.

The therapist will then develop a course of treatment that will include exercises, stretches, and possibly assistive and adaptive equipment designed to achieve mobility. The treatment may also employ the use of passive modalities involving hot and cold packs, ultrasound technology or other means in which the child does not take an active role.

All treatment is designed to meet a child's individual needs in a way that emphasizes physical fitness, and minimizes injuries and pain.

Additionally, a physical therapist provides positive reinforcement for a child by focusing on his or her capabilities, not limitations. The therapist will set goals for young patients, and work with them to meet predetermined benchmarks with confidence in a safe, supportive environment.

Therapy aids overall treatment goals such as:

- Overcoming physical limitations;
- Expanding range of joint motion;
- Building and maintaining muscle tone;
- Increasing recreational capabilities;
- Identifying alternate ways to perform everyday tasks;
- Fostering independence;
- Decreasing the likelihood of contractures, bone deformity;
- Educating children and parents about adaptive equipment;
- Providing sensory stimulation;
- Increasing fitness;
- Increasing flexibility;
- Improving posture;
- Improving gait;
- Minimizing pain and discomfort.

### **Who benefits from physical therapy?**

A child, and his or her parents or caregivers, benefit tremendously from physical therapy because it helps the child overcome physical limitations by increasing mobility, and identifies alternate methods of completing tasks.

### ***The individual with cerebral palsy benefits***

This is of benefit to the child because it makes possible something unaffected individuals take for granted: the ability to move from place to place, and interact with other children or adults by playing or performing tasks. Therapy also increases overall health by strengthening the body in a way that makes functioning not only possible, but pain and stress-free.

This is achieved not only by developing strength and flexibility in the body, but also using adaptive techniques – or equipment that can be operated by the child – that will allow the patient an alternate path to perform tasks able-bodied children their age perform.

Depending on the nature of a child's cerebral palsy, a child can live a near-normal life; persons with the condition have attended college, participated in sports and activities, excelled in their careers and have married.

Physical therapy empowers the child physically and emotionally, and sets the stage for entering adulthood as an independent individual.

### ***Parents and caregivers benefit.***

Parents and caregivers benefit because as a patient progresses, raising a child with cerebral palsy becomes less labor intensive. Parents and caregivers are often overwhelmed and under an extreme level of stress. They have several responsibilities, including assisting their child with many physical tasks, providing love and emotional support, making sure the child is receiving adequate care in a medical setting and an education at school. The more physical challenges a child can overcome or adapt to, the less hands-on assistance is required of the parents.

Additionally, a successful physical therapy program allows a parent to see their child interacting with others in a healthy way, building relationships, using their body to the best of his or her ability, and potentially, living independently.

### **What are the benefits of physical therapy?**

The benefit of physical therapy, for any patient that is experiencing physical limitations, is regaining – or developing – physical mobility.

By developing a comprehensive plan of treatment, a physical therapist can address limitations in a child's mobility – and specifically address them. This is achieved through employing exercises that increase physical function, and using adaptive equipment such as wheelchairs, walkers, canes and orthotics to improve performance.

As a child's physical abilities improve, the therapist can modify the equipment, or the overall course of therapy, to further advance a child's treatment.

The largest benefit of therapy to the child with cerebral palsy is in treatment of problematic conditions when they occur, including:

- Muscle atrophy or tightening;
- Loss in joint range of motion;
- Muscle spasticity;
- Pain in muscles and joints;
- Joint inflammation;
- Contractures (muscle rigidity);

The therapists focus on achieving optimal results and minimizing unforeseen complications.

### **When is therapy advised?**

Physical therapy typically begins after a pediatrician or a family physician determines a child has cerebral palsy, and after it is determined the young person may need assistance with his or her gross motor functionality, pain, contracture or spasticity. A diagnosis is often made before a child is 18 months old.

Because limitations on motor skills vary significantly among children with cerebral palsy, it is possible that a child may not require physical therapy.

### **How is physical therapy performed?**

Physical therapy is carried out by licensed physical therapists and physical therapy assistants, often by using means such as:

- soft tissue mobilization (kneading of the muscles);
- joint mobilization;
- specialized exercises;
- stretching;
- endurance exercises designed to meet therapeutic goals.

Physical therapy is hands-on, a therapist, or an assistant, will guide the child through exercises. Exercises often include the use of equipment, such as:



- Weights;
- Exercise machines;
- Rollers;
- Balance balls;
- Heat and cold packs;
- Ultrasound technology.

At some centers, sports or recreation like swimming, dancing, playing games such as throwing and catching a ball, may be used to help children develop muscles, balance, coordination and range of motion.

Swimming, because the child is almost entirely submerged in the water, will give children an opportunity to do exercises they cannot do otherwise; moving against the water, kicking and other beneficial exercises can be accomplished in a pool, sometimes in braces. These methods can provide children with an opportunity to play and have fun.

Adaptive equipment including braces, splints, orthotics, wheelchairs and even computers will be used in therapy; therapists will modify the equipment as needed. The therapist will also play an instructive role in this regard for children and parents, teaching them how to use the equipment.

### **Where does physical therapy occur?**

Physical therapy takes place in several settings, including outpatient medical offices or clinics, inpatient rehabilitation centers, specialized physical therapy centers, skilled nursing centers, hospitals, special education classrooms, and in the home.

The number of physical therapy settings are dependent on several factors; the most important of these is prescribed treatment of the child. Additional considerations include what adaptive equipment is used in treatment, as well as the abilities of a caregiver to provide additional therapy at home. Insurance coverage can also dictate how often a child attends therapy in a clinical setting.

In many cases, a physical therapist will prescribe exercises to be completed at home. The physical therapist or an assistant will train the individual with cerebral palsy, the parent or caregiver and the primary caregivers on how to properly perform exercises at home.



### **What happens during physical therapy?**

There is no therapeutic template for cerebral palsy since there are many forms of cerebral palsy which affect each individual differently. All physical therapy begins with a diagnosis, the child's primary doctor will then refer the child to a physical therapist while providing specific treatment goals to accomplish. At the start of physical therapy, a comprehensive medical history for the child will be obtained. Additionally, the therapist will

conduct a series of tests, observations and measurements to assess the child's body mechanics and function.

The examination may assess:

- Gait;
- Range of joint motion;
- Physical strength;
- Flexibility;
- Balance;
- Endurance;
- Joint integrity;
- Posture;
- Neuromotor development;
- Sensory integration;
- Cognitive functioning;
- Reflexes;
- Breathing, respiration.

The therapist then prepares a patient-centered plan of care that takes into account the child's condition, and the child's overall environment. The physical therapist will also determine what orthotic equipment, adaptive equipment, or assistive technologies may be needed to help a child.

Orthotic equipment can include braces that stabilize the ankles, knees, legs, torso, upper arms, lower arms, elbows or hands. Adaptive equipment includes strollers, nets, walkers and wheelchairs. The therapist will teach the child – and his or her caregivers – how to operate the equipment, and will make modifications to accommodate a child's condition.

Once the child's plan of treatment is determined, therapists will set goals for a child's progress, and work with the child to meet those benchmarks. This typically means the therapist and his or her assistants manipulate a child's body while completing stretches, strength exercises or games with specific movements or purpose.

Often therapy includes instructions for exercises, stretches, posturing and balance to be performed while outside the therapy sessions; at home, school or work.

## **What is occupational therapy?**

Occupational therapy is an integral part of a cerebral palsy patient's overall treatment program. The goal of occupational therapy is to promote a child's ability to perform daily rituals and activities in a way that will enhance their quality of life and make possible the enjoyment of independent living.

During occupational therapy, a trained therapist will guide the individual in adapting, compensating, and achieving maximum function levels. They take into account physical functioning abilities and limitations, cognitive functioning levels (i.e., reasoning and processing skills), emotional needs and desires, and ability and willingness to adapt and compensate. The existing home environment and support system play an important role, as well.

Occupational therapy is a form of therapeutic intervention. The goal of therapy is to ensure a child achieves the highest level of functional performance within their home, school, public and work environments. Occupational therapy employs adaptive processes to teach a child to perform tasks required in the normal course of a day.

This is accomplished by focusing on:

- Identifying adaptive methods a child can learn to complete tasks.
- Breaking down essential tasks into smaller, do-able steps, often modified.
- Capitalizing on the need for accomplishment, pride, enjoyment and independence.
- Developing in a child a sense of place in their environment, at school, and in the community.

**Everyday tasks** – the ones an occupational therapist will focus on – can test a child's physical and emotional resources. These tasks include:

### **Home:**

- Eating;
- Dressing;
- Personal grooming;
- Brushing teeth;
- Bathing;
- Writing;
- Grasping objects;
- Using a computer;

- Using a telephone;
- Interacting with family and caregivers;
- Preparing food;
- Housekeeping;
- Using adaptive equipment or assistive technologies.

**School:**

- Opening doors;
- Sitting at a table or desk;
- Handwriting;
- Using the bathroom;
- Traveling on the bus or in a vehicle;
- Opening a locker;
- Avoiding or overcoming physical obstacles;
- Interacting with teachers, aides and peers;
- Taking part in school activities;
- Completing assignments, homework.

**Work:**

- Using a phone;
- Using tools related to specific vocations;
- Using computers;
- Interpersonal skills;
- Job skills;

**Community:**

- Navigating public spaces;
- Using public transportation;
- Driving;
- Shopping;
- Interacting with service personnel;
- Identifying and using community-based resources.
-

## **Who benefits from occupational therapy?**

Occupational therapy can have far reaching, positive consequences for the individual with cerebral palsy, his or her parents, and caregivers. Individuals with cerebral palsy benefit from therapy because it teaches a child how to develop and maintain a daily routine – which contributes to independence and quality of life. As children grow, they want to handle everyday tasks to the best of their abilities without assistance or interference. They want to be accepted by their peers and participate socially with others. They would prefer not to be reliant on others for their basic needs.

Additionally, occupational therapy enables a child to respond to life's demands, setting the stage for him or her to develop relationships, care for themselves, provide for their own physical needs, pursue education, maintain employment, and achieve economic parity with their peers.

What a child learns in occupational therapy is put into practice in their daily rituals, from the time they wake up in the morning to get ready to go to therapy or school, finishing homework, playing with siblings, to putting on their pajamas for a good night's sleep.

### **The benefits for children are:**

- Adapting to abilities, not limitations;
- Pursue interests, hobbies, activities;
- Interacting with others;
- Being part of a community;
- Performing tasks independently;
- Responding to the demands of everyday life;
- Perceiving the importance of tasks;
- Developing critical thinking skills;
- Coping with challenges and emotions;
- Learning to adapt and compensate.

Children with severe cases of cerebral palsy can also benefit from occupational therapy; mostly through the use of specialized adaptive equipment and assistive technologies. In this circumstance, an occupational therapist will modify, then teach children how to use specialized equipment, including:

- Rotating desks;
- Computers with pre-programmed language (if they are unable to speak);

- Equipment to navigate transfers from a laying to seated position;
- Computerized environmental control systems;
- Specialized chairs that help maintain proper position for eating, breathing.

### ***Parents.***

From the time a child is diagnosed with cerebral palsy, parents worry about their child's quality of life, their ability to function, their health, their emotional status, their ability to be accepted and their future prospects. Occupational therapy can help quell some of those fears by fostering skills that will allow their child to play, interact with others, go to school, navigate the community and be productive within the workforce. Once the child masters skills within their own unique skill sets, parents will feel less overwhelmed by their child's condition.

#### **The benefits for parents and caregivers include:**

- Reduced stress;
- Opportunity to see child thrive emotionally
- Security in knowing a child can perform tasks safely

### **Caregivers.**

Parents and caregivers also benefit from occupational therapy. The benefits include:

- Decreased reliance on other for help with self-care;
- Increased physical mobility;
- Decreased need for assistance with everyday tasks (dressing, grooming, eating;
- Less physical stress from assisting a child with mobility;
- Decreased emotional dependence;

### **When is occupational therapy advised?**

Occupational therapy is based on a child's needs and can be recommended any time after a child is diagnosed with cerebral palsy. Every case of cerebral palsy is unique. A comprehensive assessment of an individual's motor skills, cognitive functioning, developmental condition, overall environment and physical and psychological needs will determine therapy goals.

### **What happens during occupational therapy?**

Occupational therapy begins with an assessment of a child's physical and mental functioning, both of which figure prominently in a child's ability to perform a task. The therapist will pay special attention to:

**Physical:**

- Range of motion;
- Flexibility;
- Muscle and hand-eye coordination;
- Reflexes;
- Developmental issues;
- Transitionary movement.

**Visual:**

- Visual clarity;
- Visual perception;
- Visual tracking;
- Visual memory;
- Spatial perception;

**Sensory:**

- Auditory ability;
- Body awareness and perception;
- Tactile response;
- Memory sequencing;
- Proprioceptive;
- Vestibular.

**Psychological/Social:**

- Temperament;
- Ability to relate to others;
- Capacity for reason;
- State of mind;
- Propensity to set goals.

**External factors:**

- Home environment;
- Potential obstacles that could modify the course of therapy;
- The role of the child in the family;
- The makeup of the child's family;
- Socio-economic status of the family;



- Cultural practices.

As a professional that is cast in the role of implementing treatment that takes into account all of these factors, the occupational therapist must ask several questions as part of his or her assessment. Some of the questions may not immediately seem relevant to a parent, but they are essential to the therapist's ability to develop workable solutions for the child.

Some of the issues an occupational therapist will consider are:

- Community a child lives in;
- Size of his or her family;
- Family's work obligations;
- Availability of community and government resources.

Once an assessment is completed, the occupational therapist will implement the treatment plan. At this time, the therapist will teach children how to complete tasks using several paced steps, using adaptations when necessary.

Further, the therapist will use exercises that will help the child understand the nature of the task and why it's important. This is vitally important because a child must not only be able to approach and complete a task, but also understand the benefit of the task and have a desire to perform it.

To meet that end, a plan of treatment for occupational must encourage:

- Personal empowerment;
- Motivation;
- Understanding of the tasks;
- Decision-making capabilities;
- Perception;
- Recall and memory;
- Self-assessment strategies;
- Critical thinking;
- Planning skills;
- Understanding cause and effect.

Occupational therapists will also use some physical exercises to assist a child as they relate to tasks, including those that encourage dexterity, flexibility, and hand-eye coordination. Additionally, interventions such as biofeedback and relaxation may also be employed to treat anxiety in a child that becomes overwhelmed while learning.

During therapy, the therapist will also determine what, if any, assistive technologies should be used to adapt limitations. The child, and his or her parents or caregivers, will be trained in the use and maintenance of equipment.

Assistive technologies may include, but not limited to:

- Computers;
- Voice-synthesizers;
- Bars that a child can grip;
- Modified household supplies;
- Bathing seats;
- Dressing devices;
- Walkers;
- Orthotics.

Parents should expect that they will be an active participant in their child's treatment. The occupational therapist should use their skills to teach parents as much about their child's abilities as possible; parental involvement and support at all levels of cerebral palsy treatment is an essential component to a child's ability to overcome their limitations. Additionally, parents must reinforce in at home what is learned in occupational therapy, so it becomes part of a child's daily routine.

### **Hippotherapy**

**Hippotherapy** is a form of physical, occupational and speech therapy in which a therapist uses the characteristic movements of a horse to provide carefully graded motor and sensory input. A foundation is established to improve neurological function and sensory processing, which can be generalized to a wide range of daily activities. Unlike therapeutic horseback riding where specific riding skills are taught, in hippotherapy, the movement of the horse is a specific treatment strategy used toward achieving a specific treatment goal, as outlined by a licensed treatment therapist.

Derived from the Greek *hippos* (horse), "hippotherapy" literally refers to treatment or therapy aided by a horse. The concept of hippotherapy finds its earliest recorded mention in the ancient Greek writings of Hippocrates. However, hippotherapy as a formalized discipline, was not developed until the 1960s, when its use began in Germany, Austria, and Switzerland as an adjunct to traditional physical therapy. In Germany, hippotherapy was a treatment coordinated and carried through by a treatment team consisting of

a physiotherapist, a specially trained horse, and a horse handler. The theories of physiotherapy practice were applied; the physiotherapist gave directives to the horse handler as to the gait, tempo, cadence, and direction for the horse to perform. The movement of the horse was carefully modulated to influence neuromuscular changes in the patient.

The first standardized hippotherapy curriculum was not officially formulated until into the late 1980s. In the mental-health field, social workers, psychologists and mental-health providers may incorporate equine-assisted psychotherapy into their treatment sessions. This is different from hippotherapy, where the movement of the horse influences or facilitates an adaptive response in the patient. Forms of equine assisted psychotherapy may have the patient on or off the horse, and the treatment is not focused on a set of specific movements for the horse to produce an adaptive response in the patient.



All therapists, who use hippotherapy in their treatment protocols, require training. In the United States, the American Hippotherapy Association (AHA) offers education to therapists, promotes research in equine assisted therapy and provides continuing education courses.

The horse's pelvis has a similar three-dimensional movement to the human's pelvis at the walk. The horse's movement is carefully graded at the walk in each treatment for the patient. This movement provides physical and sensory input which is variable, rhythmic and repetitive. The variability of the horse's gait enables the therapist to grade the degree of input to the patient and use this movement in combination with other treatment strategies to achieve desired therapy goals or functional outcomes.

In addition, the three-dimensional movement of the horse's pelvis leads to a movement response in the patient's pelvis which is similar to the movement patterns of human walking. A foundation is established to improve neurological function and sensory processing, which can be generalized to a wide range of daily activities and address functional outcomes and therapy goals.

This therapy is especially beneficial for paralyzed individuals and those in physical rehabilitation programs, as it assists in enabling capabilities.

Physical therapists who have had training in hippotherapy may incorporate the multi-dimensional movement of the horse to achieve gait training, balance, postural/core control, strengthening and range of motion goals. Improvement in gross motor skills and functional activities for developing children with disabilities has been reported. Impairments are addressed through the variability of the horse's movement by modifying the rhythm, tempo and cadence of the horses movement.

Occupational therapists providing hippotherapy utilize the movement of the horse to improve motor control, coordination, balance, attention, sensory processing and performance in daily tasks. The reciprocal multi-dimensional movement of the horse helps with the development of fine motor skills, visual motor skills, bilateral control and cognition as well. Sensory processing via hippotherapy simultaneously addresses the vestibular, proprioceptive, tactile, visual and auditory systems. The occupational therapist incorporates the movement of the horse, hippotherapy, to modulate the sensory system in preparation for a therapy or treatment goal that leads to a functional activity.

### **What is Muscular Dystrophy?**

Muscular dystrophy (MD) is a genetic disease caused by a change or mutation in 1 of the genes located on the chromosomes (DNA) in human cells. Muscular dystrophy causes

muscle weakness and a decrease in muscle mass over time. It can affect people worldwide of all races and ages. Nine types of dystrophies have been identified, and many types have variations or subtypes, resulting in more than 30 different forms. Several types of dystrophies affect children, and symptoms of the disease might begin in children at any time from birth to the teen years.

In children, boys are affected more often than girls, although girls may exhibit some of the effects of MD or be carriers of the disease. Duchenne muscular dystrophy (DMD) is the most common form of muscular dystrophy in children, occurring in approximately 1 in 3,500 to 6,000 boys born in the United States each year. Many other forms of MD exist in children, and the exact number of children who have some type of dystrophy is not known. While no cure exists for any of the dystrophies, many treatments, including physical therapy, can help maintain function by managing complications of disease progression, such as weakness and contractures. Each child who has MD has unique needs based on age, the type of dystrophy, and the progression of symptoms. Physical therapists will work with the child and family as well as other health professionals to develop an individualized treatment plan to help the child reach full potential.

Muscular dystrophy may also occur from a spontaneous mutation when a baby is forming; that mutation will not be found in the genes of either parent. Many dystrophies result from a spontaneous mutation.

### **Signs and Symptoms**

All dystrophies are genetic and progressive, cause muscle weakness, and cause children to experience activity limitations and participation restrictions.

All dystrophies cause muscle weakness that gets worse over time and leads to muscle wasting. Many dystrophies cause contractures (shortening due to tightness) of joints, curvature of the spine, respiratory (breathing) and cardiac (heart) problems, and other symptoms.

Any delay in motor milestones—the ability of the child to learn how to sit up, crawl, walk, and run at typical ages—should be investigated to determine the cause of the delay. The Gowers sign, a medical term describing the way a child gets up to stand by pushing with hands on the thighs, is often the first indication of pelvic muscle weakness. This sign is highly associated with Duchenne MD. Research has suggested that any child who continues

to turn onto his stomach before getting up from the floor after 3½ years of age should be examined for weakness.

### **How Can a Physical Therapist Help?**

The physical therapist is an important partner in health care and fitness for anyone diagnosed with MD, and physical therapy should begin as soon as possible after diagnosis and before joint or muscle tightness has developed. Physical therapists identify muscle weakness, and work with each child to keep muscles as flexible and strong as possible, help reduce or prevent contractures and deformities, and encourage movement and mobility for optimal function throughout all the stages of life. Each treatment plan is designed to meet the child's needs using a family-centered approach to care. If assistive devices are needed, the physical therapist may collaborate with other professionals to determine the best walking aids, braces, or wheelchair for each child.

**Evaluation.** The child's physical therapist will perform an evaluation that includes a detailed birth and developmental history. The physical therapist will also ask about the child's overall health, and about any parental concerns. The physical therapist will conduct a physical examination, and perform specific tests to determine the child's motor development, such as sitting, crawling, getting up to standing, and walking. Physical therapists know the importance of addressing the child's needs with a team approach where all of the health care professionals provide holistic care that ensures mobility throughout the lifespan.

**Treatment.** Physical therapists work with children who have MD to prevent or reduce joint contractures, maintain or improve cardiorespiratory and muscle strength, adapt activities or the environment to promote movement and mobility skills, and increase daily activities, which encourages participation in the community.

**Passive and active stretching.** Your physical therapist will assist you and your child in increasing joint flexibility (range of motion) and preventing or delaying the development of contractures. Passive stretching should not be painful.

**Maintaining strength.** Your physical therapist will teach you and your child exercises to maintain muscle and trunk strength and to use good posture and body mechanics throughout the lifespan. The therapist will identify games and fun tasks that promote strength. As the child grows, the therapist will identify new games and activities to reduce the risk of obesity, and increase heart health. Overexercising can damage

muscles, so families are encouraged to seek physical therapy services early in order to identify the best strengthening activities for the child.

### **Exercises for breathing.**

Breathing exercises become important as the child becomes less able to actively exercise. When we breathe in (inspiration), muscles lift the rib cage up and out, making the chest larger. Air then rushes into the lungs to fill the extra space created. When we breathe out (expiration) the muscles relax and the air is pushed out by the elasticity of the lungs. We only use muscles of expiration when air is forced out, as in coughing. As the respiratory muscles weaken in children and young people with Duchenne muscular dystrophy, this reduces the ability to inhale and exhale air forcefully. It becomes more difficult to cough and expel mucus from the lungs, which affects the amount of oxygen in the body and increases the likelihood of chest infections. An incentive spirometer can help good expiratory (breathing out) technique. Inspiratory muscle training against resistance is not recommended. It may also be helpful to encourage your child to play a wind instrument or join a singing group. Younger children could blow bubbles.

The physical therapist may provide a program to maintain good respiratory strength, or may work with respiratory therapists or speech therapists in designing such a program.

**Swimming** is particularly good exercise at all ages, both for the muscles and the lungs, and children may be able to swim or take lessons at school. It is important that children with muscular dystrophy stay warm in the water, either by continually moving or perhaps by using a children's pool, which is often warmer than a full size pool. The changing facilities also need to be warm, as well as accessible, to prevent the children becoming cold when they leave the water.

**Improving developmental skills.** Your physical therapist will help your child learn to master motor skills, such as crawling, getting up to standing, walking, and jumping. Your therapist will provide an individualized plan of care that is appropriate based on your child's developmental level and motor needs.

**Foster physical fitness and activity.** Your physical therapist will assist in determining the specific exercises, diet, and community involvement that will promote

good health. When needed, mobility aids, such as wheelchairs, splints and braces, and home devices may be prescribed to help maintain mobility.

Therapy may be provided in the home or at another location, such as a community center, school, or a physical therapy outpatient clinic. The child's needs vary greatly as the child ages. The physical therapist will work with other health care professionals, including speech/language pathologists or occupational therapists, to address all the individual's needs as treatment priorities shift.

### **Positioning**

The way a child moves and the positions adopted – to write, eat or rest, for example – are a direct response to losing muscle strength and having contractures. The child will naturally find the easiest and least tiring option, without thinking about it. Sometimes muscle strength and/or the stiffness of a contracture may be different on each side of the body.

When this happens, an asymmetry or imbalance occurs which can cause scoliosis. Passive stretching and night splints can delay the onset of contractures but it is important to know which positions to encourage and which to discourage, without nagging.

### **Prone lying**

The prone lying position (face downwards) is good for resting. It can also help prevent contractures developing in the hips and knees. Prone lying can be combined with activities such as reading or watching television. The child lies face down on a floor, couch or similar firm surface. Place a small pillow or wedge just below the hips (which should be level and the pelvis down) to encourage hip extension. The weight of the lower leg will straighten out the knees but it is important that the feet are free. Discourage asymmetrical positions as these reinforce development of contractures and scoliosis.

### **Standing**

Standing helps bone density and posture as well as assisting in the management of contractures. It should be encouraged, during the day, for short periods (i.e. half an hour) or longer blocks of time (two or three hours if possible, but you need not be prescriptive). When an older child or young adult finds it difficult to stand unsupported, but callipers are unsuitable, it may be helpful to use a standing frame, swivel walker or tilt table. They reduce the muscular effort required to stand upright and provide total body support, enabling the hip flexor, knee flexor and calf muscles to be fully stretched. Using a standing frame every day



can delay the onset of scoliosis as well as aiding digestion and circulation. Children who have callipers often use these for standing.

## **Stretches**

It is very common in muscular dystrophy for muscles and tendons to tighten. Some muscles will be affected earlier than others. The first muscle to tighten is usually the calf muscle/achilles tendon at the ankle, but the muscles around the hips, knees, elbows and fingers can also be affected.

Contractures can make some movements and activities more difficult. Regular daily stretches help maintain muscle length and keep joints mobile. Your physiotherapist can create an individual programme for your child from the exercises at the back of this book. The descriptions and diagrams are only reminders and anybody undertaking passive stretching must receive professional guidance and instruction.

There are three different types of stretches: passive, active assisted and self-stretches.

### **Passive stretches**

Passive stretches are an essential aspect of physiotherapy management and an essential aspect of any programme, at all stages of the condition. It is never too soon to introduce passive stretching. As the name suggests, the child does not actively take part in the stretching process. Passive stretches are done by a parent, carer or therapist. Slow and firm passive stretching will not harm the joint or

muscle and can be done every day. Tight and/or shortened muscle tissue is stretched by moving the joint as far as possible and maintaining the position for at least ten seconds (your physiotherapist may recommend longer, depending on your child's needs). Done properly and effectively, passive stretching is not painful but your child will experience a sensation of pulling and be aware of gentle but sustained pressure being applied. Some children put up a mild protest at passive

stretching but this is usually overcome once their confidence has been gained and a routine established.

It doesn't matter what time of day you do the passive stretching but most people find it helps to establish a routine that fits in with the other demands of family life. Make it a special time for the child, when the day's events can be shared and emotional ties strengthened.

It may help to do the stretching:

- after a bath;

- with tapes or stories, singing, story telling;
- after massaging the muscles to be stretched.

Position the child so that he or she is well supported and comfortable, and the joints not being moved are stabilised. The child must relax completely and not make any active movement or resist the stretch. If the stretching is done too quickly, the child is more likely to resist and become frightened.

Discuss and agree the duration of the stretch. Start the stretch gently and gradually increase to a maximum intensity, without pain. Overstretching should be avoided.

### **Active assisted stretches.**

Active assisted stretches are done by the parents with the child assisting the movement. When a joint becomes contracted, the tight tissue prevents the opposite muscle group from working properly. Active assisted stretches can stretch the tightened muscle and work the opposing muscle group at the same time. Active assisted stretches are particularly useful for the ankle. While you stretch the Achilles tendon, for example, your child pulls up his or her toes. The harder you work together, the more effective the stretch will be. This form of stretching helps the time pass more quickly and makes the stretches less boring for your child.

### **Self-stretches.**

Self-stretches, as the name suggests, are stretches that the child is taught to do him or herself. These are most effective in children who are still walking and are particularly useful for the ankles, knees and hips.

## **Hip Dislocation**

### **Background and Etiology**

The hip joint is one of the largest joints in the body. It is composed of one osseous (contains bone) joint. The hip is built for weight bearing and movement in several different planes. The stability of the hip joint comes from the capsule, ligaments, muscle and a cartilaginous tissue called the labrum.

### **Bone and Joint**

The hip, like the shoulder, is a ball and socket joint. It is formed by the head of the femur (thigh bone), which sits in the acetabulum, a part of pelvis. The head of the femur (the ball) is large and the acetabulum (the socket) is shallow. This allows for a greater range of motion.

Articular cartilage covers the surface of the bones involved in the hip joint. The articular cartilage has a smooth and shiny surface that allows the ends of the bones to slide freely over each other.

### **Ligaments and Labrum**

There are five major ligaments that provide stability to the hip joint. Ligaments are soft tissue structures that connect bone-to-bone. The capsule and ligaments provide passive stability to the hip joint, that allows for movement in different planes. The labrum of the hip is a fibrocartilaginous structure that is located around the acetabulum (the socket.) It provides added depth and stability to the joint.

### **Hip Dislocation**

Due to the inherent stability of the hip, dislocations are rare. When dislocations do occur, they are typically the result of trauma or extreme force. The hip can dislocate in either a posterior (back) or anterior (front) direction. A majority of hip dislocations, 70-80%, occur in the posterior direction, and 90% of these dislocations are sports related. Trauma due to motor vehicle accidents accounts for up to 70% of all hip dislocations.

### **Cause and Mechanism**

Posterior dislocations are caused when a large force impacts the leg when the knee is flexed (bent,) the hip is flexed (bent,) the hip is adducted (moved toward the opposite leg) and the hip is internally rotated (turned in.) In the hip, the head of the femur will be pushed out of the joint in a posterior (backward) direction.

- This is common in motor vehicle accidents when the knee hits the dashboard. The use of a seat belt can help prevent a hip dislocation in this instance.
- A sudden fall while the leg is in the afore mentioned position
- High contact sports like rugby or football where the player is hit and lands hard on his or her knee.
- Anterior dislocations occur when a significant force impacts the leg while the hip is flexed (bent,) abducted (away from body,) and externally rotated (turned out.)
- Anterior dislocations may occur due to jumping sports like gymnastics, basketball, or skiing where the individual lands awkwardly.

### **Symptoms**

- Pain that is severe in nature and may run down the leg to the knee, or into the back following a fall or forceful impact injury.

- Inability to walk or place weight on the knee
- Decreased ability to move the hip
- Weakness of the affected hip joint
- Numbness or tingling in the leg that may be associated with nerve involvement in the dislocation (likely the sciatic nerve.)
- The hip will appear shortened, rotated in and close to the other leg with a posterior dislocation.
- Pulse should be monitored because circulation may be effected by this injury.
- X-rays will be necessary to rule out an associated fracture, which may have occurred in addition to the dislocation.
- It may be important to assess the circulation of the hip joint following dislocation because avascular necrosis can be a complication.

### **Medical Treatment**

A hip dislocation is a medical emergency. The hip needs to be put back in place, or reduced as soon as possible.

- If there are no complications the physician will administer anesthesia or a sedative and relocate or put the hip back in place.
- In more complicated situations surgery may be indicated. This is especially true if there are complications like a fracture, nerve involvement, or vascular involvement.
- Following reduction, the patient will be given anti-inflammatory and pain medication and ice will be applied.
- If the injury is more involved, traction to the leg may be necessary.
- Dislocations with fractures may require a period of bracing.
- Weight bearing is encouraged as soon as possible, initially with crutches.
- Physical Therapy will be initiated once the physician has given clearance for weight bearing.

### **Physical Therapy**

A hip dislocation is a serious injury. Following relocation and reduction of pain, weight bearing should be initiated. Individuals will start partial weight bearing with crutches or a walker and then progress to full weight bearing. Initiation of weight bearing and progression of treatment will depend on the severity of the injury. Emphasis will be on reduction of pain, progression of weight bearing, improving range of motion, hip strength and stability.

- Gait and weight bearing activities may be used to help the patient wean-off assistive devices and progress to full weight bearing
- Range of Motion: restore range of motion, avoiding the position of dislocation while the ligaments and muscles heal
- Strengthening: Improve strength of the affected hip musculature and total leg strength.
- Stabilization: Work on the primary hip stabilizers in weight bearing functional positions to improve dynamic stability of the hip joint.
- Function: Progression to functional activities including daily life (stairs, kneeling, squatting, getting in and out of the car, etc.), or returning to high-level functions like sport performance.

### **Physical Therapy Interventions**

Common Physical Therapy interventions in the treatment of Hip Dislocation include:

- Manual Therapeutic Technique (MTT): hands on care including soft tissue massage, stretching and joint mobilization by a physical therapist to improve alignment, mobility and range of motion of the hip. Use of mobilization techniques also help to modulate pain.
- Therapeutic Exercises (TE) including stretching and strengthening exercises to regain range of motion within safe parameters and strengthen muscles of the hip and lower extremity to support, stabilize and decrease the stress placed on the joint.
- Neuromuscular Reeducation (NMR) to restore stability, retrain the lower extremity and improve movement techniques and mechanics (for example, running, kneeling, squatting and jumping) of the involved lower extremity to reduce stress on the hip joint in daily activities.
- Modalities including the use of ultrasound, electrical stimulation, ice, cold laser and others to decrease pain and inflammation of the involved tendon and bursa.
- A home program that includes strengthening, stretching and stabilization exercises and instructions to help the person perform daily tasks and advance to the next functional level are an important part of physical therapy and eventual patient independence.

### **Prognosis**

The prognosis for a full recovery depends on the severity of the injury, which may be complicated by nerve damage, loss of blood supply to the femoral head (aseptic necrosis) or associated fracture. Early reduction of the dislocation is important in limiting the chances of

developing aseptic necrosis or neurological damage. The hip relocation should be done preferably in the first six hours following injury. Individuals without complications generally do well within four months. This is especially true for athletic dislocations.

## **Flatfoot**

Flatfoot rarely causes disability, but it remains a major concern of parents. Children from the neonatal period to the preschool age are ordinarily brought to the general or the pediatric orthopedist because of their foot and gait problems, which may or may not be developmentally or clinically significant. Among them, the development of flatfoot is the most common. As the parents observe their child standing they can't help but worry about the abnormal appearance, with the arch fallen, the feet pressed flat to the floor and the heels that seem to rotate out to the sides. They wonder how the child can possibly get around on those things, and worry about the possibility of future difficulties or discomfort. These concerns spark questions like, "Will this ever get better?" "Will he need special shoes?" or "Does this need to be fixed?"

For the pediatrician evaluating flatfoot, it is important to differentiate between flexible and nonflexible (rigid) flatfoot, and to classify the condition as painful or painless. To do this, it is essential to know what the characteristics of a newborn foot are and how it develops to become a normal adult foot. Normal development of foot in children Despite its small size, the newborn foot is complex, consisting of 26 to 28 bones. The foot can be divided into three anatomic regions: the hindfoot or rearfoot (talus and calcaneus); the midfoot (navicular bone, cuboid bone, and three cuneiform bones); and the forefoot (metatarsals and phalanges).

All children are born with flat feet. Almost every child's foot initially has a large fat pad on the inside arch which slowly decreases as they grow. The longitudinal arch of the foot is not present at birth and slowly develops during childhood, usually by about age five or six. It is a process that occurs throughout growth and is not affected by the presence or absence of external arch support. Sometimes the arch takes even longer to take shape, and the normal foot arch develops in the first decade of life, but this still usually does not cause any problems. Flexible flatfoot is considered to be a manifestation of a constitutional laxity affecting all ligaments and joints, and if the foot arch appears abnormal, it is usually the result of weight-bearing stresses. Most children with flatfoot

achieve a partial correction spontaneously. Pathophysiology Function and structure of the medial longitudinal arch are affected by numerous anatomic structures, all offering potential contributions to the pathophysiology. The posterior tibial muscle and corresponding tendon are crucial to hindfoot position and foot flexibility during the gait cycle. Originating from the posterior aspect of the tibia, interosseous membrane, and fibula, the posterior tibial muscle and subsequent tendon passes posteromedially behind the medial malleolus and then inserts via multiple bands into the navicular, cuneiforms, metatarsal bases, and the sustentaculum tali. Ankle plantarflexion and forefoot adduction-supination with resultant subtalar inversion are key functions of the posterior tibialis tendon because of its posteromedial position. During the gait cycle, the foot must transition from a flexible construct at heel strike to accommodate irregular surfaces to a rigid construct at push off to maintain a rigid lever for ambulation. At heel rise, PTT initiation of transverse tarsal joint adduction with resultant subtalar inversion causes the talonavicular and calcaneocuboid joint axes to be perpendicular and therefore locked. The natural antagonist of the posterior tibial muscle is the peroneus brevis, which is responsible for forefoot abduction and subtalar joint eversion. When PTT insufficiency occurs, several deforming forces are produced. Peroneal musculature overpull may cause forefoot valgus combined with long-term heel valgus, which produces Achilles tendon contracture and transforms the gastrosoleus muscles into heel everters (rather than inverters); all contribute to dynamic factors in the deformity. Other structures vital to the medial longitudinal arch are considered static. Individual shape and size of the bony architecture of the medial arch offer significant stability. Recently, the spring ligament complex has received much attention as an important stabilizer of the medial arch. The complex ligamentous support system surrounding the talonaviculocalcaneal joint is comprised of several parts, including the superomedial calcaneonavicular ligament, inferior calcaneonavicular ligament, and a portion of the superficial deltoid. The degree of stability contributed by the spring ligament complex and deltoid ligament remains unclear. The relationship of the central component of the plantar fascia to medial arch support has long been attributed to the windlass effect. So for normal foot function, the most important thing is the fact that it should transition from a flexible construct at heel strike to accommodate irregular surfaces to a rigid construct at push off to maintain a rigid lever for ambulation, irrespective to its medial longitudinal arch height. The tendency to develop

flexible flatfoot is inherited, and the source of many kids' flat feet can be traced to a parent or another relative. The etiology of this condition is most likely excess laxity of the joint capsules and ligaments that allow the tarsal arch to collapse when weight is applied. Baby fat and ligamentous laxity at this age predispose to flattening, and rapid growth can make it even more apparent.

Flatfoot in children:How to approach, SMJ Mortazavi, et al Several studies have shown that the critical age for the development of the longitudinal arch is before six years. If wearing shoes does contribute to failure of development of the arch, the age at which it begins should influence the onset of flat foot. Shoe-wearing before the age of six would predispose to flat foot whereas if it were delayed until the child was older, the propensity for flat foot would be less. Rigid flatfoot is a congenital deformity caused by failure of the tarsal bones to separate, leaving a bony, cartilaginous or fibrous bridge between two or more of the tarsal bones. The coalition limits normal subtalar and midfoot motion, leading to inflammation of the involved joints. The peroneal tendon crosses over the subtalar joint and often goes into spasm secondary to subtalar inflammation, hence the term "peroneal spastic" flatfoot. Tarsal coalition is present in approximately 1 percent of the population and is bilateral in 50 to 60 percent of patients . Talocalcaneal coalitions comprise 48 percent of all coalitions and generally become symptomatic when patients are between eight and 12 years of age. Calcaneonavicular coalitions occur in 43% of patients and become symptomatic between 12 and 16 years of age. Clinical Manifestation Flexible flatfoot in a child almost never causes any problems. Children with flexible flatfoot, in general, are asymptomatic. If it persists into adolescence, some may experience mild aching along the bottom of the foot. Flexible flatfoot may become symptomatic in adolescents. Symptoms begin to develop as the contracted Achilles tendon limits full ankle dorsiflexion, thus transferring forces to the midfoot. Over time, these forces result in the breakdown of the tarsal joints. Patients complain of vague pain in the medial arch and ankle. On physical examination, the foot has a flat or rocker bottom, and the calcaneus valgus is apparent when standing. When the patient is standing on tiptoe, the calcaneus inverts slightly but not fully. Ankle dorsiflexion is limited to less than 5 degrees secondary to a contracted Achilles tendon. The normal subtalar and transverse tarsal motion is decreased by approximately 50 percent. Roentgenographs demonstrate a decreased dorsiflexion pitch of the calcaneus, sag at the talonavicular joint with dorsal breaking, and occasionally a rocker-bottom foot.



With the belief that the developmental flatfoot is the precursor of foot dysfunction and resultant disability later in life, some practitioners have been enthusiastic to design a management program for flatfoot today and the foot health needs of tomorrow. Thus, the arguments for or against the arch support for correcting flatfoot persist without general agreement. This debate has led to continued efforts to investigate the natural history, long-term result with treatment, and the correlating factors of flatfoot. Patients with tarsal coalition have insidious and occasionally acute onset of arch, ankle or midfoot pain. Patients are predisposed to frequent ankle sprains secondary to the limited subtalar motion. On physical examination, the patient will have a slightly flattened or flat arch. A standing calcaneal valgus is present, which will fail to invert when standing on tiptoe. Little to no motion is present in the subtalar and transverse tarsal joints, and stress on these joints frequently causes pain. Standard roentgenographic evaluation includes anteroposterior, lateral, oblique and Broden's views. Bony calcaneonavicular bars are best visualized with the oblique view, and the Broden's view best demonstrates talocalcaneal bars. A fine-cut CT scan is often necessary to demonstrate a tarsal coalition, since this study better demonstrates small bony bridges and changes consistent with cartilaginous coalitions. Technetium bone scans generally show increased uptake in the involved joints. The skin should be examined for unusual creases or folds that can be formed by various foot deviations. Certain areas of the skin might be abnormally taut, indicating extra tension on the skin, while the skin on the opposite side of the foot might reveal loose, excessive skin folds. During the next part of the examination, various foot and ankle joints are moved through their respective ranges of motion. The joints should be assessed for flexibility or rigidity, unusual positions, lack of motion, and asymmetry. Finally, the vascular examination consists of assessment of capillary refill and skin color, because pulses are difficult to palpate. Fortunately, the majority of newborns exhibit excellent lower extremity vascular supply, unless it is compromised by an extrinsic factor, such as an intrauterine amniotic band. In older children, for the pediatrician evaluating flatfoot, it is important to determine if this is benign flexible flatfoot or a more serious problem, such as vertical talus or a tarsal coalition, and to classify the condition as painful or painless. To determine flexibility, the doctor might observe the foot through a series of maneuvers. While standing they display a dropped medial longitudinal arch, foot eversion and calcaneus valgus. With the child

seated and legs dangling, the normal arch contour returns and is accentuated with passive dorsiflexion of the great toe. A nonflexible or rigid flatfoot will remain without a detectable arch in both instances. When the child stands on tiptoe, a flexible flatfoot will demonstrate an arch, with the heel pointing slightly in towards the midline which indicates that calcaneus invert from its valgus position . Then ask the child to stand on his heels, as ability to do this shows good flexibility of the heel cord or Achilles tendon. Standing on the outer and then inner borders of the foot could demonstrate good mobility of some important joints in the foot. Subtalar and transverse tarsal motion is normal in patients with flexible flatfoot. To determine subtalar motion; the examiner stabilizes the ankle with one hand and grasps the calcaneus with the other. The calcaneus is then passively everted and inverted. The normal total range of motion is between 20 and 60 degrees, with the inversion component twice that of the eversion component. Transverse tarsal motion is determined by grasping the calcaneus with one hand and the forefoot with the other. The forefoot can normally be adducted 30 degrees and abducted 15 degrees. The physician should consider tarsal coalition if the range of motion is less than that described. Often the child's shoes should be examined as well. Looking at what areas of the shoe are showing wear can help demonstrate what is happening to the feet during walking and running. Next, determining whether the foot is painful or painless is simply a matter of asking. The child with pain secondary to flatfoot may describe symptoms such as aching in the arch or cramps at night. Radiography is not necessary in the routine evaluation of flexible flatfoot.

## **Treatment**

In general, painless flatfoot requires no special treatment. Flexible flatfoot in a child almost never causes any problems and asymptomatic flexible flatfoot requires no treatment, and no evidence indicates that early treatment will prevent the development of symptomatic flexible flatfoot as an adult. In one prospective study 98 children with flexible flatfoot were treated with corrective orthopedic shoes, Helfet heel cup, a custom-molded plastic heel cup, or received no treatment. All of the groups demonstrated a significant improvement on radiographs, with no difference apparent among the groups after three years. Some children, however, may rapidly wear out the medial aspect of standard footwear. Excessive wear on shoes may be minimized by wearing more durable orthopedic oxford shoes, medial longitudinal arch supports and/or medial heel wedges. Proper footwear is important for the developing foot; but, whenever safety and comfort allow,

going barefoot stimulates proprioceptors and encourages muscular coordination and strength. The reduced incidence of flatfoot seen in barefoot populations suggests that muscle strength and mobility may be important factors in the normal development of the arches, and that a child is more likely to develop a flexible, yet strong arch when going barefoot. There is also evidence that using arch supports or even wearing shoes regularly before age 6 may worsen flat foot by interfering with the normal development of foot muscles. In addition, arch supports and special shoes are uncomfortable for children. So we need to encourage parents to let their children go barefoot whenever it is safe, and to select shoes based on function, not merely on style or cost. In these cases, it is especially important for the child to spend considerable time barefoot. While 10% of the children were receiving flat foot treatment with arch supports, this treatment was unnecessary in most cases. Strengthening of the child's lower leg muscles with home exercises, especially tibialis posterior, and internal/external rotation exercises may have a role. Also, having the child perform the towel-gathering exercise ('scrunching' a towel lying on the floor with the toes) for 15 minutes daily may be helpful. But all in all, treatment of children with physiological flat foot is ineffective and produces enormous costs for parents and health service providers. If the child is 10 or older, the flexible flatfoot can be considered permanent, and long-term use of orthotics will be required to prevent future problems in the feet, lower extremities, and spine. This is especially true for overweight or athletically active youngs who are symptomatic. They may experience mild aching along the bottom of the foot. Depending on the nature of the pain, treatment might begin with heel cord stretching exercises. If it persists, shoe inserts might be needed. Surgical treatment for persistent pain is rarely needed.

### **Massage: Flat-Foot**

Flat-foot is a sinking of the instep, with flattening and broadening of the sole of the foot. Two strong arches, a longitudinal and a transverse, are formed by the arrangement of the numerous small bones of the foot. The longitudinal arch rests on two points—the two tubercles on the under surface of the os calcis at the back and on the heads of the three middle metatarsal bones in front; the inner side of the arch is formed by the astragalus, scaphoid, cuneiform, and the three inner metatarsal bones; the outer side is formed by the os calcis, cuboid, and the outer metatarsal bones. Rather more than the middle third of the inner

border of the normal foot is raised from the ground ; the outer border is more or less in contact with the ground. From the inner border the bones arch over to the outer border and form the transverse arch. The greatest convexity is across the cuneiform and cuboid bones. The weakest part of the arch is the joint between the astragalus and the scaphoid. It is here that it is liable to yield when the muscles of the calf are fatigued and relaxed, and too much weight is in consequence thrown on the ligaments. In standing, there is always some yielding of both arches, owing to slight elasticity in the interosseous ligaments, and it is in long-continued standing, coupled perhaps with muscular weakness, that the arches yield abnormally, the result being flat-foot.

The tarsal and metatarsal bones are bound together by interosseous, plantar, and dorsal ligaments. The most important ligaments in preserving the arch of the foot are the long and short plantar, calcaneo-cuboid, and the inferior calcaneo-scaphoid.

The long calcaneo-cuboid ligament is attached to the under surface of the os calcis in front of the tuberosities, and to the ridge on the under surface of the cuboid and bases of the three middle metatarsal bones. It is the longest tarsal ligament, and in crossing the groove on the under surface of the cuboid forms a canal for the tendon of the peroneus longus to pass through to its insertion. The short calcaneo-cuboid, only 1 inch in length and very broad, is attached to the anterior tubercle of the under surface of the os calcis, and to the cuboid behind the ridge. The inferior calcaneo-scaphoid is attached to the anterior margin of the sustentaculum tali of the os calcis and to the under surface of the scaphoid. Beside uniting these two bones, this ligament supports the head of the astragalus. When it yields the head of the astragalus is pressed downwards, inwards, and forwards, and the foot becomes flattened. The tendon of the tibialis posticus, being attached to nearly all the bones of the foot, gives this ligament support underneath. Tendons of muscles attached to the under surface of the bones of the foot, and which assist in maintaining the arch, are flexor longus pollicis, tibialis posticus, peroneus longus, flexor brevis pollicis, flexor longus digitorum. The plantar fascia, which is of great strength, is also a factor in maintaining the arch.

In massage for flat-foot all the movements for the leg, foot, and toes are used, to which are added deep kneading with thumbs on the sole and a quick flapping movement done crosswise with palm of hand, also on the sole. Each joint of the toes is exercised separately with care and precision. In circumduction of the metatarso-phalangeal joints traction is made. A vibration may be given to each toe by taking the end between the thumb

and index-finger, and conveying a trembling movement to it. The tarsal bones are well manipulated. The ankle-joint is flexed, extended, adducted, abducted, circumducted inwards, and inverted.

The leg is vigorously stroked. Each group of muscles is kneaded separately with fingers and thumbs and heel of hand, then deeply and thoroughly kneaded en masse between the two hands, to get better at the deep muscles of the calf. The thumbs are made the fixed points in front, while the fingers work at the back, thus reversing the usual way of working. Fulling is done firmly, making it a deep movement. Brisk tapotement ; finish with rolling effleurage. The foot is taken in both hands, thumbs on top and fingers underneath, and vibration given to the whole limb, traction being made at the same time.

Exercises—Active.—1. Patient, standing erect, with hands on hips and toes turned in ; rises to tiptoe, then slowly brings heels back to the ground. This is repeated as often as the strength of the patient permits. It strengthens the flexors of toes and extensors of foot.

2. Standing in same position. The inner borders are turned upwards till the weight falls on the outer borders ; slowly brought down after a few seconds and repeated. This throws up the arch of the foot and stretches the peronei muscles.

3. Standing on heels and toes alternately. This strengthens the tibialis posticus and anticus.

Position of rest to be assumed after exercises : Sitting on a couch, with knees abducted and legs crossed, outer border of feet resting on couch.

Bathing the feet in warm water, followed by douches of cold water, before massage is helpful. Flat feet usually perspire freely, and require to be frequently dried while being massed. It is noticeable that they cease to perspire after a few weeks of massage.

The patient should rest for half an hour after treatment, which should be given twice a day, and when possible three times. Before rising in the morning and on going to bed at night are desirable occasions, and it is a further advantage to have it in the middle of the day ; in any case, rest in the position above described should be taken at that time.

In severe cases, when all the muscles of the lower limbs are weak, absolute rest for a time is enjoined, and the thighs are massed as well as the legs. Exercises should always stop short of fatigue, and be increased gradually—at first passive, then resistive, and later the active movements done by the patient standing.

## Stretching exercise of lower extremity.

### 1. Heel-Cord Stretching Exercise(along with Hamstring Stretching)



When restrictive heel-cords are found to impair body mechanics, they may be stretched during the course of the “*Protective Hamstring Stretching Exercise*” by merely placing the ankle at  $90^0$  so that the sole of the foot of the extended leg is flat against the wall. The bouncing action which stretches the *Hamstrings* will simultaneously stretch the heel-cord also. Hold in this stretched position for 5 seconds. Repeat the exercise with the other leg. The whole exercise programme may be repeated for 10 times. ( “*Protective Hamstring Stretching Exercises*”discussed earlier. Refer “How to take care of your back- Home Programme- Hamstring Stretching Exercises”).

### 2. Heel –Cord Stretching Exercise (along with Hamstring Stretching)- Supine Lying.

Lie supine with your buttocks close to a doorway. Keep both the legs straight. Keep one leg flat on the floor, raise the other extended leg and rest it on the doorway. Slide this leg up the doorway till a stretch is felt behind the thigh. Keeping this leg in this stretched position, take the foot backwards (dorsiflexion of the foot) till a stretch is felt in the *Calf Muscles*. Hold the foot in the maximum stretched position for 5 seconds. Slowly bring it back to the starting position. Repeat the exercise with the other leg. The whole exercise programme may be

repeated for 10 times. This exercise stretches the Hamstrings and the Heel-Cord simultaneously.

### **3. Heel-Cord Stretching Exercise (along with Hamstring Stretching) -standing**

Heel-cord may be stretched during the course of the Hamstring Stretching Exercise which is done in a standing position. (Hamstring Stretching Exercise in the standing position is already discussed. Refer "How to take care of your low back- Home Programme- Hamstring Stretching Exercises- Standing Position"). Once the maximum stretch is felt behind the thigh, take the foot backwards (dorsiflexion of the foot) until a stretch is felt in the *Calf Muscles*. Hold in this maximum stretched position for 5 seconds. Slowly bring it back to the starting position. Repeat the exercise with the other leg. The whole exercise programme may be repeated for 10 times. This exercise stretches the Hamstrings and the Heel-Cord simultaneously.

### **4. Heel-Cord Stretching Exercise**

The Heel-Cords may be stretched when the patient stands erect, but leans forward against a wall. The patient stands few feet away from the wall and bends forward until the palms of his hands rest against the wall. In this position the body of the patient leans at an angle to the wall. But he balances himself on both feet and rests on both palms. Once in this position, the patient steps forward half way to the wall with one foot. He keeps his other leg extended at the knee with the heel flat firmly on the ground. The patient then flexes rhythmically the forward leg at the knee. Flexing the arms at regular intervals allows a total back-and forth movement of the entire body. But, all the time, the rear heel must be flat on the floor. This way Heel-Cord can be stretched. The lumbar spine must be prevented from arching. A flat back must be maintained throughout. Repeat the exercise with the other leg.

The whole exercise programme may be repeated for 10 times.

### **5. Heel-Cord Stretching Exercise-Both Cords Simultaneously**

This exercise appears to be simple. But this cannot be done by everyone. The person squats as if he intends to sit on his heels, keeping both his feet slightly turned outwards and several inches apart. Both the heels must be kept flat on the floor. Use of the soles of the feet or toes must be avoided. The stretching motion is a rhythmic up-and-down bouncing movement.

The patient may maintain his balance by supporting from a chair or a wall. This exercise stretches both the cords simultaneously.

### **Passive stretching on lower extremity.**

#### **Lower Extremity Passive ROM Exercises**

Lower extremity passive exercises are for someone else to stretch your hips, legs, and knees if you are unable to do this yourself. These exercises should be done slowly and gently while you are lying on your back. Each exercise should be done ten times on each leg each day.

#### **Hip and Knee Flexion and Extension**

Cradle the leg by placing one hand under the bent knee. With the other hand, grasp the hip (or place it under the heel) for stabilization. Lift the knee and bend it toward the chest, with the kneecap pointed toward the ceiling. Do not allow the hip to twist during this movement. The foot should stay in a straight line with the hip and not swing in or out. The leg is then lowered to the starting position.



#### **Hamstring Stretching (Straight Leg Raises)**

Method 1 - Kneel between the legs and support the ankle with your arm or shoulder. The knee will be straight. Place one or both hands just above your knee, stabilizing the hip joint. If one hand is used, the other hand will be placed on the thigh of the other leg to keep it on



the bed. If both hands are used, the person's knee may rest lightly on your other thigh. Raise the leg straight up to approximately 90 degrees.



Method 2 - Place one hand under the knee and the other hand under the heel. With the knee straight and the kneecap pointed toward the ceiling, raise the whole leg toward the ceiling. When the raised knee begins to bend slightly, the hand under your knee should be moved to the top of your knee.

### **Hip Internal and External Rotation**

Place one hand on top of the knee and the other hand under the heel. Bend the knee halfway to the chest so that there is a 90 degree angle at the hip and knee. Pull the foot toward you and then push it away.

OR:

Place one hand on the thigh and other hand below the knee. Roll the leg inward until the kneecap faces the other leg. Then roll the leg outward in the opposite direction. The leg always stays straight in alignment and rolls like a log.

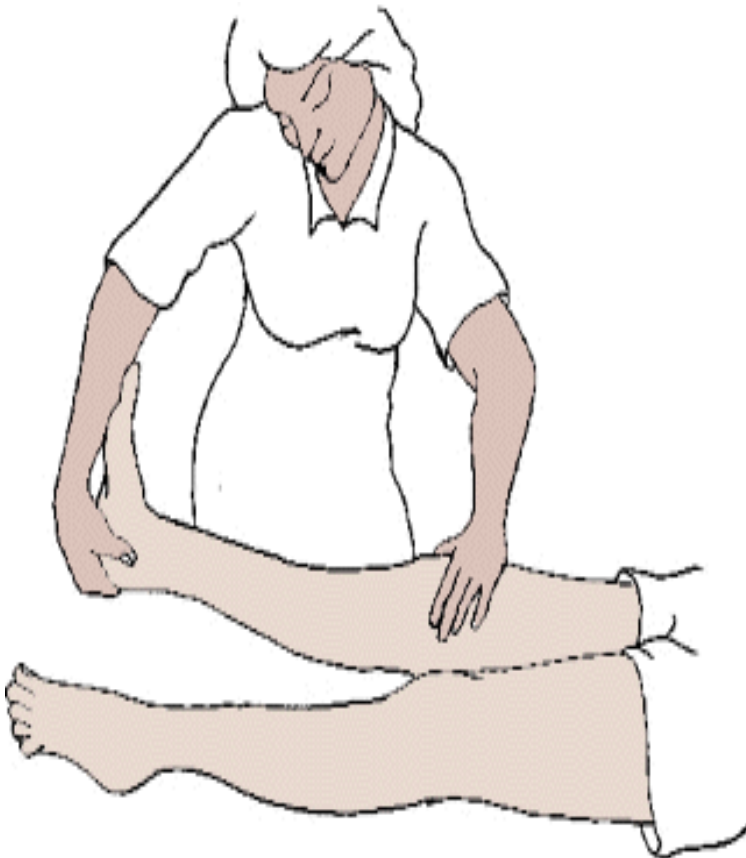
### **Hip Abduction and Adduction**

Cradle the leg by placing your hand under your knee and holding it. Place the other hand under the heel, or on the hip, to stabilize the hip joint. Keeping your knee straight, move the leg along the surface of the bed, toward you and away from the other leg, to approximately 45 degrees. Then bring the leg back to the other leg.



### **Heel-Cord Stretching**

Place one hand on the knee to prevent it from bending. Your other hand cups or cradles the heel and your forearm is placed against the ball of the foot. Push the ball of the foot forward, bending the foot toward the knee and stretching the muscles in the back of the leg.



## Ankle Dorsiflexion

Place one hand under the heel, with the foot against the forearm, and push the heel downward with this hand.

To stretch one muscle (the gastrocnemius), extend the knee, place the other hand on top of the ankle, and push in the opposite direction



To stretch the second muscle (the soleus), flex the knee, place the other hand under the calf, and push in the opposite direction.



### **Foot Inversion and Eversion**

With one hand, hold the foot near the heel. With the other hand, hold the lower leg near the ankle. The foot is moved from side to side or in a circle (up, in, down, out).

### **Toe Flexion and Extension**

With one hand, stabilize the foot just below the toes. With the other hand, gently move each or all of the toes forward and backward.

### **Hip Extension**

Place the person on his or her side and stand behind them. Place one hand under the knee with the lower leg resting on your forearm. With the other hand, hold your pelvis in place. Pull the leg backward and toward you.

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