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REVIEW OF LITERATURE

2.1. Introduction

The review of related literature is a key step in the research process. According to Wood and Haber (1995) literature review is an extensive, systematic and critical method reviewing the most important published scholarly literature on a particular topic. The major purpose of reviewing the literature is to determine what has already been done that relates to one’s problem. Another important function of review is that, it points out research strategies and specific procedures and necessary instruments that have and have not been found to be productive, in investigating one’s problem. Familiarity with previous research also facilitates interpretations of the results of the study. Finally, these reviews give information that can either support or challenge the conclusions of the investigator’s research and therefore provide clues for later research.

In India, research in the field of cerebral palsy is of recent origin. Consequently, research publications in this field are very limited. Summary of relevant materials are presented here under appropriate heads.

2.2. Theoretical overview of cerebral palsy

Under this, studies related to the definition, incidence causes, classification and diagnosis of cerebral palsy are reviewed in detail.
2.2.1. Definition and incidence of cerebral palsy

Cerebral palsy is the most common cause of physical disability affecting children in developed countries.

In 1862, William James Little, an orthopedic surgeon provided the first description of spastic rigidity related to prematurity and birth complications, referring to the condition as Little’s disease. William Osler, later introduced the term ‘Cerebral Palsy’ in 1888 (Blumenthal, 2001). Subsequently, Sigmund Freud observed that antepartum and postpartum factors might be causally related to cerebral palsy. Since the earliest definition of cerebral palsy, many others have attempted to establish a unified description of this disorder (Longo et al., 1993).

The classic definition of cerebral palsy is “a disorder of movement and posture due to a defect or lesion of the immature brain” (Bax, 1964). This definition was modified in 1992 to encapsulate the heterogeneity of the disorders covered by the term cerebral palsy to an umbrella term covering a group of non – progressive, but often changing, motor impairment syndromes secondary to lesions or anomalies of the brain arising in the early stages of development (Mutch et al., 1992).

The definition has been revised by an executive committee for a report on the definition and classification of cerebral palsy to incorporate concepts developed by the International Classification of Functioning,
Disability and Health (ICF) (Rosenbaum et al., 2007). The proposed definition is: “Cerebral palsy describes a group of permanent disorders of the development of movement and posture, causing activity limitation, that is attributed to non progressive disturbances that occurred in the developing fetal or infant brain. The motor disorders of cerebral palsy are often accompanied by disturbances of sensation, perception, cognition, communication and behavior by epilepsy and by secondary musculoskeletal problems” (Rosenbaum et al., 2007).

2.2.2. Classification of cerebral palsy

Within this thesis, classification of severity of the motor impairment of the children involved was used to describe the samples and to examine its effect on selected variables. One of the striking characteristics of cerebral palsy is its variability of presentation (Liptak and Accardo, 2004). It is a heterogeneous group of clinical syndromes with a variety of manifestations (Stanley et al., 2000; Graham and Selber, 2003).

Because of this variability, it is important that reliable classification exists for children with cerebral palsy. Classification is required to further categorize individuals with cerebral palsy into groups with the purpose of describing the nature of the problem and its severity, predicting potential future status and evaluating change in individuals at different points in time (Rosenbaum et al., 2007). Classification can serve to track incidence and
features, educate families with respect to progress and assist service planning for service providers (Gorter et al., 2004).

Traditional methods of classification have focused on topographical distribution, severity and type of movement disorder. Topographical distribution classifies children based on the distribution of involvement of the limbs of the body. The most common descriptive terms used are hemiplegia, diplegia and quadriplegia, however terms such as monoplegia and triplegia are also used (Delgado and Albright, 2003).

Spastic diplegia describes a child with gross motor problems, particularly marked in the lower limbs, with usually partially retained fine motor function in the upper limbs (Stanley et al., 2000; Bax et al., 2007). Spastic quadriplegia refers to the involvement of all four limbs and the trunk (Gorter et al., 2004) with severe motor involvement with virtually no hand movements and many have very little speech and language (Bax et al., 2007). The child with hemiplegia typically has problems restricted to one side of the body (Bax et al., 2007) with involvement of both the upper and lower limb (Stanley et al., 2000).

There is a very little evidence of the reliability of using topographical distribution to classify children with cerebral palsy and there is also disagreement among clinicians regarding the topographical patterns found. Poor reliability of topographical classification can be due to the inconsistency
of distinctions between severe diplegia and quadriplegia, and between asymmetrical hemi-syndromes and bilateral cerebral palsy (Howard et al., 2005).

Classification of cerebral palsy by movement disorder includes spastic CP (85% of CP population), dyskinetic (7%), ataxic (5%), hypo tonic (0.5%) and mixed (2.5%) (Stanley et al., 2000). Spastic CP is the most common type of movement disorder and is characterized by abnormal voluntary control, resistance to passive stretch and exaggerated reflexes (Stanley et al., 2000). Dyskinetic CP is characterized by involuntary movements and fluctuating muscle tone (Delgado and Albright, 2003). Mixed movement disorders often involve spastic with dyskinetic disorders (Gorter et al., 2004). Ataxic and hypotonic movement disorders are relatively rare (Reddihough and Collins, 2003).

Classification based on the severity of symptoms has used the terms such as mild, moderate and severe to help and describe the degree of motor impairment (Blair and Stanley, 1985). This method of classification often require individual judgment and lack standardization (Palisano et al., 1997; Oeffinger et al., 2004). There is little evidence about the reliability of classification systems based on motor impairment, severity and topographical distribution (Gorter et al., 2004). The few studies that have been done have shown poor reliability for severity and motor impairment (Blair and Stanley,
1985) and classification by motor type and topography are known to be unreliable (Stanley et al., 2000). Because of these issues with traditional classifications, it has become apparent that additional characteristics should be taken into account for a classification scheme to the understanding and management of CP (Rosenbaum et al., 2007).

For comprehensive classification of cerebral palsy, the use of four dimensions is recommended (Rosenbaum et al., 2007). These are: 1) motor abnormalities, including nature and typology of the motor disorder and functional motor abilities, 2) accompanying impairments, 3) anatomical and neuroimaging findings and 4) causation and timing (Rosenbaum et al., 2007). Functional motor abilities should be classified using objective scales such as Gross Motor Function Classification System (GMFCS) and the Manual Ability Classification System (MACS). Accompanying impairments include such things as presence of epilepsy, mental retardation, hearing and visual impairments (Rosenbaum et al., 2007).

2.2.3. Diagnosis and associated problems of cerebral palsy

The diagnosis of cerebral palsy always involves a motor deficit and the usual presenting complaint for which medical evaluation sought is that the child is not reaching motor milestones at the appropriate chronological age. In most instances, a medical history establishes that the child is not loosing function, assuring that the patient does not have a progressive or
degenerative disease. This history combined with a neurological examination establishing that the patient’s motor deficit is due to a cerebral abnormality, leads to the diagnosis of CP. There is agreement that CP is due to a defect or lesion in the developing brain, which may have had its onset in the prenatal, perinatal or post natal period (Nelson and Ellenberg, 1978). While often a cut off age for the appearance of symptoms early in life is generally not given, the great majority of children with CP present with symptoms as infants or toddlers and the diagnosis of CP is made before age 2 years. Although there is no consensus about a precise age cut off, either for the timing of the insult or the onset of symptoms, the importance is that affected individuals have similar needs for rehabilitation, education and medical and social services (Swaiman and Ashwal, 1999). Accurate determination of the etiology of CP has specific implications regarding treatment, prognosis and ongoing medical management of associated conditions. The importance of determining whether there is a malformation, genetic etiology or injury and whether the injury is due to an acquired pre, peri or post natal process has obvious significance from the point of view of assessment of recurrence of risk, counseling of families and implementation of prevention programs.

The evaluation of the child with CP, once the diagnosis had been established, can start with an imaging study either CT scan or with MRI. In neonates, neuroimaging is frequently obtained when there is a history of
complications during pregnancy, labor and delivery, when the infant is born very prematurely or when neurological symptoms or findings are present on neonatal examination. Data from 782 children with CP who had CT scans found abnormalities in 77% (Range 62% to 93%). The yield from CT scans varied depending on the type of CP (hemiplegic > ataxic > mixed > diplegic > quadriplegic > hypotonic > dyskinetic) with the percent abnormal in those with dyskinetic CP being much lower than in other forms of CP. CT scans are helpful in delineating the timing of the etiology of CP and also in detecting the conditions that surgically treatable that might not be detected by neurological examination (Wiklund et al., 1991; Miller and Cala, 1989; Chen, 1981; Kolawole et al., 1989; Taudorf et al., 1984; Schouman et al., 1989; Cohen and Duffner, 1981; Molteni et al., 1987). Data from studies involving 682 children with CP who had MRI scans found abnormalities in 89% (range 68 % to 100%). The yield in MRI dependent on the type of CP that was present (dyskinetic > quadriplegic > hemiplegic > diplegic > ataxic) and was somewhat different than that reported using CT. MRI was also helpful in determining whether the injury was prenatal, perinatal or post natal in onset (Krageloh – Mann et al., 1995; Yin et al., 2000; Candy et al., 1993; Okumura et al., 1997; Cioni et al., 1999; Jaw et al., 1998; Sugimoto et al., 1995; Hayakawa et al., 1996; Truwit et al., 1992; Yamada et al., 1993; Yokochi et al., 1991).
Metabolic disorders may on rare occasions masquerade as CP. Six case studies describe 30 children who ultimately developed what appeared to be dyskinetic CP due to glutaric aciduria. (Haworth et al., 1991; Kyllerman et al., 1994; Hauser and Peter, 1998; Baric et al., 1998; Smith et al., 2001; Hartley et al., 2001). These children typically develop normally until 5 to 10 months of age when they suffer an acute encephalopathy manifested by coma that is followed by dystonia, motor impairment and microcephaly (Haworth et al., 1991). Distinctive MRI and CT findings occur in half the patients and is manifested by frontal and temporal atrophy. Early diagnosis is important, as glutaric aciduria is treatable; early intervention may reduce significant motor and cognitive impairment. Other metabolic disorders presenting with symptoms suggestive of CP also have been reported in small case studies and include Lesch –Nyhan Syndrome (Mitchel and Mcinnes, 1984), 3-methyl glutaconic aciduria, (Straussberg et al., 1998), arginiemia, (Prasad et al., 1997) and pyruvate dehydrogenase deficiency (Lissens et al., 1999). In summary, metabolic or genetic causes of CP occur infrequently. However the true incidence is unknown as there have been no prospective studies that have examined this issue. In almost all such cases, there are atypical complaints, features in the history of a progressive rather than a static encephalopathy, findings on neuroimaging that are representative of
certain genetic or metabolic disorders, or a family history of childhood neurologic disorder with associated CP.

Children with hemiplegic CP frequently have suffered a prenatal or perinatal cerebral infarction. These children often have a coagulopathy, congenital heart disease or an infectious process as the etiology of stroke (Lynch et al., 2001). Coagulopathy testing has to be done to identify the coagulation disorders and the yield of such testing will be higher if done in neonatal period rather than of the child evaluated later at the time of diagnosis of CP.

Given the higher frequency of epilepsy in children with CP, EEG is often considered during the initial evaluation (Zafeiriou et al., 1999). The utility of EEG for establishing an etiology in this population has not been prospectively investigated. The vast majority of papers on EEG and CP are retrospective studies or case reports that describe the frequency and types of seizures in children with different forms of CP. They do not address the role of EEG in determining the etiology of CP nor in predicting the development of seizures in a child with CP. Data from studies involving 1918 children have found on average that 43% (range 35 to 62%) of children with CP develop epilepsy. They had a higher incidence of epilepsy with onset within the first year of age (47% Vs 10%). They also had a lower incidence of generalized seizures (28% Vs 3%) and of remaining seizure free (37% Vs 90%). Factors
associated with a seizure free period of one year or more in epileptic children with CP include normal intelligence, single seizure type, monotherapy, and spastic diplegia. The prevalence of epilepsy also varies depending on the type of CP that is present. Children with spastic quadriplegia (50-94%) or hemiplegia (30%) have a higher incidence of epilepsy than patients with diplegia or ataxic CP (16-29%). It may occasionally be difficult to differentiate partial complex seizures from dyskinetic movements in patients with dyskinetic CP (Murphy et al., 1993; Von-Wendt et al., 1985; Miller and Cala, 1989; Zaferiou et al., 1999; Hadjipanayis et al., 1997; Al-Sulaiman, 2001, Chambers et al., 1999; Bruck et al., 2001; Cioni et al., 1999; Kwong et al., 1998; Kaushik et al., 1997; Taudorf et al., 1984; Cohen and Duffner, 1981).

Children with CP who have abnormal neuroimaging studies are most likely to have epilepsy. Three prospective CT studies have examined the association between CT findings and epilepsy (Miller and Cala, 1989; Taudorf et al., 1984; Cohen and Duffner, 1981). 54% of children with CP and an abnormal CT had epilepsy in contrast to only 27% of those who had a normal scan.

Cognitive and neuropsychological functions in children with CP are commonly impaired. In general there is some but not absolute relation between the type of CP and severity of cognitive impairment. Children with spastic quadriplegia have greater degrees of mental impairment than children
with spastic hemiplegia. Motor deficits of children with spastic CP appear to correlate with the severity of cognitive deficits in contrast to those children with dyskinetic CP where this relation is lacking (Fennel and Dikel, 2001). Children with different forms of CP may be difficult to assess because of the motor deficits and some forms of CP, the difference between performance and verbal intelligence test scores actually increase with age (Fennel and Dikkel, 2001). Laterality of hemiplegia may also be a contributing factor. Those children with right hemiplegia may be more likely to have impaired language function due to left hemisphere injury (Aram and Eisele, 1994), although this remains controversial (Trauner et al., 1996). There is also a strong association between greater intellectual impairment in children with CP and the presence of epilepsy, an abnormal EEG or an abnormal neuroimaging study (Zafeiriou et al., 1999).

Visual impairments and disorders of ocular mobility are common (28%) in children with CP. There is an increased presence of strabismus, amblyopia, nystagmus, optic atrophy and refractive errors (Schenk-Rootlieb et al., 1992). Children whose CP is due to periventricular leucomalacia are also more likely to have visual perceptual problems.

Because of bilateral corticobulbar dysfunction in many CP syndromes, anarthric or dysarthric speech and other impairments related to oral–motor dysfunction are common. For example, articulation disorders and impaired
speech intelligibility are present in 38% of children with CP (Clarke and Hoops, 1980; Love et al., 1980). Because of their impaired mobility can cause limited interaction with individuals in the environment, children with CP might not be able to develop the linguistic skills necessary to develop more complex speech patterns (Uvebrant and Carlsson, 1994). Language deficits in CP go hand with verbal intellectual limitations associated with mental retardation (Falkman et al., 2002). Oral motor problems including feeding difficulties, swallowing dysfunction (Reilly et al., 1996; Sullivan et al., 2000; Waterman et al., 1992) and drooling (Blasco, 2002) may lead to potential serious impacts on nutrition and growth (Stallings et al., 1993), oral health (Blasco, 2002; Pope and Curzon, 1991), respiration (Shaw, 1996) and self-esteem.

Hearing impairment occurs in approximately 12% of children with CP (Zafeiriou et al., 1999; Murphy et al., 1993; Von- Wendt et al., 1985; Kolawole et al., 1989). This occurs more commonly if the etiology of CP is related to very low birth weight, kernicterus, neonatal meningitis or severe hypoxic–ischemic results. Children with CP who have mental retardation or abnormal neuroimaging studies are at greater risk for hearing impairment.

The prevalence of behavioural problems in children with CP and the nature of these problems have been reviewed by number of researchers. The prevalence of disturbed behaviours or emotional maladaptations in different
groups of children with CP has been reported to be from 30-80% (Hourcade and Parette, 1984; McDonald, 1987). The stability of behavior problems over time was described by Breslau and Marshall (1985) in a 5-year study of 225 children with physical disabilities. They found that mentation problems (items related to short term memory and school performance) and isolation were consistent and significant problems for the 82 children with CP. In school aged children with CP, other researchers have found behavioral problems including passivity, immaturity and anxiety (Haslett, 1978; Hourcade and Parette, 1984). Murphy et al (1993) analyzed the population based Metropolitan Atlanta Developmental Disabilities Study and reported that 65% of children with CP had mental retardation. Since both CP and mental retardation are related to CNS dysfunction, the prevalence of behavior disorders are higher in these children. Another population based analysis of behavior problems in children with CP done by Suzanne et al in 1995, revealed that 25.5% of the children with CP had behavior problems. The behaviour problem index, they used contained items such as anti social, anxious, depressed, head strong, hyperactive, immature, dependent, peer conflict and social withdrawal. Among these items, majority of children with CP showed problems related to headstrong and dependency items. This study also revealed that approximately 87% of the children had another
health problems, which include respiratory, gastrointestinal, circulatory musculo skeletal, sensory and other conditions.

Published data regarding the profile of handicapped situations in children with CP from India are very less in number. Bhatia and Joseph (2001) conducted a retrospective study on 100 children with CP, who attended in their clinic during the period of 1988 to 1998 to assess the need for a comprehensive assessment in these children from the rural part of South India. This study revealed that 82% of the children had one or more disabilities apart from loco motor disabilities. The commonest associated defects noted in this study were visual defects (54%) mental retardation (40%), speech defects (36%) and seizures (27%). The study also revealed that 28% children had one associated disability, 31% of children had two, 12% had three, 8% had four, 2% had five and one child had six associated disabilities and regarding the type of CP, 68% had diplegic distribution.

Study done by Juliet and Swapna in 2000, among the children with CP in West Bengal revealed that 67.9% of their sample had moderate to severe intellectual disabilities while 30.4% had mild or no intellectual disability. No mention was done regarding other associated disabilities in those children.

Thus in summary, there is insufficient evidence to recommend the optimal sequence of tests to determine the etiology of CP, taking into account
diagnostic yield and potential treatability. Obviously, all children should undergo a detailed history and physical examination. It is important to determine that the child’s condition is due to static and not a progressive or degenerative neurological disorder. It is also important to classify the type of CP as this has diagnostic implications as well as implications regarding associated problems. In order to establish an etiology and prognosis in children with CP, neuro imaging is recommended with MRI preferred to CT. However if neuro imaging performed in the perinatal period provided an etiology of the child’s condition, it may obviate the need for later study. Metabolic and genetic studies should not be routinely obtained in the evaluation of the child with CP. If the clinical history or findings on neuro imaging do not determine a specific structural abnormality or if there are additional and atypical features in the history or clinical examination, metabolic and genetic testing should be considered. Because of the incidence of cerebral infarction is high in children with hemiplegic CP, diagnostic testing for a coagulation disorder should be considered. Since children with CP commonly have associated mental retardation, ophthalmologic abnormalities, hearing impairments, speech and language disorders and disorders of oral–motor function, screening for these conditions should be part of initial assessment.
2.4. Rehabilitation approaches for children with cerebral palsy

This section discusses several intervention philosophies and approaches that are used for the rehabilitation of children with cerebral palsy. Many of the various intervention strategies incorporate theories of motor learning and motor control as well as dynamic systems and functional task-oriented approaches.

2.2.4 (1) Neurodevelopmental treatment

Neurodevelopmental treatment was initially a treatment approach developed by Berta and Karl Bobath for the treatment of children with cerebral palsy (Keshner, 1981). The philosophy of the treatment approach was based on a hierarchical view of nervous system function. The treatment for children with cerebral palsy focused on moving them through normal movement patterns to experience normal movement. Major components of this approach included reflex-inhibiting postures, inhibition of abnormal reflexes, normalization of muscle tone, and adherence to the normal developmental sequence of motor progression.

The American Academy for Cerebral Palsy and Developmental Medicine published a review of the evidence regarding neurodevelopmental treatment as a treatment approach for children with cerebral palsy (Butler and Darrah, 2001). This extensive report concluded that there is no strong evidence supporting the effectiveness of neurodevelopmental treatment for
children with cerebral palsy with respect to normalizing their muscle tone, increasing their rate of attaining motor skills, and improving their functional motor skills.

2.2.4 (2) Conductive education

Conductive education is a form of special education and rehabilitation for children and adults with motor disorders (Bairstow et al., 1991). The approach used in conductive education was developed by a Hungarian physician, Andras Peto, in Budapest after World War II. The focus is to help children with motor disorders to learn to overcome the problems of movement so that they can live more active lives. Individuals work on tasks in motor control, mobility, and communication within a structured program led by the "conductor." Minimal assistance from the conductor or others in the room is provided for each child, and the tasks are specific and goal directed for each child. The program resembles a school day in length of sessions and necessitates the cognitive ability to follow directions. Parents often report an improvement in confidence and motivation as well as bodily control when their children participate in conductive education. A detailed explanation of conductive education is given under the educational interventions in the following sections.
2.2.4 (3) Constraint-induced therapy

Constraint-induced therapy is a rehabilitation approach designed to enhance upper extremity function in many patients with neuromotor deficits. Constraint-induced therapy involves restraining the unaffected arm while allowing the patients to perform the purposeful activities with the affected arm. Beginning with animal research during the 1970s, Taub suggested that a limb thought to be nonusable is capable of movement by conditioning its use (Taub, 1997). Other researchers have also investigated the efficacy of constraint-induced therapy with the pediatric population (Willis et al., 2002; Echols et al., 2002; Page et al., 2001).

2.2.4 (4) Body weight support treadmill training

Body weight support treadmill training is an intervention that uses theories of motor learning and the importance of early task-specific training. A postural control system consisting of a harness worn by the child reduces the amount of weight that the child must bear in an upright position. The child ambulates on a treadmill at an appropriate speed while supported in the harness system. Treadmill training with a partial body weight support system provides balance and postural stability for a child while practicing gait with decreased load on the lower extremities. The theoretical basis for the use of the treadmill and body weight support system was to activate spinal and
supraspinal pattern generators for gait (Forssberg et al., 1980; Grillner and Dubac, 1988).

2.2.4 (5) Strengthening

There has been much discussion in the literature over the past 20 years pertaining to the muscle weakness of children with cerebral palsy. A number of studies have correlated the increased muscle strength with improved functional activity in children with cerebral palsy. A review of the literature in 1997 concluded that progressive resisted exercises increase muscle performance in children and adolescents with mild cerebral palsy; however, the relationship between strength training and functional abilities remains unclear (Darrah et al., 1997).

2.2.4 (6) Electrical stimulation

A discussion of electrical stimulation requires a definition of terms frequently used to differentiate the types of stimulation. Neuromuscular electrical stimulation is the electrical stimulation of the muscle through the motor nerve, usually with a goal of improving strength, improving range of motion, or facilitating motor learning. When neuromuscular electrical stimulation is applied to serve as a support or orthosis, it is referred to as functional electrical stimulation. Both types of electrical stimulation are most commonly applied transcutaneously but can be applied percutaneously and produce a muscle contraction (Reed, 1997). Multiple studies have demonstrated the
effectiveness of neuromuscular electrical stimulation with increasing range of motion and increasing the muscle strength of children with cerebral palsy (Dubowitz et al., 1998; Nauman et al., 1985; Hazelwood et al., 1994; Carmick, 1993; Comeaux et al., 1997; Treger et al., 1997).

2.2.4 (7) Therapeutic riding

Therapeutic riding and hippotherapy are often recommended to enhance the posture, balance, and motor function of children with cerebral palsy. Hippotherapy is defined as a treatment approach performed by a health professional that uses the multidimensional movement of the horse as a therapeutic intervention (A.H.A, 2003). A therapeutic riding program may use a therapist as a consultant, but it is not considered physical or occupational therapy treatment. During therapeutic riding, a riding instructor is teaching riding skills.

2.2.4 (8) Orthotic devices, splints, and casts

The goals for deciding on the use of a cast, splint, or orthotic device are varied but include (1) maintenance, or an increase in joint range of motion (2) protection or stabilization of a joint (3) promotion of joint alignment or (4) promotion of function. A splint is defined as a device that is fabricated from a low-temperature plastic. Splints may be fabricated by a therapist or orthotist and often serve as diagnostic tools or interim devices. An orthotic device is fabricated by an orthotist from high-temperature plastic materials.
Orthotic devices have changed drastically over the past 30 years from metal uprights with orthopedic shoes to orthoses that are individually molded from high-temperature plastics to fit the individual child. Orthotic devices for the lower extremity may range from a foot orthosis to a hinged ankle-foot orthosis. Serial casting is the application of multiple casts over a period of time with the goal of increasing joint range of motion. Serial casts are most frequently applied to elbows, knees, and ankles to increase joint range of motion for improved function or ease of caregiving and activities of daily living.

2.2.4 (9) Assistive technology

Assistive technology is defined as any item, piece of equipment, or product system, whether acquired commercially off the shelf, modified, or customized, that is used to increase, maintain, or improve the functional capabilities of individuals with disabilities (I.D.E.A,1990). The goal for the use of assistive technology devices is to improve postural control and support and/or increase the function and participation of individuals in their family, school, and community settings. The diversity and complexity of devices available, the modifications often necessary to customize the devices for an individual, and the expertise needed for ordering, fitting, training, and education necessitate the involvement of a team composed of multiple disciplines. Assistive technology devices are typically divided into five
categories: postural support or seating systems, wheeled mobility, augmentative and alternative communication, computers and computer access, and electronic aids to activities of daily living.

In summary the efficacy of various therapeutic interventions requires further investigation for their use with children with cerebral palsy. Therapists have a professional and an ethical responsibility to use intervention strategies that are supported by research or at a minimum are supported by sound physiologic theories. The responsibility also exists to cease the use of intervention strategies that research has shown to be ineffective. Through the use of classification systems to guide decision making and intervention strategies supported by research, therapists will be able to assist families with long term expectations for their child and guide them to appropriate intervention strategies.

2.3. Motor abilities in children with cerebral palsy

The International Classification of Functioning, Disability and Health (ICF) is the best framework that can be utilized to describe the motor abilities and clinical manifestations of CP. The ICF aims to provide a standard language and framework for the description of health and health-related states (WHO, 2001). It incorporates biological and social perspective of disablement to represent more fully the impact of CP on an individual’s life, including participation in society. The advantage of the frame work provided
by the ICF is that it provides a useful tool for communication between clinicians and for describing CP and to match outcome evaluation and treatment interventions to particular aspects of the condition.

Within ICF, body functions are the physiological functions of the body systems and body structures are anatomical parts of the body such as organs, limbs and their components. Impairments are problems in body function or structure as a significant deviation or loss (WHO, 2001). The primary injury in CP is the brain lesion resulting in an upper motor neuron lesion which is considered to have a number of positive and negative features (Graham and Selber, 2003; Mayer and Esquenazi, 2003). The positive features include spasticity, hyper-reflexia and co-contraction and the negative features include weakness, loss of selective motor control and deficits in balance and co-ordination (Gage and Novacheck, 2001; Mayer and Esquenazi, 2003). The interaction between spasticity and weakness leads to both neural and mechanical changes in muscle and progressive musculoskeletal pathology (Bache et al., 2003). The changes in muscle length and structure that occur in the muscles and bones of the extremities are therefore secondary to the central nervous system lesion (Gage and Novacheck, 2001). Overall, while the underlying brain lesion in CP is static, the musculoskeletal manifestations are progressive (Bache et al., 2003).
Within the ICF, activity is the execution of a task or action by an individual and participation is involvement in a life situation (WHO, 2001). Activity limitations are difficulties an individual may have in executing activities and participation restrictions are problems an individual may experience in involvement in life situations (WHO, 2001).

In separating the two, activity limitation can be thought of as difficulty at the person level and participation restriction at the social level (Schneidert et al., 2003). Children with CP can have different levels in activity limitation and participation restrictions.

Mobility is another area which is affected in children with CP. Mobility involves “moving by changing body position or location or by transferring from one place to another, by carrying, moving or manipulating objects, by walking, running or climbing, and by using various forms of transportation” (WHO, 2001). The reduced mobility in children with CP can limit their activity and participation level. The child with CP can move from one place to other by independent walking or with the help of walking aids or by wheel chair mobility. How well children mobilize can be associated with their levels of participation with their peers and family.

Mobility, activity and participation in children with CP are influenced by environmental factors. When measuring activity, these environmental factors require consideration. Environmental factors are external to the individual and
make up the physical, social and attitudinal environment in which people conduct their lives (WHO, 2001). Awareness of the dynamic between the child and surroundings and how this affects performance is important when considering the range of interventions possible to increase participation in the home, school and community (Goldstein et al., 2004). Children’s environments change across the stage of infancy, early childhood, middle childhood and adolescence and these changes can influence the child’s interactions (Simeonsson et al., 2003).

Participation in children with CP can be influenced by where they live (Hammal et al., 2004) and by the socio-economic status of the family (Law et al., 2006). Physical aspects of the environment that might affect mobility include accessibility, surfaces, obstacles, distances as well as time constraints. A child is more familiar with their home environment, which is likely to be more constant, than the community setting which also has longer distances to adapt to (Palisano et al., 2003).

Capability or performance are another two areas that have to be analysed while discussing the motor ability of children with CP. Performance describes what an individual does in his or her current environment and can also be understood as “involvement in life situation”. This includes the environment factors. Capacity describes an individual’s ability to execute a task or action and indicates the highest probable level of functioning (WHO,
Performance can be thought of as what a person “does do” in the usual circumstances of everyday life and capability as what a person “can do” in a defined situation from real life (Young et al., 1996).

Young et al. (1996) reported that what a child with CP “can do” is often not what they “do do”. This has implications for both measuring function and planning interventions. Treatments may improve capability in clinical setting, however, if the improvements do not translate into improved performance, the child has not received benefit. This is because performance tells more about the child’s usual function in their everyday settings and is more relevant to the child and family (Young et al., 1996).

Thus motor ability is children with CP is key area that has to be assessed with in the framework of body structure, body function, activity, mobility, participation, capability and performance. And in this thesis, the motor ability expressed as gross motor and fine motor abilities are measured by Gross Motor Function Classification System (GMFCS), Gross Motor Function Measures– 88 (GMFM-88) and Manual Ability Classification System (MACS).

2.4. Academic skills in children with cerebral palsy

Here, reviews related to the academic and cognitive ability of the children with cerebral palsy are discussed in detail.
2.4.1. Academic ability and types of cerebral palsy

The academic skills of the children with cerebral palsy depends upon primarily the physical functional level of the child and secondarily the cognitive and neuro physiological impairments present in that child. Even though the physical functional level is well explained in terms of gross motor and fine motor abilities, the traditional classification of the cerebral palsy gives the clear clinical presentations with respect to the tone and side of involvement. Spastic cerebral palsy, which contributes about 66% to 82% of the total cases, caused by the dysfunction of cerebral cortex and corticobulbar tract have increased muscle tone, and possibility of contractures in wrist, ankle, knee etc. (Menkes and Sarnat, 2000). Spastic hemiplegia, spastic diplegia and spastic quadriplegia are the three sub types coming in this spastic category. Among these three types, spastic quadriplegia is the most severe form of cerebral palsy in which all the four limbs are affected. Seizure disorders and various levels of mental retardation are common in this type. In spastic hemiplegia, only one side of the body is involved, so that with the normal other side child can actively participate in the academic activities depending upon his hand dominance. Focal epilepsies and sensory deficits are common in the affected limbs (Cohen and Duffner, 1981).
5% to 22% of the cerebral palsy cases belong to the extra pyramidal type where the pathology lies in the basal ganglia and extra pyramidal pathways. Dyskinetic symptoms such as chorea, athetoid dystonia etc are the common motor problems in this type. Because of the jerky involuntary movements, the smooth function of the hand required for the normal academic activities are severely affected in these children. Epilepsy is not common in these type of children and the intellectual function falls within the normal ranges (Lou, 1998).

The hypotonic type of cerebral palsy otherwise known as the ataxic types are caused by dysfunctions in the cerebellum which is characterized by the decreased muscle tone, incoordination, gait disturbances etc. Children with these types often develop learning disabilities (Tomlin, 1995). Intellectual functioning is rarely impaired among these children except for lower scores on intelligence test (Wechsler, 1991). Finally there are a smaller number of children who manifest a mixed clinical picture of both spastic and extra pyramidal signs. Thus the smooth spectrum of the hand, the ability of the trunk muscles to sit erect, the neck and head control against the pull of gravity etc are all depend upon the type of cerebral palsy and has its effects on the academic performance.
2.4.2. Cognitive functions of children with cerebral palsy

A measured level of intelligence is generally assumed to provide an indication of the extent to which one has developed the basic cognitive and academic skills required for success in life (Sattler, 1992). In addition, a child’s intelligence can influence both general adaptation and effectiveness of treatment for cerebral palsy (Goldkamp, 1984); data from intelligence testing can be used to assess the efficacy of educational or intervention programs and to provide indications of a child’s cognitive progression or regression.

There are some key factors which have to be taken into account while assessing and interpreting the intelligence level in children with CP. Test results must be interpreted in the context of motor, speech, visual and auditory difficulties that are present in children with CP.

Upper extremity motor impairment may interfere with the hand eye coordination, which is an essential component of performance scale sub types. Scheiman, (1984) examined the optometric function of children with CP and intelligence within the average range and results indicated that increased incidence of strabismus, amblyopia, nystagmus, optic atrophy and significant refractive errors. Articulatory and hearing impairments can also have its effects on the intelligence testing of children with CP particularly in test, which have the verbal components.
Laterality of lesion may also have its impact on performance of intelligence measures. On a battery of neuropsychological tests, despite similar Weshsler Verbal IQs, right hemiplegic children performed significantly poorer than left hemiplegic children and sibling controls on measures of syntactic awareness and repetition of semantically coherent material (Kiessling et al., 1983). Another study found that mild to moderate right hemiplegic children demonstrated impaired acquisition for drawings relative to control subjects (Carlsson, 1983). When comparing children with right and left sided hemiplegia with age matched controls for verbal and nonverbal function, both hemiplegic groups were relatively impaired in non-verbal function (Carlsson et al., 1994). Although the right hemiplegic group was more impaired in verbal function than left hemiplegic or control group, this impairment was evident only in the girls. When compared to sibling controls, children with right and left infantile hemiplegia demonstrated correlation between left hand impairment and poor arithmetic computational skills (Kiessling et al., 1983).

2.4.3. Arithmetic ability in children with cerebral palsy

As the result of motor and additional impairments, children with CP, have an increased risk for learning difficulties. However, review of literature reveals that there have been few studies that have addressed this issue and those studies have used a variety of inclusion criteria and a variety of
methods, making direct comparisons between studies difficult. Anderson (1973) investigated the school achievement of children with a physical disability associated with neurological damage (including CP and Spina Bifida) attending mainstream schools. Teachers rated 78% of these children as having mild to profound difficulties in arithmetic, whereas 69% were rated as having reading difficulties. Frampton et al. (1998) investigated the prevalence of learning difficulties in children with hemiplegic CP with an IQ of 70 or higher attending both special school and mainstream schools. A child was considered to have a specific learning difficulty if the discrepancies between their predicted ability and actual achievement placed them in the most extreme 5% of the normal population. These authors found that 36% of these children had at least one specific learning difficulty, with 25% having difficulty in arithmetic as opposed to 19% having reading difficulties. In a more recent study, occupational therapist and special education teachers examined the educational records of children with CP attending mainstream schools and concluded that 46% had at least one specific learning difficulty (Schenker et al., 2005). Arithmetic learning difficulties seems to be somewhat more prevalent in children with CP. Such arithmetic learning difficulties may be attributable to specific neuro – cognitive impairments resulting from the early brain damage inherent to CP. On the other hand, difficulties in
arithmetic might also be attributable to environmental factors such as the amount of arithmetic instruction time these children receive.

Many authors investigating arithmetic problems in other populations have cited a direct relationship between arithmetic and working memory on one side (Adams and Hitch, 1997; Dark and Benbow, 1990) and development of early numeracy (Geary et al., 2000) on the other side. Working memory has been shown to be related to arithmetic fact fluency by allowing the associations of the problem with the answer so that long-term memory associations can be formed (Geary, 1993). Since previous research, as reported above, indicates that some children with CP have deficits for working memory, it may be that deficits in arithmetic ability in children with CP are related to working memory deficits. The most widely accepted model of working memory is that of Baddeley and Hitch (1974). These authors described working memory as being comprised of three components: the phonological loop, for temporary storage of phonological information; the visual spatial sketch pad (VSSP), for temporary storage of visual spatial information; and the central executive, a modality free supervisory system responsible for a range of regulatory functions including control of both the phonological loop and the VSSP and the incorporation of information from long term memory.
Throughout the pre school years, children develop early numeracy skills that are precursors to the acquisition of normal mathematical skill (Baroody, 1987; Van de Rijt, 1996). Early numerical skills include number concept and simple counting skills. Number concept refers to the relational concepts such as more, less and the ability to arrange objects according to the size. Difficulties with arithmetic experienced by school-age children could be related to their level of understanding of number concept and simple counting skills.

Arithmetic difficulties might also be attributable to environmental mediators. For example some authors have identified a relationship between mathematical ability and the amount of arithmetic instruction time. Jenks et al. (2007) investigated mathematical ability in a combined group of children with CP and children with spina bifida. These authors compared the level of arithmetic ability of these children in special education to a control group of healthy children in mainstream education. The children in special education had lower level of mathematical ability in comparison to those in mainstream education and this difference was explained in large part by the amount of instruction time spent at mathematics.

Jenks et al. (2007) also conducted a study on the development of addition and subtraction accuracy in first graders with CP in both mainstream and special education and a control group of first graders in mainstream
education. The results revealed that the control group out performed the CP groups in addition and subtraction accuracy and this difference could not be fully explained by difference in intelligence. Both CP groups showed evidence of working memory deficits. The three groups exhibited different developmental patterns in the area of early numeracy skills. Children with CP in special education were found to receive less arithmetic instruction and instruction time was positively related to arithmetic accuracy. Structural equation modeling revealed that the effect of CP on arithmetic accuracy is mediated by intelligence, working memory, early numeracy and instruction time.

2.4.4. Language and reading ability in children with cerebral palsy.

Research has shown that children with severe speech impairments face numerous barriers in their efforts to become literate (Berninger and Gans, 1986; Vandervelden and Siegel, 2001). These barriers are related to areas on articulation, the internal speech sound system, letter knowledge, phonological processing, linguistic ability, working memory and general cognitive ability.

Because of the inability to articulate properly, these children have fewer opportunities to train speech sounds and their relations to letter symbols. There have been early claims that reading ability is directly correlated with speech and articulation. This is hardly a viewpoint nowadays.
But even though Foley and Pollatsek (1999) emphasized the role of the ability of children with speech impairment to make phonological coding, they described the articulatory element of the phonological coding as “not essential”.

The internal speech sound system can also be affected in children with speech impairments. Speech impairments come in different forms. Grunwell (1987) described two fundamental forms, the phonetic and the phonological. Children with phonetic impairments traditionally talk with non-distinct and blurry speech sounds. Children with phonological impairments, however have problems with speech sounds at a higher cognitive level. Their auditory discrimination for speech sounds is distorted. The distinction between speech sounds is less phonologically developed than in adult, and normally developed system and systematic errors occur. These errors can be paradigmatic or syntagmatic (Trask, 1995). Paradigmatic speech errors refer to errors where single speech sounds compete for a position, such that speech sounds become replaced by other speech sounds in a systematic way. Syntagmatic errors refer to more context dependent errors.

The letter knowledge of children with speech impairment is lower than in the typical population (Raitano et al., 2004). Insufficient phoneme awareness and auditory as well as visual perception deficits could be possible explanations for this. Children with severe speech impairments have
been shown to have poorer phonological skills (Blischak, 1994; Dahlgren, 1996).

Foley and Pollatsek, (1999) divided these phonological processing abilities into three component skills that have been identified as critical to the development of skilled reading (a) phonological awareness (b) phonological recording in identification of written words and (c) phonological coding to maintain information in working memory. Phonological awareness is often developed in spite of severely distorted speech (Dahlgren, 1996; Foley, 1993), but studies still have shown that children with severe dysarthria or anarthria have troubles reaching phonological awareness levels of their typically speaking peers.

The overall linguistic ability among children with speech impairments is often poor. Foley (1993) concluded that linguistic ability, as opposed to speech production ability, appeared to be the more critical factor. This linguistic deficiency can affect all linguistic levels of language (Nauder and Magnusson, 2000), such as vocabulary, morphology, syntax and pragmatics.

In close relation to phonological processing, working memory is often suggested as limited in the populations with severe speech and motor impairments. The phonological processing skills used in working memory have often been connected to the ability of oral speech. This working memory can be tested by digit span.
Finally, Blischak (1994) called for the attention to the fact that children with congenital speech impairments also may have cognitive impairments that could contribute to poor literacy skills.

Janna et al. in 2007, conducted a study on 12 cerebral palsy children with various levels of motor and speech deficits for exploring their reading skills in relation to letter knowledge, speech level, auditory discrimination, phonological awareness, language skills, digit span and non verbal IQ. This study stresses the importance of auditory discrimination skills and general language skills as a fundamental base for literacy. It also supports the fact that reading correlates with letter knowledge and phonological awareness.

2.4.5. Writing skills in children with cerebral palsy

Handwriting is an integral part of every child’s school experience. Approximately 30-60% of class time in primary school is spent in fine motor and writing activities, with writing the predominant task (Mchale and Cermak, 1992). Writing difficulties can have implications for a child’s successful participation in school and play activities, potentially leading to problems in academic performance and lowered self esteem (Cermak, 1991). Children with neurological disorders devote more time and energy to write legibly (Berninger and Rutberg, 1992). Children who need to pay considerable attention to the mechanical requirements of writing frequently have difficulty
with other higher order learning activities such as dictation, story writing, reading, spelling, comprehension and mathematics (Chu, 1992).

There are many pre-requisite skills for learning of writing. This includes the ability to balance without the use of the hands, to grasp and release an object voluntarily, to use the hands in a led and assisted fashion, to interact with the environment in the stage of construction play, and to hold utensils and writing tools and also the perception of letters and orientation to printed language (Lamme, 1979). According to Exner (1989), the three aspects of fine motor control that affect writing skills are isolation of movement, grading of movements and timing of movements.

Many studies have addressed the underlying factors relating to handwriting, such as visual motor skills, visual perception, and kinesthesia (Mareland, 1992; Tseng and Murray, 1994; Marr et al., 2001; Schneck, 1991). It has been stated that spatial and temporal concepts and cognitive skills such as attention, memory, perception and language skills are important in handwriting training during the stage of learning motor skills (Sandler et al., 1992).

Children who have the diagnosis of cerebral palsy exhibit different type of difficulties in writing skill basically depending up on their type of condition. In extra pyramidal type of cerebral palsy, due to the involuntary movements, pen holding itself will be a difficult task. When it comes to the
category of hemiplegic cerebral palsy, they are generally independent in most activities using their sound side and are expected to learn to write along with their peers. The greatest difficulty that children with hemiplegic CP face is the performance of tasks that require bilateral manipulation (Fedrizzi et al., 2003). In general, the children with CP, hand impairment depends on several factors, including the severity of paresis, extent of sensory loss, degree of spasticity, and whether or not the dystonic movement is present.

In a recent study conducted by Bumin and Kavak in 2007, found that left hemiplegic children with CP whose right side were dominant were significantly less competent at handwriting than their right dominant, healthy peers. It was also found that the impairment in proprioception seen in the non hemiplegic side in children with CP, and the impairment in bilateral coordination, speed and dexterity of the upper extremities, visual and spatial perception, visual motor organization and tactile sensory impairments negatively affected their handwriting skills. The study also suggests the usage of comprehensive sensory-perceptual motor training programmes that involve both extremities in order to minimize the existing problems related to the hand performance.

2.5. Educational interventions for children with cerebral palsy

Providing educational interventions for children with cerebral palsy is a matter of serious discussion as far as the sociocultural aspects of Kerala
state is considered. From the experience of investigator, who has a lot of informal contacts with the parents of children with cerebral palsy, teachers of special schools and the therapists who deals with cerebral palsy, claims mainly three types of interventions for satisfying the needs of children with cerebral palsy are followed in the state. In one group, the parents and the persons who are in touch with these children are least bothered about the educational aspects of children with cerebral palsy. They concentrate only on the therapeutic aspects of the rehabilitation, which is provided either in clinic, in hospitals or at community levels. Children who belong to this category are with severe motor and other impairments. In the next type, children have minimum physical disability and other impairments so that they get mainstream education along with their healthy peer group. The third category is the most common type in which the child is getting education from the special schools, along with other therapeutic interventions. But again, special schools particularly for children with cerebral palsy are very less in number in the state of Kerala so that many of the children with cerebral palsy are getting education from special schools designed for mentally retarded children. No published data are available regarding the percentage wise distribution of children with cerebral palsy into these categories.

The curriculum followed in the special schools for these children are directed by Kerala State Government and Rehabilitation Council of India.
Children are placed in different classrooms based on chronological age and developmental age into early interventional group, play group, preprimary, primary, vocational training group etc.

There are basically two types of educational methods that are followed for children with cerebral palsy. One is the traditional special education system and the second is the conductive education method. This conductive education is an educational system combined with therapeutic and rehabilitation components. During the 1940’s Andras Peto, a physician in Hungary, developed conductive education for children and adults with motor dysfunction. The conductors deliver the education programme combined in several roles such as teacher, physiotherapist, occupational therapist and nurse (Sutton, 1994).

Group plays an important role in conductive education. Emphasis is placed on the function of the child in the group situation and effect of the group on the child. The children are normally grouped together according to age and type of disabilities. The conductive education programme consists of activities to improve orthofunction, that is exercises to promote, lying, sitting, standing, walking as well as activities of daily living such as dressing, toileting etc.

Rhythmic intension is also well corporate in the programme of conductive education and incorporates singing and rhythmic activities in the
programme of physical exercises. The vocalization or singing describes the movements being presently performed or to be performed. For example, “I stretch my legs, one, two, three and so forth”.

The programme is very intensive too. The children are busily involved in various activities all day without much free time. Children’s self-motivation or achievement orientation is greatly emphasized in this method.

Those children with cerebral palsy, who attend special schools that are designed for children with mental retardation, are getting the traditional special education programme. While in special schools that are designed for cerebral palsy, they follow the so called conductive education method. But no published data are available regarding the comparison between these two methods of teaching from the schools of Kerala or even from India. But there are international studies regarding the comparisons of these systems of education.

Weber and Rochel (1992) conducted an experimental study with 24 children with CP aging between 3 to 7 years, putting 12 children into the experimental group who received conductive education and remaining 12 into the contrast group with traditional special education programme. The results showed improvement in physical, perceptual, cognitive, social and self help domains for both the groups and no statistically significant difference was found between the groups and thus supporting both the type of interventions.
Bairstow et al. (1993) conducted a quasi-experimental study in 36 children with cerebral palsy aged between 18 months to 7 years. The experimental group received conductive education while the contrast group received traditional special education. Evaluation was carried over 24 months. The variables measured were, educational attainments, general development, dysarthria, motor, behavior, parent satisfaction, parental well-being etc. The analysis revealed almost similar progress in most of the domains for both groups, with contrast group better in object transfer, postural independence, position changing independence, hip mobility, form discrimination and activities of daily living. Mother's satisfaction with help received greater for conductive education group.

Bower and McLellan (1994) studied the effects of different techniques in 33 children with cerebral palsy aged between 18 months to 7 years attending four centers of rehabilitation. Centre one aimed on oriented management, centre two concentrated on neuro developmental techniques, centre three followed the conductive education method while centre four used eclectic approach. The evaluation periods ranged from 1 to 6 months. The motor skills were measured by gross motor function measure, staff goal-setting procedures and parent satisfaction by project's own questionnaires. The results revealed no statistically significant difference between the different groups, but improved motor function was reported in all children.
Catanese et al. (1995) conducted a study on 34 children with cerebral palsy aged between 4 to 7 years for finding the effectiveness of conductive education. The experimental group received conductive education while contrast group received individual physiotherapy intervention. Evaluation was done over a period of 6 months. The variables such as motor, general development, parental perception of coping were measured using Vulpe assessment battery and questionnaire on resources and stress. The analysis revealed that improved motor skills, activities of daily living and parental coping were seen in conductive education group. On the other hand cognitive skills and social interaction were greater for the contrast group.

Hur (1997) done a quasi-experimental study on 36 children with cerebral palsy aged between 42 to 54 months. The experimental group received conductive education while the contrast group received traditional special education programme. The evaluations were done 3 times throughout 2 years of intervention. Children’s skills for independence were assessed by gross motor, interpersonal, play and leisure, and activities of daily living subscales from Vineland Adaptive Behaviour Scales and by semi-structured interviews with mothers using Development Profile II. The results showed improvements in both groups in all domain and no difference was found between the groups.
Christine et al. (2003) compared conductive education with both intensive therapy and special education services on the motor skills in children with cerebral palsy. The results of the study found that physical gains were greatest in subjects who received intensive physical, occupational and speech therapy over a five week period. In addition, children in all groups showed some improvement in physical functioning in spite of the short duration of the study. This study thus supports the findings of other authors that conductive education does not improve functional motor activities to a greater extent than other therapeutic and educational treatment methods.

Thus all the above mentioned reviews support for both the traditional special education method and for the conductive education method for the education of children with cerebral palsy. But whatever may be the method adopted, the implementation of computer aided educational programme in the special schools for children with cerebral palsy is highly essential. One of the most important reason for this is the difficulty in using the writing materials such as pen or pencil etc, by the “uncontrollable hands” of the child with cerebral palsy. This can be easily substituted by usage of keyboard or mouse by hand or even with foot for the successful completion of writing programmes. Another reason is the change in the traditional teacher student response to a goal oriented funny programmes that motivates the child with disability to identify their potential for learning to read and write.
Since special education with individualized education planning is as effective as conductive education, the concept of combination of all these therapies as eclectic approach is ideal for the rehabilitation of children with cerebral palsy along with the usage of computer-aided devices for education programme.

2.6. Summary

Even though the review of the literature and research studies pertaining to various aspects of this research problem are less in number, the topics such as cerebral palsy, its definition, classification, incidence, prevalence, diagnosis, motor abilities, cognitive and neurophysiologic functions, reading, writing and language skills of children with cerebral palsy are discussed in detail. No study was found related to the functional academic skills and motor ability of children with cerebral palsy. But still, the literature which was surveyed helped the researcher to identify a number of problems faced by individuals with cerebral palsy. Also the studies and literature surveyed herein have helped the investigator throughout the research work, especially in designing the study and in the selection of the tools and the interpretation of the results. A detailed description of the research methodology followed is given in the following chapter.