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Effective Splinting and Wearing Schedules for the Pediatric Population

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Effective Splinting and Wearing Schedules for the Pediatric Population

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CHAPTER I;

INTRODUCTION

Thousands of children are born with disabilities or become injured every year. According to the National Census Bureau (2000), there are approximately, 45 million individuals with disabilities, between the ages 5-15, living in the U.S.A. (Census, 2000). Occupational therapists are frequently involved in the treatment of these individuals, whom often are unable to participate effectively in functional activities due to their disabling conditions.

> Occupational therapy is a health profession concerned with improving a person's occupational performance. In a pediatric setting, the occupational therapist's deals with children whose occupations are usually players, preschoolers, or students. The occupational therapists evaluate a child's performance in relation to what is developmentally expected for that age group. If there is a discrepancy between developmental expectations and functional ability, the occupational therapist looks at a variety of perceptual and neuromuscular factors which influence function. Based on knowledge of neurology, kinesiology, development, medical diagnoses, and current research, the occupational therapist can identify the children who have the best potential for remediation through occupational therapy. (Bass, 2002)

Splinting is one form of treatment performed by occupational therapists. As will be presented in the literature review to follow, the efficacy of splinting treatment with children has not yet been fully established. To date the majority of the research has been based upon splint usage with adults. Fundamental differences between children and

adults, anatomically, developmentally, and psychosocially, make it imperative to evaluate splint efficacy with children. Wearing schedules recommended for children may also differ from adults, as children have different lifestyles than adults. Examining the compliance of wearing schedules with the pediatric population is also important in order to improve the effectiveness of splinting treatment.

An extensive review of the existing literature was conducted to determine the most effective splints for the pediatric population and to determine what wearing schedules are recommended. The results of the literature review were combined to produce a quick reference booklet to be used by occupational therapists. The booklet was designed to increase the use of evidence-based practice in therapeutic settings.

The definition of evidence-based practice according to Law and Baum (1998) was "bringing together information from clinical expertise and evidence from systematic research to make decisions about OT interventions for a specific client." Parush (2003) similarly described evidence based practice as, "… a process that is derived through synthesis between the preferences of the individual being treated and/or the family of the individual, research based evidence, and the knowledge and experience of the clinician" (p. 1). Using the evidence-based practice model to examine splinting with children demonstrated a definite client base, a substantial base of occupational therapy (OT) knowledge, and a lack of research evidence.

In order to fill this gap of research evidence much has begun within the profession of OT. The American Occupational Therapy Association (AOTA) has recognized the need for easy access to research literature and has created a research database to aid in increasing the ease in which therapists can access this information. With a new

understanding of the need for easy access to evidenced based information, a quick reference booklet was created to include the information derived from the existing studies on splinting with pediatrics. Benefits to using evidence-based practice for occupational therapists include: staying current on new techniques and research, supporting the client-centered approach, promoting professional competence and viability, increasing the effectiveness of treatment in order to better serve the pediatric client, and providing the best quality of care.

CHAPTER II;

LITERATURE REVIEW

Children comprise a large client population seen by occupational therapists within a specialty practice area of pediatrics. Disabilities account for the majority of the children seen by occupational therapy. Some common disabilities requiring splinting for treatment, seen by an Occupational therapist include: cerebral palsy, Rett syndrome, congenital malformations, juvenile rheumatoid arthritis, and spinal cord injuries (Charest, 2003, p. 435-436). The following is a description of each population including the sensorimotor symptoms and need for splinting intervention.

Cerebral palsy is the most common diagnosis seen by pediatric therapists for treatment. There are multiple classifications of cerebral palsy, all involving impaired control of movement appearing in the first few years of life and generally do not worsen over time. The sensorimotor symptoms are caused by faulty development of or damage to motor areas in the brain that disrupts the brain's ability to control movement and posture. Symptoms associated with cerebral palsy include difficulty with fine motor tasks (i.e. writing or using scissors), difficulty maintaining balance or walking, and difficulty with involuntary movements (i.e. swallowing/stabilizing muscles). Signs of cerebral palsy usually begin before 3 years of age (Case-Smith, 2001). In general children with cerebral palsy are slower in reaching developmental milestones such as learning to roll over, sit, crawl, or walk. Splinting has been used with this population to improve grasp skill, decrease muscle tone, and improve ability to engage in functional activities using upper extremities.

Rett Syndrome is another, more rare, diagnosis seen by therapists working with pediatrics. Rett Syndrome is a severe progressive neurological disorder that causes marked developmental regression, especially in the areas of expressive language and hand use. It affects only females. The prevalence of this disorder is 7-10 cases per 100,000 (Medline Plus Health Information, 2003). Symptoms associated with Rett Syndrome include hand wringing, hypotonia, slowed head growth, developmental regresssion, impaired language, loss of social engagement, and occasional hyperventilation or disorganized breathing. Splinting children with Rett syndrome has been used to prevent hand wringing behavior, prevent contractures, and increase functional use of the hand; as will be further discussed in the section on splinting children with Rett Syndrome.

Children suffering from congenital malformations have also been seen by therapists and received splinting treatment. Congenital abnormalities in the hand may include: more or fewer than five fingers, fingers unable to flex, and short, crooked, or webbed fingers. A few possible congenital abnormalities in the arm include: bowing of the arm, abnormally formed bones and joints, and undeveloped or non-developed parts of the arm. Splinting can be used with individuals suffering from congenital malformations in a variety of ways to correct for or compensate for the abnormality in structure.

Juvenile Rheumatoid Arthritis (JRA) affects children and is characterized by four stages of change in the joint; joint inflammation, joint contracture, joint damage, and alteration in joint growth. Symptoms associated with JRA include joint stiffness, and weakness in muscles and soft tissues surrounding the joint (http://www.pueblo.gsa.gov/cic_text/health/juvarth/juvarthr.htm#2A). Splinting has been

used with this population to decrease pain in joints, prevent contractures, and decrease joint damage.

Spinal Cord Injuries comprises a modest population of underage individuals seen by occupational therapists. There are approximately 11,000 new cases of spinal cord injury per year (www.spinalcord.uab.edu, 2001). Of the 11,000, 56% of spinal cord injuries were noted to occur between the ages of 16 and 30 (www.spinalcord.uab.edu, 2001). Symptoms of injuries vary depending on the lesion site. Injuries to the C-5 through C-8 region may be splinted to increase range of motion, prevent deformities, maintain functional hand position and assist in substitute motions in order to increase ability to engage in functional activities.

Fractures also comprise a smaller quantity of clients seen by Occupational therapy. Ljunberg, Hans, and Dahlen (2002) conducted a study on traumatic hand injuries in preschool children. They described the hand as "the most frequently injured part of the body due to accidents in children" (p. 5). The study determined that the top injuries for 455 children age 0-6 referred to the Department of Hand Surgery in Sweden were located in the volar/dorsal part of the hand, followed by single fifth digit injury. The most common causes of injuries were "getting a finger jammed in a door (34%), suffering from a burn injury (16%), or due to a fall (16%)" (Ljunberg, Hans, & Dahlen, 2002, p. 5). Fingertip injuries were the most frequent type at 33%, soft tissue injuries came in second, nail bed injuries third, and fractures fourth. The most frequent injuries in younger children in the study were fingertip injuries and burns, whereas older children in the study were more at risk for fractures occurring through jamming/crushing injuries or falls. Ball, J., & Bindler note (1999), "…fractures involving the epiphyseal plate disrupt

the growth process in children," and if not treated properly can result in, "…limb length discrepancy, joint incongruity, and angular deformities," (p. 854). Splints may be utilized with this population in order to maintain proper alignment of the joint while it heals and prevent deformity.

Several pediatric splints have been developed to aid in the rehabilitation process such as: soft thumb spica splints, resting hand splints, orthokinetic cuffs, serpentine splints, volar wrist splints, weight bearing clam shell splints and many more. So far, there has not been much research to show which splints are the most effective and what wearing schedules work best for the pediatric population. A majority of the research has focused on the efficacy of splint use with the adult population and the wearing schedules to recommend with the adult population. Many designs of pediatric splints are modified versions of the designs for adults. Children have different lifestyles than adults, are in different developmental stages, and have different needs. Due to these differences, it is important to determine what splinting styles work best and what wearing schedules are most effective for this population, in order to provide the best quality of care.

Differences between Children and Adults

Anatomical Differences

It is important when working with children to understand the intricacies and differences from adults in order to provide the best quality of care. Anatomical differences between children and adults exist. As Saidoff and McDonough (1997) stated, "It is a clinical error to consider children as a miniature model of adults. Generally, children's bone structure is more resilient and adaptable whereas their muscles, tendons, and ligaments are relatively stronger and more elastic than those of adults" (p. 44). In

addition, Snider (1997) highlighted several musculoskeletal and developmental differences between adults and children. Snider (1997) reported, “Fractures deformity or cessation of growth with resulting shortening of the extremity” (p. 551). Due to the growth factor in children it is imperative to correctly construct and utilize splints. If they are not designed and fit correctly, the child could have uneven growth.

Another anatomical difference between adults and children according to Snider is that, “Bone strength gradually increases as the child grows, but at most ages, the force required to fracture a bone in a child is less than that of an adult” (p.552). Damage to the physis or growth plate due to stress or forces outside the body, may cause uneven growth with resulting angular anatomical structures. (Snider, 1997, p. 554) It is important to remember when designing splints and splint parts to apply a gradual force and monitor it for changes.

Children may injure more quickly but they have also been noted to heal more quickly. Snider (1997) noted, “Bone healing is more rapid in children,… a fracture of the femur in an adult requires 16-20 weeks of immobilization, the same fracture in a neonate heals in 2 weeks and during early childhood after 4-6 weeks of immobilization” (p. 552). A child’s rate of healing and ability to heal is exceptional considering, “A fracture of the distal radius with 35º of volar angulation in a 5 year-old child will completely remodel in 1-2 years, even if no reduction is performed….Rotational deformities, however do not correct” (Snider, 1997, p.552). These anatomical differences are considerations for research with children in order to increase understanding and improve the care provided to this population.

Developmental Differences

During the first 6 years of life children proceed through various developmental stages, acquiring gross and fine motor skills that enable them to participate in functional activities. In the first 6-12 months children learn to reach towards midline, use full palmar grasp, use radial digital grasp, and use standard pincer grasp. They are also able to manipulate objects between two hands, release objects freely, and hold or carry large objects with two hands. During years 1-2, children's skills expand to include spherical grasp, intrinsic plus grasp, power grasp on tools, releasing one inch objects into a container, using finger to palm translation (for a small object), and scribbling with a marker. Between ages 3-5, skills such as: all types of grasp, releasing and stacking objects, using palm to finger translation, unscrewing a bottle top, turning pages, rolling a ball of clay, stabilizing a paper during coloring or scissors activities, and copying forms continue to expand and develop. At ages 6 and older fine motor hand skills and coordination continue to refine to include: handwriting skills, as well as rotation, and shifting hand manipulation skills (Exner, 2001, p. 309). It is important to carefully evaluate the use of splints with children at any age, as splinting has the potential to enhance function or interfere with the development of skills. Certain diagnoses such as cerebral palsy, may interrupt the development of the fine and gross motor skills, therefore, it is still important to understand the stages of development and their significance to treatment. The effects of splinting on development will be examined further in the efficacy of splinting section of this literature review.

Diagnostic Differences

Certain diagnoses specific to the pediatric population include juvenile rheumatoid arthritis. Although rheumatoid arthritis is often associated as a disorder of the adult and older adult, many forms of arthritis afflict more than 285,000 children in the United States (http://kidshealth.org/parent/medical/arthritis/jra.html). The most prevalent form of juvenile arthritis is juvenile rheumatoid arthritis (JRA), affecting approximately 75,000 children in the United States (http://kidshealth.org/parent/medical/arthritis/jra.html). The main difference between juvenile and adult rheumatoid arthritis is that many people with JRA outgrow the illness, while adult onset forms of arthritis usually have lifelong symptoms. Studies estimate that by adulthood, JRA symptoms disappear in more than half of all affected children. Additionally, unlike rheumatoid arthritis in an adult, JRA may affect bone development as well as the child's growth (http://kidshealth.org/parent/medical/arthritis/jra.html).

Another difference between JRA and adult rheumatoid arthritis is the percentage of people who are positive for RF. About 70 to 80 percent of all adults with rheumatoid arthritis are positive for rheumatoid factor (RF), but fewer than half of all children with rheumatoid arthritis are RF positive. Presence of RF indicates an increased chance that JRA will continue into adulthood (http://www.pueblo.gsa.gov/cic_text/health/juvarth/juvarthr.htm#2A).

Psychosocial Differences

In addition to anatomical, developmental, and diagnostic differences, children are also at different psychosocial development stages than adults. Children's major occupations are play, self-care, social roles, and school activities, which correspond to where they are at psychosocially and developmentally. Many well-known theorists have

conceptualized the stages of psychosocial development an individual goes through during their lifetime.

According to Freud, individuals progress through oral, anal, phallic, latency, and genital stages. Erikson suggests children decide between basic trust and mistrust, next proceed to autonomy or doubt and shame, then initiative versus guilt, industry versus inferiority, self-identity vs. role diffusion, and finally intimacy vs. solidarity and isolation. Piaget theorized that there were five phases of cognitive development: first, a sensorimotor period; second, a pre-operational or pre-conceptual phase; third, an initiative thought phase; fourth, a concrete operational period; and fifth, a formal operational period. Kholberg's moral development theory proposed six stages of development. Initially children were thought to have pre-conventional morality based on punishment and obedience. With maturation, they proceeded to instrumental relativism and then conventional morality or social conformity. Development then continues to law and order, post-conventional morality with social contracts, and finally to universal ethics (Law, Missiuna, Pollock, & Stewart, 2001, p. 45-46).

In all theories, the stages change as the child develops in age, suggesting that adults, if fully developed, are in a different psychosocial place than children. For example, one area in which children differ from adults psychosocially is in their ability to communicate. According to Snider (2002), "Young children may not verbalize pain, but will express the problem by…refusing to use the extremity" (p. 550). Due to differences in psychosocial development, the research conducted with splint use on adults does not apply to children in any of the discussed psychosocial realms. The critical aspect of

communicating emotions can affect splint compliance and treatment sessions. Emotions associated with compliance will be discussed further in the splinting compliance/ adherence section.

Occupational Differences

Since children are in different psychosocial stages than adults, have different developmental needs, and different anatomical capabilities, it is understandable that their occupations are also different from adults. As mentioned previously, children spend a majority of their time engaged in play, self-care activities, social roles, and school activities. These activities are integral to their development. Since average adults have developed skills over the years, they are able to engage in more complex activities than children and base their occupations on personal interests or other incentives specific to their needs. Currently, there is limited research available regarding the use of splints with children. The next section will discuss the existing research.

Splinting Research

Although, the practice of splinting has been relatively long standing with children, limited research is available and the research available generally consists of small studies or single case studies. A majority of the research examined in this literature review has involved pediatric clients with cerebral palsy. Since this population comprises a large segment of the clients seen by occupational, the research involving splinting children with cerebral palsy will be described first.

Splinting Efficacy for Children with Cerebral Palsy

It was mentioned earlier that splinting has the potential to either enhance or reduce hand function in the child. There is a fine line to manage when splinting;

however, research has shown splinting children with cerebral palsy to be associated with an improvement in hand grasp, reduction in tone, and an increase in the ability to perform functional activities.

Splinting Effects on Grasp Patterns for Children with Cerebral Palsy

Treplicky, Russell, and Law (2003) examined the effectiveness of splints and orthoses for the upper extremity with the pediatric population by performing a systematic literature review of five studies dating back to 1983. The samples of all the studies were relatively small with the largest sample being 32 participants. The article determined that "From the research that has involved children with cerebral palsy, it appears that hand splints can improve grasp" (p. 3).

Research by Exner and Bonder (1983) partially supported that claim. The study investigated the efficacy of three hand splints: the orthokinetic cuff, the short opponens splint, and the MacKinnon splint, with children with who had hemiplegic cerebral palsy, ages 3-16. Although, no significant relationship between splint type and variables measured was found. Other results indicated the orthokinetic cuff and the MacKinnon splint "appeared equal in their ability to produce change in bilateral hand use" (p. 80). The MacKinnon splint also "allowed the most positive impact on grasp" (p. 80) and grasp was shown to improve with all the splints.

The research by Currie and Mendiola (1987) analyzed the effects of a splint on prehension patterns and thumb position. Five subjects 20-26 months old participated in the study. Thumb position was demonstrated to improve. With the use of the splint, participant's thumbs were successfully repositioned out of the palm by applying slight pressure on the thenar eminence. This position did not interfere with grasp patterns.

Prehension of objects during splint wear was noted to improve from ulnar raking to use of a three jaw chuck, lateral pinch, crude pincer, or cylindrical grasp. Exploration of the environment was also noted to improve during splint wear from unilateral to bimanual. Limitations of the study included: research results based on the assessment of photographs and observations with no controls against experimenter bias discussed; small sample size; and unknown adherence to splint wearing schedules.

A small study performed by Flegle and Leibowitz (1988) also supported the efficacy of splint use with children who have hemiplegia in order to improve grasp. The study used a single-subject design. Three children with hemiplegic cerebral palsy were splinted using the MacKinnon splint and evaluated to see if the splint had a positive impact on grasp skill. Hand grasp skill was measured during 15 sessions. Grasp with splint use was noted to improve for all children. Dramatic changes were noted in the child with the poorest grasp prior to splint implementation.

Recent research conducted to determine McKie thumb and hand splints' effects on grasp for children with cerebral palsy (1999), has also supported the use of splinting to achieve improvements in hand grasp. Participants included 4 children, 2 with hemiplegic cerebral palsy and 2 with quadriplegic cerebral palsy, ages 2-3 ½ years old. All participants displayed abnormal, ineffective patterns of grasp. Grasp was evaluated using a modified version of the Erhardt Developmental Prehension Scale. The participants were videotaped twice a week in natural settings (day-care or homes) while they participated in regular Occupational Therapy (OT), Physical Therapy (PT), or Speech Therapy (ST). An AB research design was used: A phase being no splint worn in the beginning sessions, followed by B phase in which the splint was applied and the child

was directed to wear the splint 8 active hours a day. The study lasted a total of 10 weeks. Each child demonstrated a significant improvement in grasp patterns. Subjects also demonstrated an informal improvement in functional activity as observed by researchers; however this was not measured in this study.

McKie splint research (1999) coincides with research performed by Treplicky, Russell, and Law (2003), Exner and Bonder (1983), Currie and Mendiola (1987), and Flegle and Leibowitz (1988) to support the efficacy of splint usage with children who have cerebral palsy in order to achieve an improvement in grasp patterns. According to Exner (1995), traditional splinting was based on a functional compensatory approach, which "attempted to circumvent the fine motor problem through adaptations … by providing children with splints to wear during functional activities" (p. 197). Overall, based on early research, it was controversial whether or not traditional splinting could produce a negative effect on spasticity. Later research in the 1980's on new types of splints designed using neurophysiologic principles produced varying results, according to Exner (1995). The difficulty determining the efficacy of splinting with children stems from limitations of the research designs and procedures; and small sample sizes.

Splinting Effects on Muscle Tone of Children with Cerebral Palsy

Tonal changes associated with splint use were investigated by McPherson (1981). The purpose of McPherson's research was to determine if the Snook splint had an effect on the hypertonus muscles of the hand in relation to finger spreading. Participants were ages 10-18 with mild to severely abnormal tone. Splints were to be worn for 5 weeks with a progressive 15-minute increase each week. Measurements were taken immediately after splint removal using a spring-weighted scale. Results demonstrated a

significant reduction in tone after 4 weeks of wearing the splint. Tone was negatively correlated with splint wearing time. As wearing time increased, tone decreased. The effects of the splint were temporary, in that the benefit of reduced tone was not permanent after splint removal.

Research by Reid and Sochaniwskyj (1992) determined the influence of a hand positioning device on upper-extremity control of children with cerebral palsy. A before-and-after study design was utilized, in which 10 children with quadriplegic or athetoid forms of cerebral palsy were measured for changes in reaching and visual motor skills related to splint wear, during 3 sessions. Results indicated no significant differences associated with splint wear, changes in reaching, or visual motor skills. Nevertheless, the report described some evidence of increased normal muscle tone activation associated with reaching; and an improvement in visual motor performance while the splint was worn.

Although the study by McPherson (1981) demonstrated temporary benefits of tone reduction, another study by Gossman, Sahrmann, and Rose (1982) indicated that a muscle forced into passive lengthening will alter biomechanically, anatomically, and physiologically. "For example, a spastic muscle changes anatomically by adding sarcomeres to the muscle fiber and by stretching the connective tissue elements" (p. 807). Whether or not splinting can account for muscle changes is controversial with conflicting research results.

Splinting Effects on Functional Activity for Children with Cerebral Palsy

A study by Largent and Waylett (1975) illustrated that positive effects of bracing to achieve functional activity are better accomplished with younger children diagnosed

with cerebral palsy (i.e. severe athetosis) in the initial phases of hypotonicity and motion development. A greater improvement was observed in the younger children, ages 4-12, as compared to older children ages 12-15, in this study. The improvement was attributed to changes in motion development, muscle tone, and reflex patterns as the child ages. Younger children were able to engage in self-feeding when the humeral cuff of the splint was fixed to 70-80 degrees of flexion/abduction. Successful table tabletop activities could be accomplished when the humeral cuff of the brace was fixed at 30-45 degrees of flexion/abduction. Optimal brace positioning for engagement in functional activities included: an internal rotation stop for self-feeding, an external rotation assist for both activities, moderate elbow resistance for flexion and extension, supination and pronation assists, neutral wrist position, and an orthosis clip at the end of the splint. Using the bracing device researchers found younger children could better engage in functional activities. Additionally, their research suggests that tonal changes associated with growth and development for a client with cerebral palsy may be modified by splint use.

Goodman and Bazyk (1991) described a single subject case study designed to determine the effectiveness of a short thumb opponens splint on functional activity in a 4-year old female with cerebral palsy. Measurements were taken every 2 weeks for 8 weeks using active range of motion (AROM), grip and pinch strength, grasp patterns, the Box and Blocks test of manual dexterity, and one inch cube stacking. The first 4 weeks were used to establish a baseline, followed by another 4 weeks of treatment in which the subject was instructed to wear the splint 3 hours in the morning, 3 hours in the evening and all night long. All measurements were significant for 1 standard deviation level over the baseline except tip pinch and palmar pinch. Before and after photographs also

indicated a positive change in the quality of prehension. Active palmar abduction, radial abduction, and opposition of the thumb increased significantly following splinting. Increased AROM was exhibited in the photographs resulting in improved palmer prehension. Grip strength significantly increased after splint usage. The Box and Blocks test and the cube stacking resulted in an increase in functional use of the hand after splinting. Limitations were noted as: a lack of normative data for the Box and Blocks test for 4- year olds, lack of stability in AROM scores, and lack of sensitivity in the bulb vigorimeter for pinch testing. Practice due to the design set-up may have also had an effect. Long-term effects were not studied or addressed in the article. Baseline data did not reach a level of stability prior to treatment phase and there was only one subject involved in the study. Despite the limitations identified, Goodman and Bazyk's study adds to the literature supporting the positive correlation between splinting and functional usage of the hand, as well as grasp patterns and muscle strength.

Research by Nicholson, Morton, Attfield, and Rennie (2001) further supports the use of splinting to achieve functional gains. Twelve children with athetosis, ataxia, and spasticity were involved in the study. Subjects were fitted with lycra garments, ranging from a sleeved vest with gloves to a full suit with gloves and were instructed to wear the lycra garment 6 hours a day for 6 weeks. Functional gains were measured using the Pediatric Evaluation of Disability Inventory (PEDI). Eleven of the 12 subjects demonstrated improvements in at least 1 of the functional scales of the PEDI; and scores for the whole group demonstrated significant gains. This study corresponds with other research to support the use of splinting for functional improvements. However, the next study offers a different stance on the issue.

The effects of an upper extremity inhibitive weight bearing splint on muscle tone and hand function were identified in a single-subject case study by Kinghorn and Roberts (1996). The research participant was a 20 month-old boy with cerebral palsy. Recall that this age can be a critical time in a child's life, since an average child this age often engages in exploratory play, pretend or symbolic play, social play, and gross motor play, is psychosocially according to Freud in the anal stage, autonomy versus shame and doubt, and/or pre-operational phase, as well as developing all types of grasp. However, this participant's development was interrupted by cerebral palsy. The study was conducted during the 15- 20 minute long occupational therapy treatment sessions. An ABA research design format was utilized with 8 weeks of baseline data collection, followed by 8 weeks of splinting treatment, followed by an 8-week withdrawal period. Differences in muscle tone were measured using hand tracings in side-sitting and weight-bearing positions. Changes in hand function were measured by assessments involving grasping and releasing one-inch cubes and batting/trapping a 12-inch ball with the right (i.e. affected) arm. A 15-point observation rating scale was also used to determine arm/hand position.

Results indicated that after the application of the weight-bearing splint, changes in hand tracing from pre-activity to post activity were minimal. A gradual improvement in arm hand position occurred throughout the study, demonstrating an increase in the subjects' willingness to assume a weight bearing position in the right arm. No significant changes were noted in functional activity tasks throughout the 3 phases. Limitations included difficulty measuring the hand tracing to determine changes in spastic muscle tone, which may have impacted results. The splint was only used during the 15-20

minute occupational therapy sessions for 24 weeks. Subjects lack of motivation to play with the ball or blocks or discontent with the clinical setting may have been a factor in the results obtained. Even though this study (Kinghorn & Roberts, 1996) does not support the use of splinting a child in order to improve ability to engage in functional activities, other studies have supported its use (Largent & Waylett, 1975; Goodman & Bazyk, 1991; and Nicholson, Morton, Attfield, & Rennie, 2001). Despite varying research results attributed to small sample sizes and other limitations, utilizing new splinting procedures based on neurophysiologic principles for improvements in grasp, tone, and functional activities, continues to be clinically utilized by occupational therapists.

Splinting Efficacy for Children with Rett Syndrome

Three studies focused on splint usage for children with Rett's syndrome. A study by Nanaguma and Billingsley (1988) investigated the effects of hand splints on reducing stereotypic hand behavior for 3 adolescent girls with Rett syndrome. Results demonstrated a significant decrease in stereotypic hand behaviors. This study also reported an increase in finger feeding skills for one subject. The use of splinting to prevent stereotypic hand behaviors was seen as a protective measure; and this study demonstrates that the splint, rather than interfering with functional activity, actually increased the ability to self-feed in one subject.

The study by Nanaguma and Billingsley (1988) was replicated by Tuten and Meidaner (1989) to determine the hand splint's effectiveness in reducing stereotypic hand behaviors in two 5-year old children with Rett Syndrome. The results of this replicated study were in opposition to earlier results supporting the efficacy of splint use for

decreasing stereotypic hand behaviors. In this study, no change was found in the occurrence of stereotypic hand behavior with the application of identical hand splints. Also no increase in purposeful hand movement was observed.

Aron (1990) described the application of a splint, which prevented elbow flexion and restricted hand to mouth movements in 8 subjects, ages 2-14. Methods used to monitor behavior occurrence were parental interviews and clinical observation. A decrease in hand wringing behavior was reported in all 8 subjects and an increase in hand use was noted with 1 subject. Increased socialization and interaction with the environment was also reported. Interfering developmental factors contributing to an increase in socialization and interaction were not discussed.

Overall research reporting on the effects of splinting with Rett syndrome is limited, conflicting, utilized small sample sizes, and lacked empirical rigor. Despite all the limitations, these studies demonstrated possible clinical benefits of splinting children with Rett syndrome to decrease stereotypic behaviors, increase hand use, and increase socialization and interaction.

Splinting Efficacy for Children with Congenital Malformations

Kamil and Correia (1990) described a single-subject case study investigating splinting effects on a 9-month olds passive range of motion and functional ability to use the upper extremity. The dynamic elbow flexion splint was to be worn twice daily, for 1 1/2 hours at a time. Results demonstrated an increase in passive elbow flexion, and an increase in functional usage of the upper extremity for manual play and self-feeding activities. Although the results appear positive, this case study had several limitations. The measurement tools used and guards against experimenter bias were not described in

the article. Whether or not a baseline of functioning was established prior to implementation of the splint was also unknown.

A research article by Flodmark (2002) described a survey in which the strategies and experiences of therapists working with children with radial deficiency were elicited. Questionnaires were sent out and completed by five hand therapy clinics. Results indicated that a majority of the clients had been treated with static, primarily circular, splints made from orfit or turbocast. The main goal for splinting was primarily to improve passive range of motion (PROM) at the wrist. The goal was often documented and accomplished using circular, orfit or turbocast splints. The respondents' most commonly recommended wearing schedule was "from birth either continuously or during sleeping hours" (Flodmark, 2002, p.7). No guards against responder bias were identified. This article supports the use of splinting to achieve an increase in PROM at the wrist for children with radial deficiency, although it is based upon respondents' clinical opinion.

Since existing research is scarce on splinting for congenital deformities, further investigation with larger sample sizes and increased experimental rigor is needed to determine the effectiveness of splinting with children who have congenital abnormalities.

Splinting Efficacy for Children with Juvenile Rheumatoid Arthritis

Research on splinting efficacy with juvenile rheumatoid arthritis (JRA) is also scarce. Feinberg (1992) briefly touched on the efficacy of splinting a child with JRA. Although, the efficacy of splint use for JRA was not the main topic of the paper, Feinberg reported a few participants as stating, "Night time use of splints did reduce early morning stiffness," in their children (p. 20). No further research specifically related to the effectiveness of splinting with this diagnosis was discovered.

Splinting Efficacy for Children with Spinal Cord Injury

There is little research on splinting efficacy for children with spinal cord injuries, perhaps due to the small population. However one article was written by Krajnik and Bridle (1992). The article described a quantitative research study in which a survey was mailed out to occupational therapists working in a spinal cord injury center. The purpose of the survey was to collect information about the application of hand splints. Frequency and descriptive statistics focused on static and dynamic splints, selection of splints, and evaluation of hand function. This article addressed spinal cord injuries but did not state the client age, therefore it is undetermined whether the survey participants treated children or not. According to the results, static splinting was the most highly recommended type of splint by therapists working in the field with the spinal cord injury population. Dynamic splints were noted to be more frequently used with individuals who had C-6 to C-7 spinal cord injuries. A great variety of wearing schedules were reported in the study indicating a high rate of individualization. A few other trends were also discussed.

static splint.

One trend identified by Krajnik and Bridle (1992) was that resting hand splints were more likely to be worn at night; whereas static wrist supports and opponens splints were more likely to be worn during the day. Resting hand splints were most commonly selected for clients with C-5 and C-6 spinal cord injuries. Short opponens splints were commonly selected for clients with C-7 and C-8 spinal cord injuries.

dynamic splints.

Individuals with C-5 spinal cord injuries were most likely to be fitted with ratchet splints. Clients with C-6 injuries were more likely to have dynamic splints than static splints. Individuals with C-6 and C-7 spinal cord injuries were most likely to be fitted with wrist flexor hinge splints. Individuals with C-8 spinal cord injuries would more likely have static splints or if a dynamic splint was utilized, RIC tenodesis splints would be chosen (Krajnik and Bridle, 1992).

no splint.

Client non-acceptance or non-compliance was the most frequently sighted reason for not applying a splint. It was suggested that, "therapists screen clients for compliance prior to fitting dynamic splints" (Krajnik, Bridle, 1992, p. 154). The article also stated, "Garber and Gregario (1990) found that overall splint use declined to 39% after 2 years" (p. 155). This may indicate a need for intermittent reassessment and the development of reinforcement programs for splinting adherence. This study's results showed that splinting is an accepted intervention by therapists working with this population, although effectiveness was not clearly addressed.

Splinting Efficacy for Children with Fractures

No research has been identified for splint use with children with fractures. Rather using splints to treat fractures has been supported by clinical experience and long-standing protocol history.

Miscellaneous Splinting Research

Scope is a disability organization in England and Wales focusing on people with cerebral palsy. Scope's aim is for disabled individuals to achieve equality through the creation of a society in which disabled individuals are valued and have the same human and civil rights as everyone else. The scope organization has not yet published its research on the a clinical evaluation of the effectiveness of dynamic lycra splinting related to functional abilities of children and adults with Cerebral Palsy as it is still in progress. This study was accessed through a citation in a related article by S. Tatum (2002).

Participant's included 23 adults and 17 children with varying diagnoses. Subjects reportedly participated in a 7-month project, in which they wore the dynamic lycra-splint for 6 months in order to determine effects associated with spasticity, level of disability, range of motion, and functional ability. Several assessments and measurements were taken during the study including the Canadian Occupational Performance Measure, the Office of Populations Censuses and Surveys (OPCS) disability scale, a spasticity measurement scale, and other measurements. Significant improvements were indicated in both the performance and satisfaction scales of the COPM. Significant reduction in spasticity in certain muscles was achieved. A significant positive impact on the overall disability scale was also reported. The research indicated that lycra-based splinting is beneficial for a range of movement and clinical disorders. According to this study, a positive relationship on the participants' ability to function was associated with use of the lycra-based splinting. This study demonstrated that splinting can achieve functional improvements, despite the diagnoses. Clinical judgment on the client's functional

limitations appeared important for determining if lycra-based splinting would be beneficial to clients.

Splinting research still needed

Overall, therapists accept the use of splinting as standard treatment for various diagnoses. It has been a long-standing practice, despite the lack of empirical support for some diagnoses. Overall, splinting children with cerebral palsy was shown to be effective by the majority of the published research data. Splinting for other diagnoses to achieve positive client outcomes still is empirically uncertain considering there is an exceptional deficiency of research data. The problem posed by lack of empirical study could be resolved by creating easier methods to incorporate research practice into clinical practice and/or replicating studies with rigorous designs using larger populations.

This lack of research evidence poses a threat to those clinicians desiring to practice using the evidence-based practice model. Following the evidence-based practice model the clinician would first use OT knowledge and experience to assess and collaborate with the client determining the needs and associated client factors (Parush 2003, Law 2002, Lieberman & Scheer 2000, & AOTA 2003). . Once the decision had been made to implement a splinting program; assuring compliance should follow.

Adherence and Compliance to Medical Regimens

Adherence to a therapy regimen is important for any splinting program of treatment to work, because the therapist may only see a client one to two times a week or less. The majority of splint usage and treatment may occur at home or in other environments.

Non-adherence to overall medical regimens has been identified as a major detriment and is estimated by Berg, (1993) to cost approximately $100 billion annually. Costs are associated with the need for additional treatments, diagnostic studies, and clinic appointments. Rapoff (2002) reported that the negative effects of non-adherence to a medical regimen can also have detrimental effects to clients "…reducing their academic and social functioning," and contributing "…to poorer disease outcomes and compromised quality of life for clients and their families" (p. 374).

To avoid the negative effects associated with non-compliance, it is important to first understand the reasons associated with non-compliance. A few studies have been conducted to determine problems associated with non-adherence to splint wearing schedules.

Research on Problems influencing Non-Adherence to Medical Regimens

Close, Davies, Price, and Goodyer (1986) evaluated factors associated with adherence to medical regimens, with emphasis on emotional factors. Results of their research suggested adherence to difficult medical routines can have a psychological impact on the child and family resulting in decreased self-esteem, an external locus of control, and increased feelings of depression. Since difficult medical regimens have potential to produce damaging emotional effects on the participants, it is imperative that therapists work collaboratively with clients in order to create splinting programs that are realistic as well as effective for client and family lifestyles.

In a pilot study of families of children with chronic arthritis by Britton (1999), 46 families answered questionnaires related to six key issues. One of the key issues was parents' understanding of treatment. Another key issue focused on parents' view of the

splinting programs. The study found that 18 of the 46 clients (39%) wore splints daily; and 9 of the 46 clients wore splints occasionally. Thirty-nine percent of the participants regularly wore a combination of day and night time splints. Respondents stated that it did not take long to don or doff the splints, but that 41% of participants needed an adult to help them do so. Decreased family understanding of the reasons for splinting, were associated as a factor contributing to less adherence by children in using their splints.

This study demonstrated the importance of clearly explaining the purpose of the splint to family members and checking to make sure they understand in order to increase adherence. It also demonstrated the amount of assistance a parent may have to provide in order to accommodate the wearing schedule set up by the professional. As mentioned previously, considering those lifestyle factors of both the child and the caregiver are important when creating a wearing schedule for a child and family.

Further investigation into issues concerning families' experiences with children living with JRA was conducted through an ethnographic study by Britton (2002) Information on exercise and splinting obtained in the study was limited to one clinical practice setting. The study had three parts. In stage one of the pilot study, a questionnaire was distributed to families of children with JRA. In stage two, the study narrowed its focus to a questionnaire given to girls age 7-8 and 11-13, their siblings, and families. During stage two, journals were kept, in-depth interviews were conducted, and also video diaries. Results showed that, "nearly all the mothers took responsibility for supervising the daily routine" (p. 2). Three factors influenced the adherence to a program according to the study: a.) the amount of rigor/hassle involved, b.) the ability to cope with distress to the family and child, and c.) the parent's perspective on the therapeutic

regimen benefits.

The main complaints by participants noted in the study, in regards to splints were, "children did not like wearing their splints, and said they were uncomfortable, hot, and obvious to the onlooker" (Britton, 2002, p. 4). In this study, four mothers reported "that the night splints seemed to ease the children's pain in the morning" (p. 4), once again providing support to the use of splinting with children.

The research by Britton (2002) identified many problems associated with adherence to medical regimens such as: decreased understanding of splint use, parental assistance required to don and doff, adherence to difficult wearing schedules, decreased ability of families to cope, discomfort, and discontent with aesthetics of the splint. Sufficient literature exists providing several solutions to combat these problems and will be presented in the following paragraphs.

Possible solutions to Non-adherence

Decreased Understanding of Splint Use

Suggestions by Rapoff (2002) to combat a decreased understanding of splint use include: using positive reinforcement, and provide verbal and written instructions "designed to inform clients and their families about diseases, treatment regimens, potential side effects, and the importance of consistent adherence" (p. 375). Other educational strategies to encourage adherence through understanding include: repeating information as needed, particularly when children are first diagnosed because clients and parents may experience emotional distress, which interferes with recall. Health care professionals may also "Check for understanding –openly encourage questions-secure a

verbalized commitment to attempt to follow the prescribed regimen" (Rapoff, 2002, p. 376).

Parental Assistance Required to Don and Doff Splint

In order to combat the issue of parental donning and doffing splints, Charest (2003) recommended that, "Children who have reached 8+ years, depending on the expected compliance, can be taught self-donning and care of the splint, which may increase the child's sense of independence" (p. 441).

Adherence to Difficult Wearing Schedules

Difficult wearing schedules for children can be minimized by individualizing and integrating the splint wearing schedule into the lifestyle of children and family members to increase the convenience and compliance of splint usage. Behavioral methods for increasing adherence such as, "…a calendar to track adherence, setting an alarm to times when medications are to be taken, pairing regimen related behaviors with established behaviors," could also be implemented (Rapoff, 2002, p. 377). Effective discipline instruction may be incorporated into parental/caregiver education in order to increase child compliance.

A study by Mandal, (2000), reported that a positive reinforcement techniques increased compliance in children. During the study four misbehaving children were given instructions by their parents using the following techniques. Techniques include effective instruction delivery and time in. Time In (TI) was defined as "as verbal and/or physical praise for appropriate behavior" (Mandal, et al. p. 2). Effective instruction delivery (EID) included: "…eye contact prior to instruction delivery, praise for eye contact, using a directive statement rather than a question format, close proximity prior to

instruction delivery, descriptive instructions, a 5-10 wait second for the child's response, and praise for compliance" (Mandal, et al., p. 2). Compliance measures for both children involved in the baseline and EID experimental phase increased significantly from 40% to 78% for one child and from 21.4% to 78% for another child. Compliance measures for both children involved in the baseline and TI experimental phase also increased significantly from 45% to 85% for one child and from 16.6% to 75% for another. Most children demonstrated a higher percentage of compliance when both methods were used. Relatively high levels of child compliance were achieved using the positive behavior management procedures. Recommending the use of these strategies in caregiver education may be helpful to increase splint compliance in a child.

Decreased Ability of Families to Cope

In addition to positive behavior management and effective instruction delivery, coping skills for families can be addressed in treatment sessions. This content may ease the distress to the family dynamics, stemming from increased responsibilities associated with having a child with a disability or injury.

Discomfort and Discontent with the Splint

Charest (2003) provided some suggestions to reduce discomfort to children wearing splints. The suggestions included that splinting material be selected based on the clinicians' best judgment, taking into consideration several factors associated with the diagnosis and children's lifestyle. Factors to consider when choosing splinting material for a child: "child's age, muscle tone, level of cooperation and level of pain" (p. 442). Lightweight splinting material (1/16" to 3/32" thickness) was recommended for young children with weak muscles. Neoprene was recommended as a good material for children

actively using their hand, while stronger material would be required for “severe spasticity and rigid deformity” (p.442). Perforated material was also noted to be beneficial for children with diagnoses that involve excessive perspiration.

To prevent discomfort associated with incorrect fit Wilton (1997) recommended,

> inclusion of more proximal joints to anchor the splint (but still allow flexibility for optimal interaction with the environment), use of circumferential designs to gain strength and ensure good pressure dispersion over very fragile skin, effective means to secure the splint to the limb to prevent little curious people from removing the splint when unsupervised, and incorporating special features to encourage wearing. (p. 16)

To make the splint more aesthetically appealing to a young child, safe decorations could be added such as cloth cartoon pictures. Charest (2003) recommended avoiding small pieces that may be bitten or sucked off. For an older child, involvement in the selection of colors and creating a “low profile” splint is preferred. (Charest, 2003, p. 440).

The previously described methods to increase adherence by combating the problems identified have not been empirically examined, with the exception of the EID and TI research. Other methods are based on clinical experience and literature recommendations. Further research could be conducted to determine if the intervention methods described (e.g. teaching coping skills, providing repetitive instruction, adding decorations) are effective for increasing client compliance. Follow-up programs could also be implemented by the therapist in order to make splint modifications and increase splint compliance through addressing client needs.

CHAPTER III;

ACTIVITIES & METHODOLOGY

The definition of evidence-based practice according to Law & Baum (1998) was "bringing together information from clinical expertise and evidence from systematic research to make decisions about occupational therapy interventions for a specific client." Parush, (2003) similarly described evidence-based practice as, "… a process that is derived through synthesis between the preferences of the individual being treated and/or the family of the individual, research based evidence, and the knowledge and experience of the clinician" (p. 1).

Following the evidence-based practice model, the clinician would first use occupational therapy knowledge and experience to assess and collaborate with the client, determining the needs and associated client factors (Parush 2003, Law 2002, Lieberman & Scheer 2000, & AOTA 2003). Next the clinician would consult the research evidence to determine what interventions would be appropriate and effective. Finally, the Occupational therapist would use their expertise to collaborate with the client and individualize the treatment to better suit the client. Benefits to using evidence-based practice include: staying current on new techniques and research, supporting the client-centered approach, promoting professional competence and viability, increasing the effectiveness of treatment in order to better serve the pediatric client, and provide the best quality of care.

The evidence-based practice model serves as the basis for this scholarly project. Using the evidence-based practice model to examine splinting with children

demonstrated a definite client base, a substantial base of occupational therapy knowledge, and a lack of research evidence. Without research evidence, determining the effectiveness of interventions is difficult.

Due to the gap in research, clinicians desiring to use the evidence-based practice model are unable and the benefits associated with the evidence based practice model cannot be realized. An increase in empirical data would aid in clearly establishing the benefits associated with splinting children. Using the empirical data, as well as other information the therapist would be better prepared to decide whether splinting treatment should be implemented.

In addition to the need for increased empirical research, Lieberman and Scheer (2002) identified the need for easy access to research literature. The American Occupational Therapy Association has created a research database known as OT Search (formerly Bibsys) to aid in increasing the ease in which therapists can access research information.

The literature review summarized in Chapter II determined the existing research on splinting with children and children's compliance to splinting regimens. The following key terms were identified: splints, orthotics, orthoses, casts, cerebral palsy, juvenile rheumatoid arthritis, pediatrics, children, upper extremity, arm, hand, fractures, compliance, adherence, congenital malformations/anomalies, spinal cord injuries, and Rett syndrome. Key terms were researched using Medline database, OT search, CINAHL, PubMed, ODIN, and Google. Articles were reviewed and references were reviewed for further research findings.

Articles regarding splint use with children were summarized using a modified version of the structured abstract template developed by Liebermann and Scheer (2002). See Appendix A. All splinting with children summaries were combined and indexed according to the diagnosis, and splint type. Diagnoses included: cerebral palsy, congenital anomalies, fractures, juvenile rheumatoid arthritis, Rett syndrome, and spinal cord injuries. Splint types included: MacKinnon splint, Orthokinetic cuff, resting hand splint, thumb splints (clam shell, opponens), wrist splints, Snook splint, McKie splint, and dynamic splints. An additional section addresses common splint adherence problems and recommendations.

With a new understanding of the need for evidenced-based information, it was decided to create a quick reference booklet focused on splinting children based on the information obtained in the literature review. The primary goal of the booklet was to provide pediatric occupational therapists with a quick reference on current research involving splinting children with certain diagnoses, in order to facilitate the use of evidence-based practice and increase the effectiveness of their practice. The booklet provides a synopsis of current research and references. Using the evidence-based practice model, methods for clinical use of the information provided are expected to be individualized. The therapist is expected to self-evaluate their own knowledge of and ability to apply/explain current research in their own practice to determine effective and non-effective splinting practices for individual children with specific diagnoses.

The secondary goal of the booklet was to provide a quick reference to pediatric occupational therapists on current compliance and adherence research for children and following medical regimens. A compliance section focuses on common adherence

problems and suggestions. Again, occupational therapists are expected to self-evaluate and apply this information using the principles of evidence-based practice.

CHAPTER IV;

PRODUCT

Quick Reference To Research on Splinting Children

Dedication

To everyone that provided me with the knowledge to write this booklet, Thank-you. Specific thanks to Jan Stube my advisor for her challenging and thoughtful input.

Introduction

This booklet was designed to provide be a quick reference for Occupational Therapy (OT) practitioners working with children and splinting and desiring easy access to evidence-based literature. Evidence-based practice is a relatively new concept involving the combination of research literature with OT knowledge and client factors in order to provide the best treatment and produce the most effective practice. Following the evidence-based practice model, the clinician would first use occupational therapy knowledge and experience to assess and collaborate with the client, determining the needs and associated client factors (Parush 2003, Law 2002, Lieberman & Scheer 2000, & AOTA 2003). Next the clinician would consult the research evidence to determine what interventions would be appropriate and effective. Finally, the Occupational therapist would use their expertise to collaborate with the client and individualize the treatment to better suit the client. Benefits to using EBP include: staying current on new techniques and research, supporting the client-centered approach, promoting professional competence and viability, increasing the effectiveness of treatment in order to better serve the pediatric client, and provide the best quality of care.

The primary goal of the booklet was to provide pediatric occupational therapists with a quick reference on current research involving splinting children with certain diagnoses, in order to facilitate the use of evidence-based practice and increase the effectiveness of their practice. The booklet provides a synopsis of current research and references. Using the evidence-based practice model, methods for clinical use of the information provided are expected to be individualized. The therapist is expected to self-evaluate their own knowledge of and ability to apply/explain current research in their own practice to determine effective and non-effective splinting practices for individual children with specific diagnoses.

The secondary goal of the booklet was to provide a quick reference to pediatric occupational therapists on current compliance and adherence research for children and following medical regimens. The compliance section focuses on common adherence problems and suggestions. Again, occupational therapists are expected to self-evaluate and apply this information using the principles of evidence-based practice.

In the quick reference booklet the research articles are presented using a form created by Lieberman and Scheer (2000). The articles may not be described in full, with sections of the Lieberman and Scheer (2000) form omitted due to a lack of information in the article. References are provided for anyone wishing to further investigate articles. The level of evidence rating noted on the form, was derived from a table created by Trombly, Tickle-Degnen, Baker, Murphy, and Ma (1999), as follows:

The ICDH-2 Outcome terminology was categorized into three levels: body function level, activity level, and participation level; according to information from Mandich, Miller, and Law (2002, p. 53). The definition of body function is "the physiological functions of the body systems" (Mandich, Miller, & Law, 2002, p. 53). Activity is defined as, "the performance of a task or action by an individual" and participation is defined as, "an individual's involvement in life situations in relation to health conditions; body functions; and structures, activities, and contextual factors," (Mandich, Miller, & Law, 2002, p. 53). At least one of the three categories were included under ICDH-2 Terminology if the article intervention was focused in that area. For example, if an article focused on improving range of motion and self-feeding activities; body function level and activity level would be included under the ICDH-2 terminology portion of the form.

The OT Outcome terminology was derived from the American Occupational Therapy Association's Uniform terminology (2003).

References

Law, M. (2002). *Evidence-Based Rehabilitation; A Guide to Practice.* Thorofare, NJ: SLACK Inc.

Leiberman, D., & Scheer, J. (2002). AOTA's Evidence-Based Literature Review Project: An Overview. *The American Journal of Occupational Therapy, 56*(3), 344-349.

Mandich, A., Miller, L., & Law, M. (2002) Outcomes in Evidence-Based Practice. In M. Law (Ed.) *Evidence-Based Rehabilitation; A Guide to Practice* (pp. 49-69). Thorofare, NJ: SLACK Inc.

Occupational therapy practice framework: Domain and process. *American Journal of Occupational Therapy. 56,* 609-639.

Parush, S. (2003). Evidence based practice in occupational therapy – our challenge in the 21st century. *The Israel Journal of Occupational Therapy, 12*(2), 60.

Trombly, C.A., Tickle-Degnen, L., Baker, N., Murphy, S., & Ma, H. (1999). Levels of evidence for occupational therapy outcomes research. Unpublished table, Boston University.

Table of Contents

Arthritis

Feinberg, J. (1992). Effect of the Arthritis Health Professional on Compliance with use of resting hand splints by patients with rheumatoid arthritis. *Arthritis Care and Research, 5*(1), 17-23.

Comments:

LEVEL OF EVIDENCE: NA-B-2-a	The questionnaire format is a non-experimental design. There were less than 20 respondents, moderate internal validity, and high external validity.				
RESEARCH OBJECTIVE:					
DESIGN: ف RCT ف Single Case ف Case Control ف Cohort ف Before-After ف Cross-Sectional					
SAMPLING PROCEDURE: ف Random ف Consecutive ف Controlled ف Convenience	Participants were mailed a questionnaire and all five clinics responded.				
SAMPLE: N= _ ___ M age=_____ Male_____ Female_____ Ethnicity=_____					
Participant Characteristics	Medical Diagnosis/Disorder Diagnoses reported to be seen by respondents included:			OT Treatment Diagnosis Children requiring splint treatment.	
OUTCOMES Measuring compliance to splinting programs.	Measures	Reliability	Validity	Outcome OT Terminology:	Outcomes ICDH-2 Terminology: - Body function level
INTERVENTION	Description Splinting protocol	Delivered by Therapists	Setting Hand therapy clinic settings in Sweden??	Frequency/Duration	
RESULTS	Night time use of splints did reduce early morning stiffness according to four participants.				
CONCLUSIONS Biases: ف Attention ف Drop outs ف Masking/Binding ف Contamination ف Co-Intervention	Responses are do control for responder bias and may be based on opinion rather than actual effects. The design does not account for a placebo effect and the study is not directly focused on determining the splint efficacy rather it is focused on compliance to a splinting program.				

Cerebral Palsy

Largent, P., & Waylett, J. (1975). Follow-up study on Upper Extremity Bracing for Children with Severe Athetosis. *The American Journal of Occupational Therapy, (29)*6, 341 – 348.

Comments:

LEVEL OF EVIDENCE: III-B-3-b	Non-randomized control trial-one group(one treatment) pre-test and post-test, less than 20 participants, low internal validity, moderate external validity.				
RESEARCH OBJECTIVE:	Re-evaluate children involved in the 1971 Waylett & Barber study, examining independence in self-feeding and table-top activities associated with the ability to function using the arm brace in order to: formulate criteria for appropriate pt. selection, identify motion problems that can be successfully braced, and determine the most effective configurations to aid in arm control.				
DESIGN: ڤ RCT ڤ Single Case ڤ Case Control ڤ Cohort ڤ Before-After ڤ Cross-Sectional	Ex-post Facto design.				
SAMPLING PROCEDURE: ڤ Random ڤ Consecutive ڤ Controlled ڤ Convenience					
SAMPLE: N= _11__ M age=_4-15_ Male_____ Female_____ Ethnicity=_____					
Participant Characteristics Required head and neck control, variable muscle tone, at a developmental level to begin self-feeding, able to follow simple verbal and non-verbal directions, demonstrated motivation, had sufficient bulbar control, with severe athetosis.	Medical Diagnosis/Disorder Cerebral Palsy - Severe Athetosis			OT Treatment Diagnosis Decreased ability to self-feed, and engage in table-top activities.	
OUTCOMES Increase ability to self-feed, engage in table-top activities, and function using the arm brace.	Measures Not described.	Reliability None reported in this article.	Validity Not reported.	Outcome OT Terminology:	Outcomes ICDH-2 Terminology: -Activity level -Participation level
INTERVENTION	Description Children were fitted with the arm brace and a therapist worked with each subject for approx. 1 hour.	Delivered by Therapist	Setting Meal times Pacific State Hospital	Frequency/Duration Twice daily for 6-9 months.	
RESULTS	Type of motion problems successfully braced included: generalized hypotonia when inactive and attempting to perform purposeful motion, with minimal				

	degree of tone and posturing in the trunk muscles. The six individuals successfully braced were between the ages of 4-12, suggesting "bracing to achieve a functional activity may be indicated at an early age when the initial phase of hypotonicity in beginning motion development is still evident," and indicating that, "…perhaps after the age of 12 when strong reflex patterning persists with increasing tone, no remarkable change in functional abilities can take place" (p. 345). Most effective configuration of the arm brace is: Humeral cuff fixed at 70-80 deg. of flexion/abduction for self-feeding, 30-45 degrees for table top activities, internal rotation stop for self-feeding, external rotation assist for both activities, mod. elbow resistance for flexion and extension, supination assist, pronation assist, neutral wrist position, and a clip for the wrist/hand orthosis. Severe physical control problems could not be solved with this arm brace.
CONCLUSIONS Biases: ڤAttention ڤ Drop outs ڤMasking/Binding ڤContamination ڤCo-Intervention	Limitations to the research include unknown reliability and validity, small sample size, and extraneous variables not accounted for in this article (such as: wearing schedules).

McPherson, J.J. (1981). Objective evaluation of splint designed to reduce hypertonicity.

The American Journal of Occupational Therapy, 35, 189-194.

Comments:

LEVEL OF EVIDENCE: III-B-2-b	Non-randomized control trial- one group (one treatment), less than 20 participants, moderate internal validity, and moderate external validity.				
RESEARCH OBJECTIVE:	To determine if the Snook Splint had an effect on the hypertonus muscles of the hand in relation to finger spreading.				
DESIGN: ف RCT ف Single Case ف Case Control ف Cohort ف Before-After ف Cross-Sectional	Pre-experimental design. The group was measured pre- and post-intervention.				
SAMPLING PROCEDURE: ف Random ف Consecutive ف Controlled ف Convenience					
SAMPLE: N= _5__ M age=_10-18_ Male_____ Female_____ Ethnicity=_____					
Participant Characteristics Ages 10-18 with severe and profound handicaps, at least 8 years post-damage.	Medical Diagnosis/Disorder Three with severe abnormal tone and two with mild abnormal tone.		OT Treatment Diagnosis Spastic muscle tone inhibiting function		
OUTCOMES	Measures Spring-weighted Scale was used to measure finger spreading.	Reliability Statistical analysis was used.	Validity Statistical analysis of data was used and an internal validity tool.	Outcome OT Terminology:	Outcomes ICDH-2 Terminology: -Body function level
INTERVENTION Application of the Snook Splint.	Description Snook splint was worn.	Delivered by Therapist	Setting	Frequency/Duration Worn for 5 weeks with a progressive 15 minute increase each week.	
RESULTS	Results demonstrated a significant reduction in tone after 4 weeks of wearing the splint. Tone was negatively correlated with splint wearing time. As wearing time increased, tone decreased. The found effects of splint wearing were not permanent.				
CONCLUSIONS Biases: ف Attention ف Drop outs ف Masking/Binding ف Contamination ف Co-Intervention	Limitations include: no measurements for change in hand functioning were described, small sample size, adherence to splinting program was unknown, internal validity tool was not tested.				

Exner, C., & Bonder, B. (1983). Comparative Effects of Three Hand-Splints on Bilateral Hand Use, Grasp, and Arm-Hand Posture in Hemiplegic Children: A Pilot Study. *The Occupational Therapy Journal of Research, 3*(2), 75-93.

Comments:

LEVEL OF EVIDENCE: III-B-3-b	Pilot study utilizing a counter balanced experimental design, less than 20 subjects, low internal validity, and moderate external validity.				
RESEARCH OBJECTIVE:	To investigate the effects of hand-splinting on bilateral hand use, grasp skill, and arm-hand posture in hemiplegic cerebral palsied children, using three different splints: the orthokinetic cuff, the short oppponens thumb splint, and the MacKinnon splint, both during and after a period of splinting.				
DESIGN: ڤ RCT ڤ Single Case ڤ Case Control ڤ Cohort ڤ Before-After ڤ Cross-Sectional	Counter-balance design used to determine effects between pre-test and experimental condition.				
SAMPLING PROCEDURE: ڤ Random ڤ Consecutive ڤ Controlled ڤ Convenience					
SAMPLE: N= _12__ M age=_7yr 6 mo_ Male_____ Female_____ Ethnicity=_____	Children ages 3-16 were included in the study.				
Participant Characteristics Children whom suffered brain damage near the time of birth, with a developmental level of 18 months, no severe behavior problems, no pica, no significant uncorrected visual deficits, the ability to attend to task for at least 5 minutes, with parents who have a good history of punctuality to appointments, and motivation to follow through.	Medical Diagnosis/Disorder Hemiplegic cerebral Palsy		OT Treatment Diagnosis Difficulties with functional hand use, grasp, and arm posture.		
OUTCOMES Increase hand function. Improve bilateral hand use. Improve grasp. Improve arm posture.	Measures Tests were created to evaluate bilateral hand use, grasp, and arm-hand posture, based on similar assessments found in the literature. Bilateral hand use consisted of an ordinal scale rating zero to four abnormal to normal movements. The grasp test was based on	Reliability Good inter-rater reliability.	Validity Content validity was determined by experienced therapists. Tests created may not have effectively discriminated the small changes or improvements noted.	Outcome OT Terminology:	Outcomes ICDH-2 Terminology: -Body function level -Activity level

	Weiss and Flatt's evaluation of 8 types of grasps. The hand postures were evaluated based on photographs (through passive observation).				
INTERVENTION Splint application.	Description One of three splints applied.	Delivered by Investigators or COTA	Setting John F. Kennedy Institute	Frequency/Duration Splints were worn 8 hours per day for 6 weeks, with a two week interval between each type of splint.	
RESULTS	No significant relationship was found between the type of splint and changes in bilateral hand-use, grasp, or arm-hand posture. 41.6% of participants improved in bilateral hand use with the orthokinetic cuff. 58.3% of subjects improved in bilateral hand use or grasp with the MacKinnon splint.				
CONCLUSIONS Biases: ڤAttention ڤ Drop outs ڤMasking/Binding ڤContamination ڤCo-Intervention	Extraneous variables unaccounted for include: inconsistent adherence to the recommended wearing schedule, IQ, developmental age, chronological age, medications, severity of motor involvement, primitive reflexes, current strength, current hand use, child's interest in hand use, parental attitudes, and previous therapy. No returning to baseline after some improvements were noted with one splint before implementation of another splint and small sample size also limited the study.				

Currie, D., & Mendiola, A. (1987). Cortical Thumb Orthosis for Children with Spastic Hemiplegic Cerebral Palsy. Archive *of Physical Medicine and Rehabilitation, 61,* 169-192.

Comments:

LEVEL OF EVIDENCE: III-B-3-b	Non-randomized control trial-one group with pre-and post-test, less than 20 subjects, low internal validity, and moderate external validity.				
RESEARCH OBJECTIVE:	This study was performed to determine whether the cortical thumb orthosis hand an effect on the 1.) position of the thumb while wearing the orthosis, 2.) function of the paretic hand in relation to the prehension while wearing the orthosis.				
DESIGN: ڤ RCT ڤ Single Case ڤ Case Control ڤ Cohort ڤ Before-After ڤ Cross-Sectional					
SAMPLING PROCEDURE: ڤ Random ڤ Consecutive ڤ Controlled ڤ Convenience	Unknown-appeared to be a convenient sample.				
SAMPLE: N= _5__ M age=_____ Male_____ Female_____ Ethnicity=_____	Subjects were 20-26 months in age.				
Participant Characteristics		Medical Diagnosis/Disorder Spastic Hemiplegic Cerebral Palsy		OT Treatment Diagnosis Poor thumb position. Poor prehension. Poor functional use of the hand.	
OUTCOMES Improve thumb position. Improve prehension patterns. Increase bimanual actions.	Measures Photographs Ability to grasp a one inch cube, raisin, and glass. Use of bimanual actions.	Reliability Not described.	Validity Not described.	Outcome OT Terminology:	Outcomes ICDH-2 Terminology: -Body function level -Activity level
INTERVENTION Splint application	Description Application of the cortical thumb orthosis. Not clearly established or described in this article.	Delivered by Therapists	Setting Home and early intervention classroom setting.	Frequency/Duration Observations were taken prior to the application of the orthosis and one week post application, via photographs. The subjects were instructed to wear the splint during all waking hours, which included an early childhood intervention classroom time.	
RESULTS	The first objective was accomplished in all 5 subjects (repositioning the thumb out of the thumb-in-palm position by controlling only the first meta-carpal bone and pressing against the thenar eminence, while not interfering with grasping or sensory feedback from the thumb.) The hand function and prehension patterns improved similarly for all 5 subjects; with the orthosis				

	subjects could grasp a one-inch cube using a three-jaw-chuck position, rather than the previous ulnar raking; for grasping a drinking glass participants improved to use cylinder grasp with both hands rather than previously using the "good" hand for playing with toys; subjects demonstrated an increase in bimanual exploration rather than previously using unilateral exploration. The results are supportive of the efficacy of the cortical thumb orthosis for increasing the functional ability of the hand for children with hemiplegic cerebral palsy.
CONCLUSIONS Biases: ڤAttention ڤ Drop outs ڤMasking/Binding ڤContamination ڤCo-Intervention	No standardized assessments were described as being used in this study. Also no controls were described to guard against experimenter biases. Small sample size and no sample criteria described also limit the study.

Aldstadt Casey, C., & Kratz, E. (1988). Soft Splinting with Neoprene: The Thumb Abduction Supinator Splint. *The American Journal of Occupational Therapy*, *42*(6), 395-398.

Comments:

LEVEL OF EVIDENCE: NA-A-3-c	Not a research study- Narrative, more than 20 subjects, low internal validity, and low external validity.				
RESEARCH OBJECTIVE:	The Thumb Abduction Supinator Splint (TASS) was made in order to increase use of the impaired arm in bilateral activities.				
DESIGN: ڤ RCT ڤ Single Case ڤ Case Control ڤ Cohort ڤ Before-After ڤ Cross-Sectional					
SAMPLING PROCEDURE: ڤ Random ڤ Consecutive ڤ Controlled ڤ Convenience					
SAMPLE: N= _50__ M age=_____ Male_____ Female_____ Ethnicity=_____	50 subjects age 10 months and up.				
Participant Characteristics Children with neuromuscular disorders (primarily cerebral palsy or head injuries), with good cognition, good sensation, and good motivation.	Medical Diagnosis/Disorder Neuromuscular disorders-Cerebral Palsy or Head Injury			OT Treatment Diagnosis Increased muscle tone, decreased bilateral hand use and poor arm positioning.	
OUTCOMES Decrease muscle tone. Improve bilateral hand use. Improve arm positioning.	Measures No formal assessments described.	Reliability	Validity	Outcome OT Terminology:	Outcomes ICDH-2 Terminology: -Body function level -Activity level
INTERVENTION	Description Application of the Thumb Abduction Splint made from Neoprene.	Delivered by	Setting Gillette Children's Hospital and Milwaukee Children's Hospital.	Frequency/Duration	
RESULTS	"The splint has been especially useful in helping young hemiplegic children learn early to incorporate the impaired arm in bilateral activities," (p. 397). "The TASS has been most useful for the child whose upper extremity has mild to moderate spasticity but no severe contractures, and is in a pattern of forearm pronation, fisted hand, and thumb in palm," (p. 397). Improvements in function noted after application of the TASS include: decreased spasticity, and appropriate forearm positioning for bilateral activities such as: playing catch with a beach ball, swinging on a swing, and pushing a stroller or walker. The article also described improved fine-motor ability such as: lateral and tip pinch.				
CONCLUSIONS Biases: ڤAttention ڤ Drop outs ڤMasking/Binding ڤContamination	No controls were used to support the results claimed. Results appear to be based on clinical application and are subject to critical analysis by the reader. No precautions				

Co-Interventionف	were taken to avoid experimenter bias.

Flegle, J.H., and Leibowitz, J.M. (1988). Improvement in Grasp Skill in Children with Hemiplegia with the MacKinnon Splint. *Research in Developmental Disabilities, 9,* 145-151.

Comments:

LEVEL OF EVIDENCE: IV-B-2-b	Prospective single subject study, less than 20 subjects, moderate internal validity, and moderate external validity.				
RESEARCH OBJECTIVE:	To determine if the MacKinnon splint has a positive impact on grasp skill in children with hemiplegia.				
DESIGN: ف RCT ف Single Case ف Case Control ف Cohort ف Before-After ف Cross-Sectional					
SAMPLING PROCEDURE: ف Random ف Consecutive ف Controlled ف Convenience					
SAMPLE: N= _3 __ M age=_____ Male_____ Female_____ Ethnicity=_____					
Participant Characteristics	Medical Diagnosis/Disorder Hemiplegic Cerebral Palsy			OT Treatment Diagnosis Poor grasp	
OUTCOMES Improve hand grasp.	Measures	Reliability	Validity	Outcome OT Terminology:	Outcomes ICDH-2 Terminology: - Body function level
INTERVENTION	Description Application of the MacKinnon Splint.	Delivered by Therapist	Setting	Frequency/Duration Grasp skill measured over 15 sessions.	
RESULTS	Hand grasp improved for all subjects. The most dramatic improvement occurred with the child with the poorest grasp prior to splint implementation.				
CONCLUSIONS Biases: ف Attention ف Drop outs ف Masking/Binding ف Contamination ف Co-Intervention					

Goodman, G., & Bazyk, S. (1991). The Effects of a Short Thumb Opponens Splint on Hand Function in Cerebral Palsy: A Single-subject Study. *The American Journal of Occupational Therapy*, *45*(8), 726-731.

Comments:

<table>
<tr><td>LEVEL OF EVIDENCE:
NA-B-1-c</td><td colspan="5">Single subject case study with pre- and post-test, less than 20 subjects, high internal validity, and low external validity.</td></tr>
<tr><td>RESEARCH OBJECTIVE:</td><td colspan="5">The purpose of this study was to determine the effectiveness of a short thumb opponens splint on hand function in a four year-old girl with cerebral palsy.</td></tr>
<tr><td>DESIGN:
ف RCT ف Single Case
ف Case Control ف Cohort
ف Before-After
ف Cross-Sectional</td><td colspan="5"></td></tr>
<tr><td>SAMPLING PROCEDURE:
ف Random ف Consecutive
ف Controlled ف Convenience</td><td colspan="5"></td></tr>
<tr><td>SAMPLE:
N= __1__ M age=_4___

Male_____ Female_ X_ _

Ethnicity=_____</td><td colspan="5"></td></tr>
<tr><td colspan="2">Participant Characteristics

Four year-old female with cerebral palsy.</td><td colspan="2">Medical Diagnosis/Disorder
Cerebral Palsy</td><td colspan="2">OT Treatment Diagnosis
Poor range of motion. Poor manual dexterity. Poor grip and pinch strength. Poor prehension patterns.</td></tr>
<tr><td>OUTCOMES
Increase active range of motion.
Increase grip strength.
Increase pinch strength.
Increase manual dexterity.
Improve prehension skills.</td><td>Measures
Measurements were taken every 2 weeks for 8 weeks including:
▪Active range of motion (measured at the carpometacarpal joint in radial abduction, palmar abduction, and opposition),
▪Grip strength (vigorimeter),
▪Pinch strength (B& L pinch gauge),
▪Manual dexterity (Box and Blocks test),
▪One-inch cube stacking ability measured, and observation of prehension</td><td>Reliability
Good Reliability in standardized measurement tools (e.g. Box and Blocks, pinch strength, grip strength).</td><td>Validity
Good content validity as measurements is appropriate for the outcome.</td><td>Outcome OT Terminology:</td><td>Outcomes ICDH-2 Terminology:
- Body function level

-Activity level</td></tr>
</table>

	using photographs was recorded.				
INTERVENTION	Description Application of the volar-type short thumb opponens splint.	Delivered by Therapist	Setting	Frequency/Duration The first 4 weeks were used to establish a baseline, followed by a second 4 weeks of treatment in which the subject was instructed to wear the splint 3 hours in the morning, 3 hours in the evening, and all not long.	
RESULTS	All of the variables were significant for an improvement in one standard deviation level over the baseline, except tip pinch and palmar pinch. Before and after photographs also indicated a positive change in the quality of prehension. Active palmar abduction, radial abduction, and opposition of the thumb increased significantly following splinting. Increased active range of motion was exhibited in the photographs resulting in improved palmar prehension. Grip strength significantly increased after splint usage. The Box and Blocks test and the cube stacking demonstrated an increase in functional use of the hand after splinting.				
CONCLUSIONS Biases: ڤAttention ڤ Drop outs ڤMasking/Binding ڤContamination ڤCo-Intervention	Limitations were noted as a lack of normative data for the Box and Blocks test (for 4 year-olds), lack of stability in range of motion scores, and lack of sensitivity in the bulb vigorimeter for pinch testing. Practice due to the design set-up may have had an effect. Long-term effects were not studied. Baseline data did not reach a level of stability prior to the treatment phase. There was a small sample size (one person).				

Reid, D.T., & Sochaniwskyj, A. (1992). Influences of Hand Positioning Device on Upper Extremity Control of Children with Cerebral Palsy. *International Journal of Rehabilitation Research, 15,* 15-29.

Comments:

LEVEL OF EVIDENCE: III-B-2-b	Non-randomized control trial-one group with pre- and post-test, less than 20 subjects, moderate internal validity, and moderate external validity.				
RESEARCH OBJECTIVE:	To determine the effects of a hand positioning device on the upper extremity control of children with cerebral palsy.				
DESIGN: ف RCT ف Single Case ف Case Control ف Cohort ف Before-After ف Cross-Sectional					
SAMPLING PROCEDURE: ف Random ف Consecutive ف Controlled ف Convenience					
SAMPLE: N= 10 M age=_____ Male_____ Female_____ Ethnicity=_____					
Participant Characteristics		Medical Diagnosis/Disorder Quadriplegic or Athetoid forms of Cerebral Palsy		OT Treatment Diagnosis Poor upper extremity control and functioning	
OUTCOMES Improve visual motor performance. Increase reaching and exploration.	Measures Visual motor skills and Reaching were evaluated.	Reliability	Validity	Outcome OT Terminology:	Outcomes ICDH-2 Terminology: -Body function level -Activity level
INTERVENTION Application of hand positioning device.	Description	Delivered by	Setting	Frequency/Duration Measurements were taken over three sessions with and without the splint.	
RESULTS	No significant differences were found. An increase in normal muscle activation during reaching and improvements in visual motor performance were noted by some to occur with splint usage.				
CONCLUSIONS Biases: ف Attention ف Drop outs ف Masking/Binding ف Contamination ف Co-Intervention	The tests may not have been sensitive enough to the changes occurring.				

Blair, E., Ballantyne, J., Horsman, S., & Chauvel, P. (1995). A Study of Dynamic Proximal Stability Splint in the Management of Children with Cerebral Palsy. *Developmental Medicine and Child Neurology*, *37*, 544-554.

Comments:

<table>
<tr><td colspan="2">LEVEL OF EVIDENCE:
III-A-2-b</td><td colspan="4">Non-randomized control trial with pre-and post-test, more than 20 subjects, moderate internal validity, and moderate external validity.</td></tr>
<tr><td colspan="2">RESEARCH OBJECTIVE:</td><td colspan="4">To determine a dynamic proximal stability splints (UPsuit) affects on postural stability and upper extremity functioning.</td></tr>
<tr><td colspan="2">DESIGN:
ف RCT ف Single Case
ف Case Control ف Cohort
ف Before-After
ف Cross-Sectional</td><td colspan="4"></td></tr>
<tr><td colspan="2">SAMPLING PROCEDURE:
ف Random ف Consecutive
ف Controlled ف Convenience</td><td colspan="4">LOOK UP!!</td></tr>
<tr><td colspan="2">SAMPLE:
N= _32__ M age=_____

Male_____ Female_____

Ethnicity=_____</td><td colspan="4"></td></tr>
<tr><td colspan="2">Participant Characteristics</td><td colspan="2">Medical Diagnosis/Disorder
Cerebral Palsy</td><td colspan="2">OT Treatment Diagnosis

Poor postural stability and poor arm movements.</td></tr>
<tr><td>OUTCOMES

Improvement in postural stability. Improvement in arm motions.</td><td>Measures
Measurements were taken weeks 3, 7, 10, and 13.</td><td>Reliability</td><td>Validity</td><td>Outcome OT Terminology:</td><td>Outcomes ICDH-2 Terminology:
- Body function level</td></tr>
<tr><td>INTERVENTION
Application of the UPsuit.</td><td colspan="2">Description</td><td>Delivered by
Therapists</td><td>Setting
Home</td><td>Frequency/Duration
UPsuit was worn for weeks 5-7 and 11-16 of the 4 month study.</td></tr>
<tr><td colspan="2">RESULTS</td><td colspan="4">An improvement in postural stability and upper extremity movements were noted to be associated with wearing the UPsuit.</td></tr>
<tr><td colspan="2">CONCLUSIONS
Biases: ف Attention ف Drop outs
ف Masking/Binding
ف Contamination
ف Co-Intervention</td><td colspan="4">Poor design jeopardized the studies validity.</td></tr>
</table>

Wallen, M. & MacKay, S. (1995). An evaluation of the Soft Splint in the Acute Management of Elbow Hypertonicity. *Occupational Therapy Journal of Research*, *15*, 3-16.

Comments:

LEVEL OF EVIDENCE: IV-B-2-c	Single-subject design with less than 20 subjects, with moderate internal validity, and low external validity.				
RESEARCH OBJECTIVE:	Study to examine the effects of a soft splint in managing elbow hypertonicity.				
DESIGN: ف RCT ف Single Case ف Case Control ف Cohort ف Before-After ف Cross-Sectional					
SAMPLING PROCEDURE: ف Random ف Consecutive ف Controlled ف Convenience					
SAMPLE: N= _1___ M age=_11__ Male_____ Female__X__ Ethnicity=_____					
Participant Characteristics Eleven year-old female with severe traumatic brain injury in a coma.		Medical Diagnosis/Disorder Severe Traumatic Brain Injury in a Coma		OT Treatment Diagnosis Decreased range of motion at the elbow, and decreased muscle tone.	
OUTCOMES Increase range of motion. Increase muscle tone. Prevent deformity.	Measures	Reliability	Validity	Outcome OT Terminology:	Outcomes ICDH-2 Terminology: - Body function level
INTERVENTION	Description Application of the soft-elbow splint.	Delivered by	Setting	Frequency/Duration	
RESULTS					
CONCLUSIONS Biases: ف Attention ف Drop outs ف Masking/Binding ف Contamination ف Co-Intervention					

Kinghorn, J. & Roberts, G. (1996). The Effect of an Inhibitive Weight-Bearing Splint on Tone and Function: A single case study. *The American Journal of Occupational Therapy*, *50*(10), 807-815.

Comments:

LEVEL OF EVIDENCE:					
RESEARCH OBJECTIVE:	To investigate the effects of an upper extremity weight-bearing splint on muscle tone and functional hand skills in a child with cerebral palsy.				
DESIGN: ف RCT ف Single Case ف Case Control ف Cohort ف Before-After ف Cross-Sectional	An ABA research design format was utilized with 8 weeks of baseline data collection, followed by 8 weeks of splinting treatment, followed by an 8 week withdrawal period.				
SAMPLING PROCEDURE: ف Random ف Consecutive ف Controlled ف Convenience					
SAMPLE: N= 1 M age=20 mo. Male_____ Female_____ Ethnicity=_____	One 20 month-old boy with spastic quadriplegia.				
Participant Characteristics One 20 month-old boy with spastic quadriplegia with right side involvement greater than left.	Medical Diagnosis/Disorder Spastic Quadriplegia			OT Treatment Diagnosis High muscle tone. Poor arm-hand posture. Decreased functional activity.	
OUTCOMES Decrease muscle tone. Improve arm-hand posture. Increase functional activity.	Measures Hand tracing while in side-sitting and weight-bearing was performed to determine the presence of muscle tone and change in muscle tone. A 15-point observation rating scale was constructed to evaluate arm-hand posture. Functional activities were evaluated using 2 fine-motor activities (grasping and releasing a one-inch cube and batting/trapping a 12-inch ball with the right arm).	Reliability	Validity Decreased content validity as the measurements is not standardized.	Outcome OT Terminology:	Outcomes ICDH-2 Terminology: -Body function level -Activity level
INTERVENTION	Description Application of the	Delivered by Therapist	Setting Clinic setting	Frequency/Duration The study was conducted during the 15-	

	weight-bearing splint to the right hand.			20 minute long occupational therapy treatment sessions. An ABA research design format was utilized with 8 weeks of baseline data collection, followed by 8 weeks of splinting treatment, followed by an 8 week withdrawal period.
RESULTS		Results indicate that after the application of the weight-bearing splint, changes in hand tracing from pre-activity to post-activity were minimal. A gradual improvement in arm-hand position occurred throughout the study demonstrating an increase in the subject's willingness to assume a weight-bearing position in the right arm. No significant changes were noted in functional activity tasks throughout the 3 phases.		
CONCLUSIONS Biases: ڤAttention ڤ Drop outs ڤMasking/Binding ڤContamination ڤCo-Intervention		Limitations include: difficulty measuring the hand tracing to determine changes in spastic muscle tone. The splint was only used during the 15-20 minute occupational therapy session for 24 weeks. Subjects lack of motivation to play with the ball or blocks or discontent with the clinical setting may have been a factor in the results obtained.		

McKie Splint Studies

Comments:

LEVEL OF EVIDENCE: III-B-2-b	Non-randomized control trial-one group with pre- and post-test, less than 20 subjects, moderate internal validity, and moderate external validity.				
RESEARCH OBJECTIVE:	To examine the effectiveness of the McKie Thumb splint in changing grasp patterns in children with cerebral palsy.				
DESIGN: ف RCT ف Single Case ف Case Control ف Cohort ف Before-After ف Cross-Sectional	An AB research design was used. A phase being no splint worn in the beginning therapy sessions, followed by B phase in which the splint was applied and the child was to wear the splint 8 active hours a day. The study lasted 10 weeks.				
SAMPLING PROCEDURE: ف Random ف Consecutive ف Controlled ف Convenience					
SAMPLE: N= _4__ M age=_____ Male_____ Female_____ Ethnicity=_____	Four children ages 2-3 ½ years-old with cerebral palsy.				
Participant Characteristics Two children with hemiplegic cerebral palsy and two with quadriplegic cerebral palsy. All children exhibited abnormal or ineffective patterns of grasp.	Medical Diagnosis/Disorder Cerebral Palsy		OT Treatment Diagnosis Poor grasp patterns.		
OUTCOMES Improve grasp patterns.	Measures Children were videotaped twice a week in natural settings (day care or homes) while they participated in regular occupational therapy, physical therapy, and speech therapy. The Erhardt Developmental Prehension Scale was used to evaluate grasp patterns.	Reliability A double blind procedure was used to eliminate rater bias.	Validity Statistical analysis was used.	Outcome OT Terminology:	Outcomes ICDH-2 Terminology: - Activity level
INTERVENTION	Description Application of the McKie Thumb Splint.	Delivered by Therapist	Setting University of Wisconsin, Madison- Natural	Frequency/Duration The study lasted 10 weeks with 2 phases. During the first phase	

			settings (home or day-care).	(A) no splint was worn; during the second phase (B) the splint was applied.
RESULTS	Each child demonstrated a significant improvement in grasp patterns. Subjects also demonstrated an improvement in functional activity, not measured in this study.			
CONCLUSIONS Biases: ڤAttention ڤ Drop outs ڤMasking/Binding ڤContamination ڤCo-Intervention	Measurement of adherence to the splint wearing schedules was not described in this article and the research suffered from a small sample size (4).			

McKie Splint Studies

Comments:

LEVEL OF EVIDENCE: IV-B-3-b	Single-subject design, with less than 20 subjects, low internal validity, and moderate external validity.				
RESEARCH OBJECTIVE:	To examine the videotapes and determine the effectiveness of the thumb splint with supinator strap in changing supination range of motion.				
DESIGN: ف RCT ■ Single Case ف Case Control ف Cohort ف Before-After ف Cross-Sectional	An Ex-post facto design was utilized in which examined the relationship between the splinting strap and supination through passive observation of videotapes. This study was a continuation of the previous McKie study looking at different variables.				
SAMPLING PROCEDURE: ف Random ف Consecutive ف Controlled ■ Convenience					
SAMPLE: N= 3 M age=_____ Male_____ Female_____ Ethnicity=_____	Three children ages 2-3 ½ years participated in the study. Only children with a supinator strap in the previous study were re-examined.				
Participant Characteristics Participants were derived from the previous McKie splint study and included if they demonstrated a limitation in supination.	Medical Diagnosis/Disorder Cerebral Palsy			OT Treatment Diagnosis Decreased ability to supinate the forearm (decreased range of motion).	
OUTCOMES Improve supination (range of motion) in the forearm.	Measures Re-examination of the videotapes.	Reliability Rater reliability was not described.	Validity Content validity of measurements was not described.	Outcome OT Terminology:	Outcomes ICDH-2 Terminology: - Body function level
INTERVENTION Splint application.	Description Application of McKie thumb splint with supinator strap.	Delivered by Therapist	Setting University of Wisconsin, Madison- Natural settings (home or day-care).	Frequency/Duration The study lasted 10 weeks with 2 phases. During the first phase (A) no splint was worn; during the second phase (B) the splint was applied.	
RESULTS	Results indicated that the children gained an average of 15 degrees supination on average after the application of the splint with supinator strap.				
CONCLUSIONS Biases: ف Attention ف Drop outs ف Masking/Binding ف Contamination ف Co-Intervention	Limitations include: small sample size (3), no statistical measurements described in the article, and no guards against rater biases described.				

Nicholson, JH., Morton, R., Attfield, S., & Rennie, D. (2001). Assessment of Upper Limb Function and Movement in Children with Cerebral Palsy Wearing Lycra-Garments. *Developmental Medicine and Child Neurology, 43*, 384-391.

Comments:

LEVEL OF EVIDENCE: IV-B-2-b	Pre-experimental single-subject design, with less than 20 subjects, moderate internal validity, and moderate external validity.				
RESEARCH OBJECTIVE:	To determine the effects of lycra-based splinting on upper extremity limb function and movement in children with cerebral palsy.				
DESIGN: ف RCT ف Single Case ف Case Control ف Cohort ف Before-After ف Cross-Sectional					
SAMPLING PROCEDURE: ف Random ف Consecutive ف Controlled ف Convenience					
SAMPLE: N= 12 M age=_____ Male_____ Female_____ Ethnicity=_____					
Participant Characteristics Children with athetosis, ataxia, and spasticity were included.		Medical Diagnosis/Disorder Cerebral Palsy		OT Treatment Diagnosis Decreased upper extremity limb use for functional activities.	
OUTCOMES Improve the functional capacity of the upper extremity for children with cerebral palsy.	Measures Ability to function in various areas was examined using the Pediatric Evaluation of Disability Inventory (PEDI). It includes: mobility, self-help, and social scales.	Reliability The PEDI is a standardized test and has good test-retest reliability.	Validity The standardized PEDI also demonstrates good content validity for measuring functional capacity. Statistical analysis was used.	Outcome OT Terminology:	Outcomes ICDH-2 Terminology: - Activity level - Participation level
INTERVENTION	Description Children were fitted with lycra-garments, ranging from a sleeved vest with gloves to a full suit with gloves.	Delivered by Researcher	Setting		Frequency/Duration Subjects were instructed to wear the lycr-garment for 6 hours a day for 6 weeks.
RESULTS	Eleven of the twelve children made improvements in at				

	least one of the functional scales of the PEDI and scores for the whole group demonstrated significant gains.
CONCLUSIONS Biases: ڤAttention ڤ Drop outs ڤMasking/Binding ڤContamination ڤCo-Intervention	Limitations include: small sample size and adherence to wearing schedule was not described.

Congenital Anomalies

Kamil, N., & Correia, A. (1990). A Dynamic Elbow Flexion Splint for an Infant with Arthrogryposis. *The American Journal of Occupational Therapy*, *44*(5), 460-461.

Comments:

LEVEL OF EVIDENCE: IV-B-3-c	Single-subject design, with less than 20 subjects, low internal validity, and low external validity.				
RESEARCH OBJECTIVE:	To determine the effects of a dynamic elbow flexion splint on infants passive range of motion and functional ability to use the upper extremity for activities.				
DESIGN: ف RCT ف Single Case ف Case Control ف Cohort ف Before-After ف Cross-Sectional	Single case study design.				
SAMPLING PROCEDURE: ف Random ف Consecutive ف Controlled ف Convenience					
SAMPLE: N= __1__ M age=_9 mo. Male_____ Female_____ Ethnicity=_____	One nine-month old infant.				
Participant Characteristics One 9-month-old infant with arthrogryposis.	Medical Diagnosis/Disorder Arthrogryposis			OT Treatment Diagnosis Poor elbow flexion (range of motion). Decreased functional use of the upper extremity.	
OUTCOMES Improve passive elbow flexion and increase functional use of the upper extremity.	Measures	Reliability	Validity	Outcome OT Terminology:	Outcomes ICDH-2 Terminology: - Body function level - Activity level
INTERVENTION	Description Application of the dynamic elbow flexion splint.	Delivered by Therapist	Setting		Frequency/Duration Dynamic splint to be worn twice daily for 1 ½ hours at a time.
RESULTS	Results demonstrated an increase in passive elbow flexion, and an increase in functional usage of the upper extremity for manual play and self-feeding activities.				
CONCLUSIONS Biases: ف Attention ف Drop outs ف Masking/Binding ف Contamination ف Co-Intervention	Limitations include: unknown if a baseline was established, unknown measurement tools, unknown compliance to wearing schedule, no guards against experimenter biases described, and small sample size.				

Flodmark, C. (2002). Splinting small Children with Radial Deficiency-strategies and experiences of treatment (Department of Hand Surgery, Uppsala University Hospital, Sweden No. 14). Abstract retrieved September 24, 2003, from http://hpo.uas.se/meeting/nkh2002/Abstracts/AbstractsB.html

Comments:

<table>
<tr><td>LEVEL OF EVIDENCE:
NA-B-3-c</td><td colspan="5">Non-experimental survey design, with less than 20 subjects, low internal validity, and low external validity.</td></tr>
<tr><td>RESEARCH OBJECTIVE:</td><td colspan="5">To examine the strategies and experiences of therapists splinting small children with radial deficiency.</td></tr>
<tr><td>DESIGN:
ڤ RCT ڤ Single Case
ڤ Case Control ڤ Cohort
ڤ Before-After
ڤ Cross-Sectional</td><td colspan="5">Non-experimental survey design.</td></tr>
<tr><td>SAMPLING PROCEDURE:
ڤ Random ڤ Consecutive
ڤ Controlled ڤ Convenience</td><td colspan="5"></td></tr>
<tr><td>SAMPLE:
N= 5 M age=_____

Male_____ Female_____

Ethnicity=_____</td><td colspan="5">Five adults working in hand therapy clinics responded.</td></tr>
<tr><td>Participant Characteristics
Five adults working in hand therapy clinics responded.</td><td colspan="3">Medical Diagnosis/Disorder</td><td colspan="2">OT Treatment Diagnosis</td></tr>
<tr><td>OUTCOMES</td><td>Measures
Questionairres were sent out and completed by five hand therapy clinics with questions focused on Type of splint used, goals associated with splint usage, and wearing schedules.</td><td>Reliability</td><td>Validity</td><td>Outcome OT Terminology:</td><td>Outcomes ICDH-2 Terminology:
- Body function level

- Activity level

- Participation level</td></tr>
<tr><td>INTERVENTION</td><td>Description
Distribution of quesitonairres.</td><td>Delivered by
Mail ☺</td><td>Setting
Hand Therapy Clinics</td><td colspan="2">Frequency/Duration</td></tr>
<tr><td>RESULTS</td><td colspan="5">Results indicated that a majority of the patients had been treated with static, primarily circular, splints made from orfit or</td></tr>
</table>

	turbocast. Goals for splinting were primarily to improve passive range of motion at the wrist. It was often documented and accomplished using that type of splint. Most commonly recommended wearing schedule was: "from birth either continuously or during sleeping hours" (p.7).
CONCLUSIONS Biases: ف Attention ف Drop outs ف Masking/Binding ف Contamination ف Co-Intervention	The study was limited by: possible respondent bias and small sample size.

Fractures

Rett Syndrome

Nanaguma, F. & Billingsley, G. (1988). The Effect of Hand Splints on Stereotypic Hand Behavior in Three Girls with Rett Syndrome. *Physical Therapy, 68,* 664-671.

Comments:

<table>
<tr><td>LEVEL OF EVIDENCE:
IV-B-3-c</td><td colspan="5">Single-subject design, with less than 20 subjects, low internal validity, and low external validity.</td></tr>
<tr><td>RESEARCH OBJECTIVE:</td><td colspan="5">To evaluate a hand splints effectiveness in reducing stereotypic hand behaviors.</td></tr>
<tr><td>DESIGN:
ف RCT ف Single Case
ف Case Control ف Cohort
ف Before-After
ف Cross-Sectional</td><td colspan="5"></td></tr>
<tr><td>SAMPLING PROCEDURE:
ف Random ف Consecutive
ف Controlled ف Convenience</td><td colspan="5"></td></tr>
<tr><td>SAMPLE:
N= __3__ M age=_____

Male_____ Female__X__

Ethnicity=_____</td><td colspan="5">Three female adolescents with Rett syndrome participated in the study.</td></tr>
<tr><td colspan="2">Participant Characteristics
Three female adolescents with Rett syndrome participated in the study.</td><td colspan="2">Medical Diagnosis/Disorder
Rett Syndrome</td><td colspan="2">OT Treatment Diagnosis
Stereotypic hand behaviors interfering with function.</td></tr>
<tr><td>OUTCOMES
Decrease stereotypic hand behaviors.</td><td>Measures</td><td>Reliability</td><td>Validity</td><td>Outcome OT Terminology:</td><td>Outcomes ICDH-2 Terminology:
- Body function level
- Activity level</td></tr>
<tr><td>INTERVENTION</td><td>Description
Application of the hand splint.</td><td>Delivered by</td><td>Setting</td><td colspan="2">Frequency/Duration</td></tr>
<tr><td colspan="2">RESULTS</td><td colspan="4">Results demonstrated a significant decrease in stereotypic hand behaviors. One subject demonstrated an increase in finger feeding skills.</td></tr>
<tr><td colspan="2">CONCLUSIONS
Biases: ف Attention ف Drop outs
ف Masking/Binding
ف Contamination
ف Co-Intervention</td><td colspan="4">Measures, reliability, validity, and intervention were not described thoroughly.</td></tr>
</table>

Tuten, H. & Meidaner, J. (1989). Effect of Hand Splints on Stereotypic Hand Behavior of Girls with Rett Syndrome: A Replication Study. *Physical Therapy, 69*, 1099-1103.

Comments:

LEVEL OF EVIDENCE: IV-B-3-c	Single-subject design, with less than 20 subjects, low internal validity, and low external validity.				
RESEARCH OBJECTIVE:	A replication of Nanaguma and Billingsley's study, to determine the hand splints effectiveness in reducing stereotypic hand behaviors in children with Rett syndrome.				
DESIGN: ف RCT ف Single Case ف Case Control ف Cohort ف Before-After ف Cross-Sectional					
SAMPLING PROCEDURE: ف Random ف Consecutive ف Controlled ف Convenience					
SAMPLE: N= 2 M age=_____ Male_____ Female_____ Ethnicity=_____	Two 5-year-old children with Rett syndrome.				
Participant Characteristics Two 5-year-old children with Rett syndrome.	Medical Diagnosis/Disorder Rett Syndrome		OT Treatment Diagnosis Stereotypic hand behaviors interfering with function.		
OUTCOMES Decrease stereotypic hand behaviors.	Measures	Reliability	Validity	Outcome OT Terminology:	Outcomes ICDH-2 Terminology: - Body function level
INTERVENTION	Description Application of the hand splint.	Delivered by Therapist	Setting	Frequency/Duration	
RESULTS	No change was found in the occurrence of stereotypic hand behavior with the application of identical hand splints. No increase in purposeful hand movement was observed.				
CONCLUSIONS Biases: ف Attention ف Drop outs ف Masking/Binding ف Contamination ف Co-Intervention	More information needed on intervention, measures, reliability, validity, etc.				

Aron, M. (1990). The Use and Effectiveness of Elbow Splints in the Rett Syndrome. *Brain Development, 12*, 162-163.

Comments:

LEVEL OF EVIDENCE: NA-B-3-c	Narrative pre-experimental design, with less than 20 subjects, low internal validity, and low external validity.				
RESEARCH OBJECTIVE:	To evaluate the effectiveness of an elbow splint on decreasing stereotypic hand behaviors in children with Rett syndrome.				
DESIGN: ڤ RCT ڤ Single Case ڤ Case Control ڤ Cohort ڤ Before-After ڤ Cross-Sectional	Non-experimental passive observational design combined with a pre-experimental survey design.				
SAMPLING PROCEDURE: ڤ Random ڤ Consecutive ڤ Controlled ڤ Convenience					
SAMPLE: N= __8__ M age=_____ Male_____ Female_____ Ethnicity=_____	Eight subjects with Rett syndrome, ages 2-14 were include in the study.				
Participant Characteristics Eight subjects with Rett syndrome, ages 2-14 were include in the study.	Medical Diagnosis/Disorder Rett syndrome			OT Treatment Diagnosis Stereotypic hand behaviors interfering with function.	
OUTCOMES Decrease stereotypic hand behaviors.	Measures Parental interviews and clinical observations were used to monitor the occurrence of stereotypic hand behaviors.	Reliability	Validity	Outcome OT Terminology:	Outcomes ICDH-2 Terminology: - Body function level
INTERVENTION	Description Application of elbow splint that prevented elbow flexion and hand to mouth movements.	Delivered by Researcher	Setting	Frequency/Duration	
RESULTS	A decrease in hand-wringing behavior was reported in all 8 subjects and an increase in hand use was reported with one subject. Increased socialization and interaction within the environment was also reported.				
CONCLUSIONS Biases: ڤAttention ڤ Drop outs ڤMasking/Binding ڤContamination ڤCo-Intervention	No measurements for evaluating socialization, hand functioning, or environmental interaction were described. Responder bias may have had an effect.				

Spinal Cord Injury

Krajnik, S., & Bridle, M. (1992). Hand Splinting in Quadriplegia: Current Practice. *The American Journal of Occupational Therapy, 46*, 149-156.

Comments:

LEVEL OF EVIDENCE: NA-B-2-a	A non-experimental survey design was used, less than 20 respondents, with moderate internal validity, and high external validity.				
RESEARCH OBJECTIVE:	The purpose of the survey was to collect information about the application of hand splints. To determine the frequency and descriptive statistics focused on static and dynamic splinting, selection of splints, and evaluation of hand function.				
DESIGN: ف RCT ف Single Case ف Case Control ف Cohort ف Before-After ف Cross-Sectional	Non-experimental survey design.				
SAMPLING PROCEDURE: ف Random ف Consecutive ف Controlled ف Convenience	Survey sent out to occupational therapists working in spinal cord injury centers.				
SAMPLE: N= _____ M age=_____ Male_____ Female_____ Ethnicity=_____					
Participant Characteristics Respondents were occupational therapists working in spinal cord injury centers with individuals whose injuries are C-5 through C-8.	Medical Diagnosis/Disorder Spinal Cord Injuries		OT Treatment Diagnosis Functional limitations of the hand.		
OUTCOMES Determine frequency and descriptive statistics focused on static and dynamic splinting, selection of splints, and evaluation of hand function.	Measures Questions on the survey; Frequency of various types of splint use, wearing schedules, and reasons for not using a splint.	Reliability	Validity Use of statistical analysis of data.	Outcome OT Terminology:	Outcomes ICDH-2 Terminology: - Body function level - Participation level
INTERVENTION Upper extremity splinting	Description	Delivered by Therapists	Setting	Frequency/Duration	
RESULTS	Results indicated that static splinting was the most highly recommended splint used. Dynamic splinting was more frequently used with C-6 or C-7 spinal cord injuries by survey respondents. Resting hand splints were commonly recommended for C-5 and C-6 spinal cord injury patients. Short opponens splints were commonly recommended for clients with C-7 or C-8 spinal cord injuries. Resting hand splints wearing schedule was more likely to be during night time, and wrist supports or opponens splints wearing schedules were more likely to be during daytime. If an individual with C-5 spinal cord injury were to be fitted with a dynamic splint, it would most likely be the ratchet splint. Clients with C-6 spinal cord injuries were more likely to be dynamically splinted. Individuals with C-6 and C-7 spinal cord injuries were likely to be fitted with flexor hinge splints. Those with C-8 spinal cord injuries were more likely to be have static splints than dynamic, but if a				

	dynamic were utilized it would be the RIC tenodesis splint. The most commonly sited reason according to respondents for not using a splint was: patient non-compliance.
CONCLUSIONS Biases: ڤAttention ڤ Drop outs ڤMasking/Binding ڤContamination ڤCo-Intervention	Limitations include: responder biases. It is unknown if therapists saw children in during their practice.

Miscellaneous Splinting Research

Tatum, S. (2002). Lycra-based Splinting: Can it Really Help?. Retrieved November 6, 2003,

From http://www.scope.org.uk/

Comments:

<table>
<tr><td>LEVEL OF EVIDENCE:
I-A-2-b</td><td colspan="4">Randomized control trial?, with more than 20 subjects, moderate internal validity and moderate external validity.</td></tr>
<tr><td>RESEARCH OBJECTIVE:</td><td colspan="4">To investigate the effects of dynamic lycra-splinting on individuals with a range of movement disorders and clinical diagnoses.</td></tr>
<tr><td>DESIGN:
ف RCT ف Single Case
ف Case Control ف Cohort
ف Before-After
ف Cross-Sectional</td><td colspan="4"></td></tr>
<tr><td>SAMPLING PROCEDURE:
ف Random ف Consecutive
ف Controlled ف Convenience</td><td colspan="4"></td></tr>
<tr><td>SAMPLE:
N= _17__ M age=_____

Male_____ Female_____

Ethnicity=_____</td><td colspan="4">23 adults and 17 children with a range of movement disorders and clinical diagnoses.</td></tr>
<tr><td colspan="2">Participant Characteristics
23 adults and 17 children with a range of movement disorders and clinical diagnoses.</td><td colspan="2">Medical Diagnosis/Disorder
Varied</td><td colspan="2">OT Treatment Diagnosis</td></tr>
<tr><td>OUTCOMES
Determine range of activities that were important to the individual, & how the subject’s muscles were working. Decrease the level of help needed in activities. Increase the ease of splint usage. Improve perceptions of splint. Increase ability to sit, use a switch, walk, & use hands. Improve position of limb.</td><td>Measures
The Canadian Occupational Performance Measure was used to evaluate performance of functional activities and satisfaction with the activity performance. The OPCS disability scale was used to determine subjects overall disability score. A measure for spasticity was used but not</td><td>Reliability
Standardized tests demonstrate good validity (COPM and OPCS).</td><td>Validity
Statistical analysis of the data was used.</td><td>Outcome OT Terminology:</td><td>Outcomes ICDH-2 Terminology:
- Body function level

- Activity level

- Participation level</td></tr>
</table>

	described. Other measures were not described.				
INTERVENTION	Description	Delivered by	Setting	Frequency/Duration Subjects participated in a 7 month project, in which they wore the dynamic lycra-splint for 6 months.	
RESULTS	Significant improvements were indicated in both the performance and satisfaction scales of the COPM. Significant reduction in spasticity in certain muscles was achieved. Significant impact positively on the overall disability scale was also reported. Research indicates that lycra-based splinting is beneficial for a range of movement and clinical disorders. A positive impact on the ability to function was associated with the use of lycra-splinting.				
CONCLUSIONS Biases: ڤAttention ڤ Drop outs ڤMasking/Binding ڤContamination ڤCo-Intervention	In regards to level of help needed, an increase in developmental level with age may have had an effect (unless it was accounted for in data analysis not described). Extraneous variables were not described in this article.				

INDEX

Authors:

Diagnosis:

CHAPTER V;

SUMMARY & CONCLUSION

The purpose of this project was to identify effective splinting and wearing schedules for the pediatric population and create a quick reference manual for therapists to increase the use of evidence-based practice and better serve the pediatric population. Throughout this project a literature review was conducted to highlight the difference between children and adults, identify existing research to determine the effectiveness of splinting as well as pinpoint some of the compliance and adherence issues associated with splinting for children. No information was located on the most effective wearing schedule, however information on problems and possible solutions to improve compliance were recognized in the compliance/ adherence section of this scholarly project.

A moderate amount of research supporting the use of splinting for children with cerebral palsy was located. Less supportive research was located on the topics of: Rett syndrome, congenital malformations, juvenile rheumatoid arthritis, spinal cord injuries, and fractures. Problems identified in the literature review included an overall lack of strong empirical evidence supporting the use of splints with children due to flaws in early studies; a substantial deficiency of empirical research evidence supporting the use of splinting for children with diagnoses other than cerebral palsy; a need for easy access to research for use in evidence-based occupational therapy practice; and further research into the effectiveness of increasing compliance through measures suggested in the splinting adherence and compliance section of this scholarly project.

Suggestions to resolve the problems identified above include: conducting larger, more rigorous studies to examine splinting with children; conducting more studies that look at different diagnoses such as: Rett syndrome, congenital malformations, juvenile rheumatoid arthritis, etc.; increasing the ease in conducting studies through use of already set-up forms etc., increasing easy access to research through the use of OT Search, web sites, and quick reference booklets focused on specific subjects (for those without the use of computers); and an increase in studies examining compliance and adherence methods or programs for splinting.

The focus of Chapter IV in this project was aimed at resolving the problem associated with the need for access to research on splinting with children. The quick reference booklet was designed to help occupational therapists stay current on new techniques and research, support the use of a client-centered approach, promote professional competence and viability, increase the effectiveness of treatment in order to better serve the pediatric client, and provide the best quality of care. Limitations of this booklet included difficulty locating some of the research studies information resulting in omissions within article summaries. The booklet was also limited since new research studies recently being released will not be included. The research studies' information included in the summary may not be as accurate as summaries released by the authors themselves. Never the less, through the use of quick reference booklets such as the one developed in this scholarly project, evidence-based practice for occupational therapists will be enhanced. Ultimately, client care will be improved by the combination of occupational therapist knowledge, client-centered care, and application of current relevant research.

Appendix A;

LIEBERMANN & SCHEER FORM

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