

# Effectiveness of upper limb splinting for children with Cerebral Palsy.

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**Prepared by:** Kate Truman

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## **CLINICAL SCENARIO**

Approximately 7,000 people in New Zealand have some degree of cerebral palsy (CP), one third are under 21 years of age (Cerebral Palsy Society of New Zealand, 1984-2007). CP affects, movement, muscle tone, and coordination (Yamamoto, 2007). Children with CP may experience delayed motor development, this is seen through children using primitive patterns of grasping and lacking precise and coordinated movements (Yamamoto, 2007). Treatment should be specific to the child and their movement patterns and limitations of function (Danella & Vogtle, 1992). Splinting is used to enhance functional skills by supporting weak joints or to inhibit the effect of spastic muscles by holding the child's hand in a functional position (Geyer, Kurtz and Byarm, 1998). This allows children to improve grasp, manipulation and release. Different types of splints have different purposes. Yamamoto (2007) states resting or night splints are used to maintain range of motion, and soft splints/dynamic splints allow movement of the fingers and thumbs and are used during functional activities to reduce tone and promote typical patterns of movement. From the students knowledge Occupational Therapist (OT) are involved with customising splints for clients and some OT's have specialised in 'Hand Therapy'.

## **FOCUSSED CLINICAL QUESTION**

In children with Cerebral Palsy with hemiplegia does splinting of the hands, increase hand function.

## **SUMMARY of Search, 'Best' Evidence' appraised, and Key Findings**

There were a variety of studies on this topic many of them identified alternative treatments to splinting. The articles found were either systematic reviews or quantitative studies, no qualitative studies were found. Due to the Otago Polytechnic databases restrictions some articles PDF's were not available. Inter-loan forms were completed for three articles. The search terms used were very specific, more general terms such as; orthotics and splinting could have been used. Six articles were found relating to the focus question. The systematic review/met-analysis didn't have significant information on splinting to be included. Burter, Medora, Keene & Qualls (2008) found sufficient evidence supporting the

use of static and dynamic splints to prove the studies hypothesis. In contrast Steultjens, Dekker, Bouter, Van De Nes, Lambregts & Van De Ende (2004) found insufficient evidence supporting splinting. The key findings were that further evidence is needed to support the use of splinting to increase hand function.

**CLINICAL BOTTOM LINE**

There is varying evidence to support hand splinting will increase hand function for children with spastic hemiplegic CP. Therefore more research is required to evaluate the effectiveness of this intervention.

**LIMITATION OF THIS CAT**

This critical appraisal has been peer reviewed by one lecturer as part of an assignment.

**SEARCH STRATEGY**

**Terms used to guide search strategy:**

Patient/Client Group: “Cerebral Palsy” and Children, Intervention (or Assessment): “Hand splint\*” or “Upper limb splint\*” and Outcome(s): “Hand function”. It was not necessary to identify an age group as the majority of articles related to children. A manual search of all reference lists of all relevant articles found was also conducted. Additionally, a hand search of the Clinical Rehabilitation Journal was conducted.

Databases and sites searched	Search terms	Limits used
<ul style="list-style-type: none"> <li>• CINAHL with full text</li> <li>• Cochrane Library</li> <li>• OT seeker</li> <li>• Pro Quest 5000</li> </ul>	<p>“Cerebral Palsy” OR hemiplegia OR children            OR “Hand splint*” OR “Upper limb splint*” OR            “Hand function”            (Dependant of database specific terms and search method)</p>	<p>Nil</p>

**INCLUSION and EXCLUSION CRITERIA**

Inclusion:

Age of participants was 3-19.

Articles published in English

Diagnosed with Cerebral Palsy with hemiplegia of upper limbs

Intervention has the aim to increase function of the wrist/fingers (overall hand)

Exclusion:

Publications before the systematic review date.

Focus on casting as a splinting technique.

Focus on specific motor function rather than general.

## RESULTS OF SEARCH

Through searching databases, manual searching and hand searching six relevant studies were located and categorised as shown in Table 1 (based on Taylor, 2007, p. 15)

**Table 1: Summary of Study Designs of Articles retrieved**

<b>Study Design/ Methodology of Articles Retrieved</b>	<b>Level</b>	<b>Author (Year)</b>
Systematic review	1	Steultjens, Dekker, Bouter, Van De Nes, Lambregts & Van De Ende (2004)
Systematic review & met -analysis	1	Sakzewki, Ziviani & Boyd (2009)
Quantitative- Non-randomised experimental study	3	Burter, Medora, Keene & Qualls (2008)
Critical review	5	Teplicky, Law & Russell (2002)
Quantitative-	3	Reid & Sochaniwskyj (1992)
Quantitative-	3	Exner & Bonder (1983)

## BEST EVIDENCE

The following studies were identified as the 'best' evidence and selected for critical appraisal. Due to the requirements of the assignment two articles of different design either systematic review, quantitative and/or qualitative study needed to be chosen. There were no qualitative studies found. There were limited studies found specifically on hand splinting, other intervention techniques were preferred.

### 1. Burter, Medora, Keene & Qualls (2008)

This quantitative study was the most relevant in terms of the focus question. The study looked at testing two different types of splints (static and dynamic) and measuring 3 different aspects of hand function (grip, pincer and dexterity). This was also chosen because it was outside of the systematic review date, therefore not reviewed. Additionally, the author was an Occupational Therapist.

### 2. Steultjens, Dekker, Bouter, Van De Nes, Lambregts & Van De Ende (2004)

This was the only relevant systematic review found that was related to splinting. From the articles reviewed only three studies matched the inclusion/exclusion criteria of the critical appraisal, of these one study was identified in table 1.

## SUMMARY OF BEST EVIDENCE

### 1. Burter, Medora, Keene & Qualls (2008).

Law, Stewart, Pollock, Letts, Bosch & Westmorland. (1998). Guidelines for critical review/quantitative studies were followed for the critical appraisal.

<p><b>Study purpose:</b> Was the purpose stated clearly? Yes</p>	<p>The purpose of this study was to, “compare grip, pinch, dexterity, and EMG activity of selected upper extremity (UE) muscles while participants with and without CP wore no, static, and dynamic splints” (p. 37).</p>
<p><b>Literature</b> Was relevant background literature reviewed? Yes</p>	<p>The author used a significant amount of information regarding the clinical importance of the study. The author drew on nine different pieces of literature, predominantly journal articles just in the introduction. Significant research was completed regarding, previous studies completed relating to splints and muscle activation. To the authors knowledge there had been no studies completed about the specific topic of interest.</p>
<p><b>Design</b> Specific design not stated.</p>	<p>Quantitative Control group and experimental group. Participants were selected as a convenient sample.</p>
<p><b>Sample</b> N=15 Was the sample described in detail? Yes Was sample size justified? No</p>	<p>A convenience sampling method was used. The author did not justify why this was the case. Fifteen children enrolled in the study, of these ten were in the experimental group and 5 in the control group. Nothing was stated specifically justifying the sample size. The experimental group was recruited through the regional university rehabilitation hospital, local school district and private practice. These children had the diagnosis of spastic hemiplegia. The control group were recruited from schools/preschool. These children were in regular classrooms with good academic progress or in preschool settings with pre-academic development skills at age level. The experimental group was split into two those with left hemiplegia and right hemiplegia. This was because children with CP are only splinted on hands with spasticity so equal numbers of children with right and left</p>

	<p>hemiplegia were needed. The children ranged in age 4-13 years. There was no significant age difference between the groups. Informed consent was given from parents and assent was given from children older than seven.</p>
<p><b>Outcomes</b></p> <p>Were the outcome measures reliable? Yes and No</p> <p>Were the outcome measures valid? Yes</p>	<p>Two sessions were conducted by the research team. The second session was scheduled within a two-week period. Session one: the children were fitted with custom static and dynamic splints. Active and passive range of motion tests was conducted. Session two: testing session. EMG electrodes were placed on eight muscles measuring the maximum voluntary contractions while performing the; 1) grip strength (three repetitions), 2) lateral pinch (three repetitions) and 3) one trial (following one practise trial) of the peg test. The splints were used during the tests only and alternating splint/no split order was followed when testing. The author stated different functional activities could be used to more clearly understand splinting.</p>
<p><b>Intervention</b></p> <p>Intervention was described in detail? No</p> <p>Contamination was avoided? N/A</p> <p>Cointervention was avoided? Not addressed</p>	<p>The only information regarding the intervention was “children were fitted with custom static and dynamic splints, by the research team” (p. 38). The ‘research team’ was not elaborated on, therefore we did not know the number of people in the team or their qualifications. There was no information regarding how long the splints were to be worn for between the first and second session. The setting of the intervention was not detailed. Nothing was stated regarding participants using co-interventions. However, the study had detailed exclusion criteria that covered having previous treatments within the past six months. Nothing was stated regarding the present time. Both the grip and pinch strength measures were calibrated and procedures followed. Children’s norms were used for both measures. The adapted nine whole peg test, had no standardised norms to compare against, therefore the credibility of the test is reduced.</p>
<p><b>Results</b></p> <p>Results reported in terms of statistically significant? Yes</p>	<p>The author clearly stated the significance level was set at 0.05. More than appropriate statistical measures were used including; mean, standard deviation and log transformation. Due to the large number of out comes an ANOVA was required this also involved, a post hoc analysis to find patterns in the data. These can be classed as being two tailed statistical tests. The control group did</p>

<p>Were the analysis methods appropriate? Yes</p> <p>Clinical importance was reported? Yes</p>	<p>not have significant changes in grip, pinch or dexterity with either splinting condition. The CP group had greater grip and dexterity with the dynamic splint and greater pinch with no splints. Both control and CP group had less muscle activation with the static splints. These results support in part the author's hypothesis. The author made links to other research that found similar results.</p>
<p><b>Conclusion and Clinical Implications</b></p> <p>Conclusion was appropriate given the study methods and results? Yes</p>	<p>The author's findings were clear and valid. Reference is made to clinicians using the dynamic splints to enhance grip and dexterity. Caution is given when using static splints and the implications clearly stated. The author stated further investigation is needed to determine efficacy of the different splints over time and more functional activities used to have a clearer understanding of splinting.</p>

## 2. Steultjens, Dekker, Bouter, Van De Nes, Lambregts & Van De Ende (2004).

Taylor (2007) guidelines were followed for the critical appraisal.

<p><b>Aim/Objective of the Systematic Review</b></p> <p>To determine whether, "OT interventions improve functional ability and social participation for children with CP" (p.2).</p> <p><b>Study Design</b></p> <p>Systematic review</p> <p><b>Search Strategy</b></p> <p>The author searched the following databases; MEDLINE (1966 until June 2003), CINAHL (1982 until December 2002), EMBASE (1982 until December 2002), SCISEARCH (1974 until December 2002), AMED (1985 until December 2002), Cochrane Controlled Trails register, The Rehabilitation and Related Therapists (RRT) Field (Cochrane collaboration), and two Dutch libraries of medical rehabilitation literature (Dutch National Institute Allied Health Professions (NPI), Netherlands Institute for Health Service Research (NIVEL). Reference lists of all studies identified were scanned and the authors contacted to identify further studies.</p>
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## **Articles reviewed**

In total 1004 references of studies were found. After the initial search of titles and abstracts it was narrowed down to 128 full articles, of these, 47 studies were concerned with the efficacy of OT in children with CP. 17 of these articles fulfilled all four inclusion criteria, from these, 8 were randomised control trials (RCT)/ control clinical trials (CCT), and 9 of other design (OD). Of these final articles 4 were related to 'provision of splints', 1 RCT and 3 OD. The RCT was the only study that related to splinting, the others focussed on Lycra garments.

## **Selection criteria**

Inclusion criteria:

Efficacy studies with either a controlled design or a design other than controlled (OD's)

Intervention with children (<19 years) with clinically diagnosed Cerebral Palsy

Used outcome measures: functional ability or social participation, or process measures

Full-length publications or manuscripts.

Exclusion criteria:

Single subject design used

Children with diseases other than CP

Outcome measures not in scope of review

Low methodological quality

## **Method**

- The methodological quality of all studies was carried out by two independent reviewers (EMJS, BLML).
- For the RCTs and CCTs the criteria used was recommended by van Tulder, looking at internal validity and statistical criteria.
- Studies were high quality if at least six criteria were scored positively.
- For ODs the van Tulder criteria was modified by the authors. The modification included looking at descriptive criteria.
- Studies were sufficient quality if at least four criteria were met.
- Statistical calculations were carried out including standardised mean difference, variables and odds ratios with corresponding 95% confidence intervals.
- There was too much diversity in the results to do a met-analysis therefore, so a best-evidence synthesis was performed.
- The synthesis was based on van Tulder, but was modified to take into account the characteristic of the studies found.
- A sensitivity analysis was performed, excluding low-quality studies.

## **Results**

Of the four studies found relating to 'provision of splints' there was only one using splints as intervention. From this study they reported no significant differences in the motor skills outcome measure between three different splints. Therefore, there is insufficient evidence for the efficacy of splinting

## **Original Authors' Conclusions**

The author states inconclusive evidence for the efficacy of OT practise for children with CP was found. This is on the account of methodological flaws in original studies. The author identifies functional ability and social participation should be the main outcome measures. Future research is needed with emphasis on methodological quality issues, sample size and outcome measures.

## **CRITICAL APPRAISAL**

### **Are the results Valid?**

In order for a systematic review to be valid Taylor (2007), recommends a number of questions need to be answered. The review answered some of these questions, they are as followed; a clear focus of the systematic review was defined, a large amount of data bases searched, clear inclusion criteria stated, added an appendix of the methodological evaluation tool used. However, it did not state; who choose the search terms, what adaptations the medical librarian made, no alternative words were used for, validity and reliability of methodological evaluation tool.

### **What are the results?**

Taylor (2007) suggests questions to follow to rate the systematic review results. The review rates well according to these and well justifies the results found. No significant results were found regarding splinting, only one study had a significant p-value. This study used Lycra as an intervention so is not appropriate for the critical appraisal.

### **How will these results help me work with my client?**

Due to the limited studies involved the review did not highlight anything different that therapists would not already know. The author did highlight, future research should critically reflect on methodological issues such as homogeneity, sample size and outcome measures.

## **Summary/Conclusion**

The study found for all sections there is, inconclusive findings regarding the efficacy of OT for children with CP. This reflects the overall difficulty in efficacy research into OT for children with CP. From articles found relating to splinting only four can be linked with hand splinting, three of these being excluded because of insufficient methodological quality. The student chose not to focus on Lycra garments.

### **IMPLICATIONS FOR PRACTICE, EDUCATION and FUTURE RESEARCH**

The evidence identified, supports and refutes, that splinting is significant in increasing hand function in children with spastic hemiplegic CP. The evidence indicates that further research is necessary. Future research should focus on different types of splints being worn while carrying out functional activities.

The study by Burter, Medora, Keene & Qualls (2008) showed statistical significant results. The test measures used (apart from the adapted nine whole peg test) were standardised assessments typically used when measuring improvements in hand functioning. The critical appraisal identified limitations as; having a short intervention period, small sample size, and not using functional activity as the assessment for the study.

The systematic review by Steultjens, Dekker, Bouter, Van De Nes, Lambregts & Van De Ende (2004) lacked sufficient credibility due to the studies methodology, sample size and outcome measure issues. The study found insufficient evidence. Additionally, throughout the study, links were made to OT's and how the studies will affect the profession.

The level of evidence found in this appraisal is not sufficient enough to be used to make decisions on hand splinting in practice. Relevance to OT practice, the research findings provided the clinical message that further research is needed. The research highlights that OT's in the past and present are involved in using splints to treat children with spastic hemiplegic CP. Therefore, OT's need to be competent in using splinting as an intervention technique. OT's need to use their clinical judgement along side this research to make the best choice if splinting is appropriate for the client. Due to the lack of findings OT's may benefit from looking at alternative interventions of care that show greater overall significance in increasing hand function of children with spastic hemiplegia CP.

There is limited empirical evidence supporting splint use, leading to continued controversies as to the efficacy of splint use: whether or not to splint, how long to wear a splint, and what type of splint design to use. Despite these controversies, splinting remains a practise that is used to treat children with spastic hemiplegic CP.

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