

The effectiveness of splinting or casting as a sole intervention, for upper limb function in children with cerebral palsy.

Prepared by: Philippa Prebble

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CLINICAL SCENARIO: Orthosis or splints are commonly used to address physical impairments or disabilities (Deshaies, 2008). These are often used alongside progressive casting to treat spasticity in conditions such as cerebral palsy (CP) (Yamamoto, 2007). CP affects approximately 2 out of 1000 children (<http://www.cpsoc.org.nz/>) often resulting in muscle tone abnormalities such as spasticity, hypotonicity or fluctuating tone. Although splinting is used by physicians, physical therapists and other health professionals, it is the occupational therapists who are usually involved in recommending the appropriate orthoses or casting in order to enable occupational performance (Deshaies, 2008).

FOCUSSED CLINICAL QUESTION:

In children with cerebral palsy, is the use of splints or casting effective as a sole intervention in improving upper limb function?

SUMMARY:

Although this is a common area of practice, the search results gave little strong quantitative evidence in this area; with most results either being for splinting with a combination of other treatments or focusing on areas not involving the upper limbs. Most evidence was also from a medical or physical therapy perspective, with little from an occupational therapy viewpoint. From the evidence found, two studies were chosen as best evidence: A single subject study by Goodman & Bazyk (1991) and a literature review of systematic reviews by Autti-Ramo et al. (2006). Both studies came to the conclusion that although there is evidence of some positive effects of the sole use of splinting or casting on upper limb function, it is limited in its strength and further research is clearly needed.

CLINICAL BOTTOM LINE:

There is limited evidence to support the notion that splinting or casting alone is an effective intervention in improving upper limb function in children with cerebral palsy; however there is no evidence to show that it is ineffective.

Limitation of this CAT: This critical appraisal has been peer-reviewed by one lecturer as part of an assignment.

SEARCH STRATEGY:

Databases and sites searched	Search Terms	Limits used	Results
CINAHL	"cerebral palsy" + splint* + child*	- Boolean/ phrase - English - Peer reviewed - Research article	15
Pubmed Central	"cerebral palsy" and splinting	- None	55
Pubmed	"cerebral palsy" + splint* + child*	- Meta analysis - RCT - Clinical trials - English language - Ages 0-18yrs	9
OT Seeker	"cerebral palsy" + splint*	- Paediatric/ adolescence.	0 direct hits 36 near matches.
Proquest Central	"cerebral palsy" + splint* + child*	- Scholarly journals	6
Google scholar	"cerebral palsy" + splint + "occupational therapy"	- None	1290

Although searching using a limit of 'full text only' is an option in many databases, it was chosen not to use this, as it gave a wider variety of results and often complete articles could be located via article linker or a manual search of journals located in library. Manual searching of reference lists in various articles was also completed.

INCLUSION and EXCLUSION CRITERIA

- **Inclusion:**

- Diagnosis of cerebral palsy
- Children aged 0-18yrs
- Included hand function in outcome measures.
- Included splinting or casting as intervention
- Full text version easily accessible on line or through journals available in the Bill Robertson Library, Otago Polytechnic

- **Exclusion:**

- Treatment of other neurological conditions such as stroke with splints
- Adults 18yrs and above.
- Splinting combined with other treatments such as Botox as interventions
- Studies focusing solely on lower limb function

RESULTS OF SEARCH

Table 1: Summary of Study Designs of Articles retrieved

Study Design/ Methodology of Articles Retrieved	Level (Based on Taylor (2007))	Author (Year)
Quantitative - Multiple single subject design	3	Corn, Imms, Timewell, Carter, Collins, Dubbeld, Schubiger & Froude (2003).
Literature review of systematic reviews *	1	Autti-Ramo, Suoranta, Auttila, Malmivaova & Makela (2006)
Review (Not systematic)	N/A	Teplicky, Law & Russell (2002).
Quantitative - AB single subject design *	3	Goodman & Bazyk (1991)

Quantitative - Pre test/ post test pilot study	3	Reid (1992)
Quantitative - RCT	2	Blair, Ballantyne, Horsman & Chauval (1995)

* = Articles chosen for critical review.

BEST EVIDENCE

The following studies were identified as the 'best' evidence and selected for critical appraisal:

- Autti-Ramo et al. (2006): This was chosen as a systematic review, as it provides the highest level (level one) of evidence from all articles available and is relatively recent. Although it is a literature review, it looks at systematic reviews therefore it has been chosen as it gives an overview of all research available.
- Goodman & Bazyk (1991): This was chosen, as although it is not the highest level of quantitative evidence found; it best addresses the clinical question, is applicable to occupational therapy and was able to be accessed easily.

SUMMARY OF BEST EVIDENCE

Study One: *The effects of a short thumb opponens splint on hand function in cerebral palsy: A single-subject study* by Goodman, G. & Bazyk, S. (1991).

Aim/Objective of the Study/Systematic Review: "To objectively measure the effects of a short thumb opponens splint on hand function and on the underlying aspects of hand function in a child with moderate spastic quadriplegia" (pp727).

Study Design: AB single subject research design.

Setting: The study was undertaken by researchers from the Cleveland State University, USA; however the testing was done in the subjects' home.

Participants: N = 1. As the study was a single subject design, the only participant was a four year old female with cerebral palsy, who had moderate spastic quadriplegia with greater hyper tonicity on the left side

Method: The treatment was carried out by the authors of the paper. Prior to the study, two sessions were spent with the subject to practice evaluations and establish rapport. Baseline data was then collected from the subject prior to treatment, over a 4 week period with two sessions a week. The treatment consisted of a volar-type short thumb splint, made specifically for the test subject (pp728). It was to be worn for three hours in the morning, three hours in the evening and all night. Evaluation data was collected twice weekly, using the same testing methods as the baseline data, over a four week period. The splint was not worn during the evaluation process.

Outcome Measures: The following tests were used to measure performance before and after treatment:

- Active range of motion of carpometacarpal joint in radial abduction, palmar abduction and opposition.
- Assessment of grip strength with the Martin Vigorimeter.
- Assessment of tip, lateral and palmar pinch with the B & L Pinch Gauge
- Scores on the Box and Block Test of manual dexterity.
- The average number of 1-in cubes stacked in three trials.
- Observation of qualitative aspects of prehension with the Erhardt Developmental Prehension Assessment and photographs.

Results: One of the main results to appear was that the child's performance was inconsistent across testing, with none of the variables contained 80% of the scores within 15% of the mean (pp. 729). However, after analysis, looking at the slope, trend and levels of the data (pp.729), it was concluded that there was a "significant increase in underlying aspects of hand function and in hand function following the application and wearing of a short thumb opponens splint" (pp. 730). Areas such as active palmar abduction, radial abduction, opposition and grasp strength all showed significant improvement and there were positive changes in the results of the Box and Block Test and cube stacking. The only area that did not significantly improve was in the palmar and tip pinch strength.

Original Authors' Conclusions: The authors conclude that for this child, the use of the short thumb opponens splint did improve hand function after four weeks of splint wear. However, they acknowledge that further studies are required, with larger sample sizes; before the results can be generalised to other children with cerebral palsy.

Critical Appraisal:

Validity: Using guidelines from Law et al. (1997), the following areas have been looked at to address validity of the study:

Did the trial address a clearly focused issue?

The study has a clear aim stated, along with a hypothesis of an increase of underlying aspects of hand function and in hand function along with qualitative changes in grasp patterns (pp. 727).

Background literature:

In order to define the topic, the authors used limited references; however they identified five studies that look at the effects of splinting on spasticity, most of which concentrate on adults and none of which used objective measures to show changes in hand function. They did provide a detailed description of the most relevant trial, looking at the benefits of the thumb opponens splint; but also clearly identified that very few other studies have objectively measured the splints effectiveness.

Study design:

The use of an AB single subject design was chosen as the study had time constraints, which restricted using more complex single subject designs. However, as Law et al. (1998) states, this design method can mean that it is difficult to conclude that treatment alone resulted in changes, as other factors in the subjects life may change over time (pp. 3). The authors also identify this as a limitation to the study as it “limits the ability to make causal inferences from the results” (pp. 731).

Biases: Law et al. (1998) defines three types of biases as being sample, measurement and intervention biases. There is a possibility of a small sample bias, as no information is given as to how the child was recruited for the study. There was potential for measurement biases to occur, which the authors avoided by using a wide range of outcome measures, with two researchers present when evaluation was being completed. No mention was also made of any other co-interventions occurring during this period, such as physical or occupational therapy, or medications. This could also influence results.

Ethics: Although the researchers are based within a university setting, no mention was made of ethical procedures around this study, which could be questioned as the research involved children. It may have not been included as the study was conducted at a time when ethical requirements were different to today.

Outcome measures:

The outcome measures used had standardised instructions and norms for children were used to eliminate experimenter bias and provide accurate measurements. The authors did identify that the outcome measures were chosen as they “were found to be the most objective and

standardized tests available for the variables being studied” (pp. 728); however no mention is made of their validity or reliability.

Intervention:

The study was described in depth, detailing the subject, how the splint was made, outcome measures used, length of time of study and how data was analysed. From this information, it could easily be replicated; however aspects may need to be altered, as they were designed for the specific individual studied, especially if using a larger sample size.

Results:

The results were analysed by looking at the variability of scores from the mean for the baseline and treatment data, individually and as a whole. The auto correlation coefficients were also computed for each variable. Celeration lines were computed to further quantitatively analyse the data and provide a visual analysis (pp. 729). The data was looked at in terms of changes in slope, trend and level and changes presented in table form, with the clinical significance highlighted in this and the text. Although the results are judged to be statistically significant, there is no presence of standard statistical tests, such as t-tests, to show probability of such results.

Summary:

In conclusion, although the results of the study were positive, there were aspects of this study that could lead to its clinical significance being questioned. The authors openly acknowledged the design limitations and small sample size; however the data analysis techniques could also be questioned, along with the lack of ethical procedures. The study does provide a positive outcome for the use of splinting in children with cerebral palsy; however it does not justify the use of splinting as a sole intervention without further study.

Study Two: *Effectiveness of upper and lower limb casting and orthoses in children with cerebral palsy: An overview of review articles* by Autti-Ramo, Suoranta, Anttila, Malmivaara & Makela (2006).

Aim/Objective: “To identify systematically gathered information on the effectiveness of using casting and orthoses in children with cerebral palsy, to see whether this information can be of help in clinical decision making and in producing evidence based guidelines” (pp.90).

Study Design: A review of systematic reviews.

Search strategy: Databases searched: MEDLINE, PreMEDLINE, the Cochrane central register of Controlled Trials, the Cochrane Database of Systematic Reviews, the Database of Abstracts of Reviews of Effects (DARE), the ACP Journal Club, CINAHL and PEDro.

Search terms: “cerebral palsy” and “exp. orthotic devices” were used individually. The PEDro database was searched using “cerebral palsy” and “review”. A parallel search using “cerebral palsy” combined with various physiotherapy terms such as ‘bobath’ or ‘positioning’ was also done using the same databases (pp.90).

Inclusion/ Exclusion criteria:

Altogether there were 55 articles located from both searches. All titles and abstracts were reviewed by two of the authors and classified according to inclusion criteria, which are not stated in the final review. However, the following exclusion criteria were identified:

- Other interventions – such as physical therapy or Botulinum toxin type A.
- Descriptive reviews
- Retrospective studies
- Case studies
- Insufficient search methods or inclusion/ exclusion criteria given.

From these 55 studies, 23 were deemed potentially relevant and full studies were assessed in-depth. Five were taken to be part of the review (pp. 90).

Setting: The review authors are all doctors, affiliated to the Finish Office for Health Technology Assessment (FinOHTA).

Method: Using a predetermined data extraction sheet, the authors analysed each systematic review, looking at validation of the reviews, synthesis, results, conclusions and application. Two other researches also extracted data on the original study designs within the systematic

reviews such as the type of orthotic intervention, the number of patients and the outcomes (pp. 94). Each review was given a methodological quality score, based on the search and selection methods, validity assessment and synthesis. The data from the results of each review was then analysed, using a qualitative approach. They only used results that were presented in summary tables and had been published as full, peer review articles. From this information, evidence as to the effectiveness of casting and orthoses was looked at from both the reviewers' conclusions and from the researchers own analysis of results from the original studies.

Results: The authors summarised the results according to intervention type:

- Lower limb casting: it was concluded that it does have a short term effect on the passive range of ankle dorsiflexion.
- Lower limb orthoses: evidence for the use of orthoses to prevent deformities is lacking and there is weak evidence that they improve function; however this is not helped by the many different designs and materials used.
- Upper limb casting: may have a short term effect on quality and range of movement when combined with physical or occupational therapy interventions, but “unclear whether the effect is clinically important”.
- Upper limb orthoses: Suggests that the type of splint or orthosis should be task specific, but the effect on hand function or play has not been studied.

Original Authors' Conclusions: The authors concluded that although there is good evidence for a positive short term effect of lower limb casting; there was a distinct lack of evidence on the use of upper and lower limb orthoses in children with cerebral palsy. They also identified that there was a lack of “original, well-designed and long term studies” (pp. 102).

Critical Appraisal:

Validity:

Did the review address a clearly focused issue?

The authors clearly identified their issue that was being addresses as well as the objective of the review. They offered a short explanation on cerebral palsy and the use of casting and orthoses, which was backed up with relevant literature.

Included studies:

All studies included addressed the issue of casting or splinting in children with cerebral palsy and were systematic reviews, which provide a high level of evidence; however the authors identified that the quality of the studies was obscure and the inclusion/ exclusion criteria of

many could be questioned. The use of the review by Teplicky et al. (2002) could also be questioned, as this appears to be a critical or literature review.

Inclusion/ exclusion criteria:

Although the inclusion criteria were not clearly stated, the reason for the exclusion of articles was presented clearly in a table form. Details of the reviews included were also provided in a table form, which shows the materials and methods used. Two researchers were used to identify articles, using a predetermined inclusion criteria based on prior evidence, which prevented any bias. No language or date restrictions were in place, therefore covering all possible studies available. To assess the methodological quality, the authors used a modified quality scale which gave each study a methodological quality score. From this, it can be seen that only one of the five studies has a strong methodological score, which could influence results.

Interpretation of Results:

The authors clearly identified that as a result of the review, no quantitative data was found in the original studies of the five systematic reviews; therefore no statistical evidence is provided to compare studies. A qualitative review of the findings is presented base on each type of intervention; which although is not strong evidence, does identify the data from the reviews and a short conclusion of each intervention is presented.

Conclusions/ recommendations:

The design and quality of the systematic reviews studied made it difficult for the authors to draw clear conclusions, which they do acknowledge. However they did identify the key results of each intervention, along with the limitations that may have affected results such as orthoses design. As a result of this, they have provided a clear set of recommendations for future research in this area.

Summary:

In conclusion, although the methods of the review were valid, standard measures for reviewing the data such as meta-analysis, was unable to be used as the information was found to be mainly qualitative. The strength of the clinical usefulness of the review can then be questioned, as although it provides a good overview of personal experiences of the intervention, it does not provide strong evidence into its use; however it does clearly identify the need for more research into this area.

IMPLICATIONS FOR PRACTICE, EDUCATION and FUTURE RESEARCH

Although it is a commonly used intervention, the evidence for the use of casts or orthoses in children with cerebral palsy is not strong. Both studies reviewed identified that there were benefits to upper limb function; however each has aspects of the research methodology that could be questioned. There is a clear need for stronger, more quantitative research in this area; with both studies identifying the need for more long term research in order to gauge better functional gains. As it is an area of practice that is used by both physical and occupational therapists, this lack of clear research and guidelines could result in interdisciplinary differences in the use of the intervention, resulting in confusion for both therapists and patients. The lack of clear guidelines can also influence treatment due to the large number of different casts and splints available to use, with more therapists relying on personal experience and clinical judgement solely, rather than incorporating evidence based practice; in order to choose the best option for their client. However, there was no evidence against the use of splinting, therefore it can be seen to still be useful in the treatment of spasticity in cerebral palsy, but care is needed with its use. This critical appraisal focused solely on the use of splinting or casting alone as an intervention; however there is further research into the use of these alongside techniques such as Botox or surgery, which has not been addressed but could provide further evidence into its use.

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