



Effectiveness of Helmet Therapy in Infants with Positional Skull Deformity: A Literature Review

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Review Article

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ABSTRACT

Background: Positional skull deformity usually manifests during first six months of life due to various factors like premature births or multiple births, improper positioning of infant's head as the head of an infant is softer than the older children's head, thus leading to either positional brachycephaly or positional plagiocephaly. Early helmet therapy intervention may improve the shape of the skull by reducing the risk of secondary cosmetic and nervous system complications.

Aim: To study the effectiveness of helmet therapy in infants with positional skull deformity.

Methods: The data source for this literature review is done by studying and reviewing articles through various data like Pub Med, Google Scholar, science direct, Elsevier and medicine Cochrane library.

Conclusion: Helmet therapy is contemplated to be effective in the treatment of mild-moderate-severe positional skull deformity than repositioning therapy by improving the structure of the misshaped skull, as well as the use of helmet therapy is reviewed not to hinder the head circumference growth in infants.

Keywords: *Helmet therapy; moulding orthosis; positional skull deformity; brachycephaly; plagiocephaly; cranial orthosis; flat head syndrome.*

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1. INTRODUCTION

Positional skull deformity (PSD) is a deformity in which the occiput is flattened with consistent facial asymmetry. There are mainly two types of PSD namely deformational /positional plagiocephaly and deformational/positional brachycephaly. Plagiocephaly is a deformity where in the head of an infant can become flattened on one side, causing the head to appear asymmetrical and distorted. Brachycephaly is a deformity in which the entire back of head can become flattened, leading to widening of the head and sometimes the forward-facing part of the skull may bulge out in compensation to it [1,2]. Positional skull deformities are considered to be among the most frequently encountered difficulties during the child growth and development, especially in infants below 6 months of age. Its worldwide incidence rates are extremely low; thus, it requires a comprehensive diagnosis and various other examinations. The prevalence of PSD has augmented in the meantime after the launch of the American academy of paediatrics "Back to sleep" campaign in 1992-which recommends that the infants should be made to sleep in the supine position in order to avert sudden infant death syndrome. PSD might be considered as one of the sources for shifting of the eyes and ears, or one-sided temple (forehead) protrusions, ensuing in facial asymmetry. Such facial variations may persevere, often leading to mistreatment of the children in their later span of lives, thus undesirably affecting their psychological health. Infants with severe form of PSD may also have ear-nose-throat dysfunction (ENTD) or in some cases an accompanying damage of the nervous system development or increased pressure on brain, causing them serious harm. Recent clinical researches have indicated that maximum mild to moderate PSD can be recuperated to normal or be suggestively revised by repositioning therapy at the initial phases in infants (within 4 months of birth). The former PSD is identified, better will be the correction impact and lower the expense. With an upsurge in an infant's age, the solidity of the skull expands, the assortment of head movements rises and is problematic to control, and the trouble of correction will be abundant. For moderate and severe PSD after 4 months of age, the child may have to wear a helmet or undergo remedial surgical procedure in rare cases, which will enormously expand the expense of therapy, discomfort (for the infant) and burden on the family. Along these lines, it is critical to identify and correct PSD in early

infancy [3]. Helmet therapy also identified as "cranial orthosis" is a form of therapy wherein an infant is tailored with a special helmet to precise the shape of the skull. Helmet therapy is generally not aching or uncomfortable for the infants if the helmet is fitted properly. Extent of the therapy can differ based on the infant's requirements. These helmets are made out of a firm external shell and a foam internal area that places mild, reliable pressure in order to reshape the skull [4]. The use of repositioning therapy in the treatment of PSD has shown to be effective in case of infants below 6 months of age, whereas helmet therapy is said to be more effective and has shown more favourable outcomes when compared to repositioning therapy. It seems to isolate out peripheral factors that intensifies the risk of repositioning therapy failure (for example: in case of infants more than 4 months of age, helmet therapy is more reliable than repositioning therapy as the infant's skull starts to harden and the head movements increases [1]. The determination of the study is to review various literature to analyse the effectiveness of helmet therapy in infants with positional skull deformity.

2. METHODOLOGY

2.1 Design

Literature review.

2.2 Search Strategy

The search was conducted in the electronic data bases of PubMed, Science direct, Google Scholar, Elsevier, Medicine Cochrane Library since 2011-2020.

2.3 Search Criteria

The search yielded 55 studies of which 23 were pertinent to the study and was involved throughout the review, supplementary sources were sought to simplify the issues, from this search articles specifically the effects of helmet therapy in infants with positional skull deformity were included.

2.3.1 Inclusion criteria

Systemic reviews, randomised controlled trial (RCT), case study, differential studies done on positional skull deformity and studies in which helmet therapy is utilized for infants with brachycephaly and plagiocephaly is been included.

Table 1. Review of literatures

| Author | Title of the article and year | Methodology | Conclusion |
|--|--|---|--|
| 1. M Kelly Edward F Joganic, Stephen P Beals, Jeff A Riggs, Mary Kay and Timothy R [5] | Helmet Treatment of Infants with Deformational Brachycephaly (2018) | The study population included of 4205 infants with brachycephaly and these infants were separated into 3 groups, the groups were divided on the source of entrance age of cranial orthosis treatment. | The study concluded by saying that, lesser the entrance age of the infant (less than 9 months) for the treatment, shorter will be the duration of the helmet therapy. |
| 2. Renske M Van Wijk, Leo A Van, Catharina G M, Catharina P B Van, Maarten J and Magda M Boere [6] | Helmet therapy in infants with positional skull deformation: randomised controlled trial (2014) | 84 infants aged 5 to 6 months with moderate to severe skull deformation were involved in the study out of which 42 infants were allocated to helmet therapy and the rest 42 to natural course of the condition. Contrast was made after 6 months between both the group of infants. | On the source of equal effectiveness of both helmet therapy and the natural course, the study resolved by stating there was added side effects in case infants treated with helmet therapy and thus the helmet therapy for infants with PSD was discouraged. |
| 3. Juan Wen, Jun Qian, Lei Zhang, Chenbo Ji, Xirong Guo, Xia Chi and Meiling Tong [1] | Effect of helmet therapy in the treatment of positional head deformity (2020) | Totally 376 infants of age 2-40 months were analysed with positional skull deformity and involved in the study out of 110 infants were treated with helmet therapy and the rest with postural correction training. | The study concluded by stating that helmet therapy is useful in the treatment of mild-moderate-severe positional skull deformity. |
| 4. Mandeep S Tamber, Dimitrios N, Alexandra B, Lisa C Baird, David F, Susan Durham, Paul K, Alexander Y, Catherine Mazzalo, Cathaeine McClung, Rachana T and Ann Marie [7] | Congress of Neurological Surgeons Systematic Review and Evidence-Based Guideline on the Role of Cranial Molding Orthosis | a systemic review intended for the management of positional plagiocephaly, for which studies meeting the inclusion standards were designated and an evidentiary table was made which briefed the study's result. | The conclusion of the studies stated that helmet therapy showed effective and faster improvement of severe cranial asymmetry in infants with positional plagiocephaly when treated during early infancy than in infants treated with conservative therapy. |
| 5. Han-Su Yoo, Dong Kyun Rah and Yong Oock Kim [2] | Outcome Analysis of Cranial Molding Therapy in Nonsynostotic Plagiocephaly (2012) | Totally 108 infants with plagiocephaly were included in the studies who underwent helmet therapy and these infants were classified into various groups on the basis of age of initiation of therapy, severity of the condition and compliance of the patient. | Article stated that helmet therapy is effective in the treatment of plagiocephaly and the duration of the helmet therapy must be more than 20 hours per day. |
| 6. Patricia Mortenson, Paul Steinbok and David Smith [8] | Deformational plagiocephaly and orthotic treatment: indications and limitations (2012) | A literature review was directed to recapitulate existing suggestion supporting anticipatory measures and re-positional and orthotic interferences. | The conclusion of the study stated that for a good outcome utilization of repositioning therapy is needed in young infants and helmet therapy should be initiated for infants with severe DP at the age of 4-6 months. |
| 7. Mi-hyang Han, Jin Young Kang, Hye Young Han, Yun-hwa Cho and Dae-Hyun Jang [9] | Relationship between starting age of cranial-remolding-orthosis therapy and effectiveness of treatment in children with deformational plagiocephaly (2013) | Totally 310 infants with DP were involved in the studies who were divided into different groups on the basis of their age. | The study concluded by stating that an infant whose is below 5 months of age is a perfect candidate to undergo cranial-remolding-orthosis therapy for DP. |
| 8. Hyehoon Choi, Seong Hoon Lim, Joon Sung Kim and Bo Young Hong [10] | Outcome Analysis of the Effects of Helmet Therapy in Infants with Brachycephaly (2020) | In total 207 infants of 3-4 months of age with cranial index (CI) >90% who also availed helmet therapy for approximately 3 years by following the therapy principles were involved in the study. | The article reported that helmet therapy may be effective in treating infants with severe brachycephaly aged 3-14 months. |

2.3.2 Exclusion criteria

Articles on observational studies, published in any other language other than English and articles without full text format were excluded.

3. RESULTS AND DISCUSSION

Positional skull deformity is a condition characterized by the flattening of an infant's head which may be caused due to continuous pressure on one spot of the head [11] and various prenatal, perinatal, and postnatal factors such as primiparous mother, obstetric intervention (forceps, ventouse), multiple births, premature births, little tummy time, torticollis and many more [12]. An infant's skull is considered to be softer than the older children because they are malleable to help ease them through the birth canal. A softer skull is a normal part of the development, but any pressure on it can lead to a change in the shape of the head [11,12]. They are mainly of 2 types that are plagiocephaly which results in unilateral flattening in the parieto-occipital region and brachycephaly that is symmetrical flattening of the back of the head (frontal bossing) [11,13]. The diagnosis of the positional skull deformity is mainly done through the physical findings and radiological findings. In physical findings, the examiner has to look down to the top of the infant's head, view the position of the ears, and note the position of cheekbones (maxilla). By doing this, the typical plagiocephalic feature that is the parallelogram shape of the head along with unilateral bossing and a typical brachycephalic feature that is frontal bossing can be ruled out. Along with this an assessment of the neck should be made to check for the presence of torticollis as it may lead to restricted head movements along with the flattened head shape. Radiological findings of the positional skull deformity mainly involve skull radiographs, CT scan which is used to identify any deformed structures of the skull; cranial vault asymmetry and cranial vault asymmetry index helps to obtain a three-dimensional image of the skull with the diagonal diameter of the skull which helps in determining the positional skull deformity [11,12,14]. Prevention of positional skull deformity can be started during the antenatal period by providing the parents with counseling regarding childbirth, followed by after birth prevention which involves frequent changing of head position by providing sensory stimulus to the infant (tactile, visual, auditory), by increasing the tummy time and positioning the infant sideways during interaction with parents, avoiding the prolonged use of car seaters and by

limiting the use of blankets and swaddles that restricts the movement [14]. For the treatment of the positional skull deformity helmet therapy, repositioning therapy and physical therapy are the foremost therapeutic choices that are available. Repositioning therapy here mainly focuses on avoiding pressure on the flattened part of the head and positioning the rounded side of the infant's head-dependent against the mattress [14,15]. Physical therapy is mainly prescribed when the infant has reduced neck mobility and this mainly occurs when positional skull deformity is associated with torticollis, in situation a pediatric physical therapist performs and teaches the parents or the caregivers the exercises that will precise the shortening of sternocleidomastoid muscles, that is the correction of torticollis [1,16]. Helmet therapy is mostly used or seen as beneficial when both repositioning therapy and physical therapy lack in showing desirable response. Helmet therapy mainly involves daily wearing of customized cranial orthotic molding helmet for around 23 hours a day with exception of one hour for bathing and cleaning purpose for infant's who are below 8 months of age, [17,18] these helmets relieve the heaviness on the flattened part of the skull and permits the skull to grow in the anticipated directions [1]. These commissioned orthotic helmets are made of high-temperature thermoplastic resources and lined with high density, hypoallergic therapeutic graded foam, and this helmet mold is made by taking a three-dimensional laser image of the infant's head [8]. One main factor about the helmet is that it should be adjusted or changed each time the head grows [1]. In some rare cases, the usage of the orthotic helmet has shown various side effects such as skin rashes, pain is been noticed in few infants, sweating, the odor of the helmet, and the infant would cry for more than 10-15 minutes due to irritation, waking up more than 4 times a night, but when the infant's get adapted to the usage of the helmet the side effects also seemed to reduce [6]. According to the 8 reviewed literature in this study, 7 of their results presume that the use of an orthotic helmet or the helmet therapy has been well-thought-out to be effective in managing the positional skull deformity in infants and has shown desired outcomes that is the re-shaping of the skull into its near to normal shape.

4. CONCLUSION

Positional skull deformity is the clinical manifestation is seen in infants due to multiple or

premature births, improper positioning of the infant's head due to which pressure is been imposed more on one side of the head, and reduced tummy time, which further causes the misshaping of the structure of the head that is either leading to positional brachycephaly or positional plagiocephaly. Reviewed studies conclude that helmet therapy successfully helps in correcting positional skull deformities and it seems to insulate out the exterior factors that upsurge the risk of conservative therapy failure. After reviewing the various literature, we conclude that helmet therapy is useful in the complete correction of PSD providing that the treatment is initiated while brain growth is enduring and infants are compliant.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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