THE NEW ZEALAND MEDICAL JOURNAL
Vol 116 No 1181 ISSN 1175 8716

Correction of deformational auricular anomalies by moulding – results of a fast-track service

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Abstract

Aim To report on the result of a fast-track referral service in treating deformational auricular anomalies using moulding therapy, by employing nurses who were familiar with the indications and technique, working in close liaison with plastic surgeons.

Methods A deformational auricular anomaly is defined as an ear having normal chondrocutaneous components but an abnormal architecture; therefore, it can be manipulated digitally to a normal shape. Having demonstrated the value of auricular moulding therapy to our neonatal practitioners, we established a fast-track referral and treatment protocol for infants with deformational auricular anomalies. Treatment was initiated promptly by one of four nurses. The type and severity of the auricular anomaly were documented both clinically and photographically before and three months following cessation of treatment. Assessment of the results was made by comparing the pre- and post-treatment photographs and by a postal questionnaire, which was dispatched to the parents of the patients three months after treatment was discontinued.

Results Sixteen male and 14 female patients, aged between one day and 15 weeks (mean 24 days) with 44 deformational auricular anomalies, underwent moulding therapy. Complete correction or marked improvement was achieved in 26 patients (87%) with 38 ears (86%) while slight or no improvement occurred in 4 patients (6 ears), following one to 14 (mean 7) weeks of moulding. Questionnaires were returned by the parents of 24 patients (80%). According to the parents' assessment, complete correction or marked improvement occurred in 29 of 35 anomalous ears (83%) in 20 of these 24 patients (83%). All parents felt that auricular moulding was worthwhile.

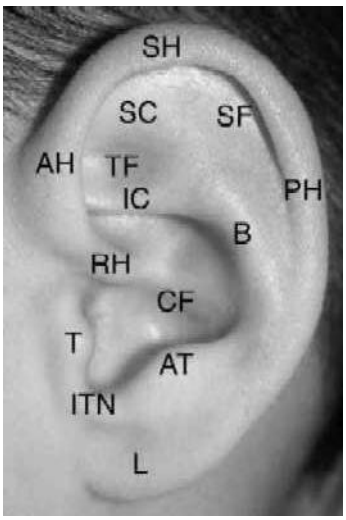
Conclusions Deformational auricular anomalies should be treated non-surgically with moulding therapy. For this treatment to be effective, it should be initiated in the first three months of life. Parental persistence with the treatment is essential for a satisfactory outcome. A fast-track referral service, employing nurses who form the first point of contact and work in close association with a plastic surgery service, is an effective treatment strategy that will largely negate the need for surgical correction of deformational auricular anomalies.

The ear or the auricle consists of a complex, convoluted, yellow elastic cartilage framework that is covered with hairless skin. The convoluted prominences and concavities of the underlying cartilage give rise to the characteristic topographic anatomy of the human ear (Figure 1).[1]

The helix is the most external portion of the auricle. It consists of the root, anterior, superior and posterior portions. The lobule consists of fibro-fatty tissue and does not contain cartilage. The antihelix, which separates the concha from the helix, is a Y-shaped structure consisting of a body inferiorly and two crura superiorly. The body of

the antihelix blends into the antitragus, which is sited superior to the lobule. The antitragus is separated from the tragus by the intertragic notch. The tragus is located anterior and lateral to the external auditory canal, thus partly obscuring it. The scaphoid fossa lies between the superior crus and the body of the antihelix anteriorly and the helix posteriorly. The crura of the antihelix and anterior part of the helix form the boundaries of the triangular fossa.[1]

Figure 1. The topographic anatomy of the human ear (RH = root of the helix; CF = conchal fossa; AH = anterior portion of the helix; IC = inferior crus of the antihelix; SC = superior crus of the antihelix; SH = superior portion of the helix; PH = posterior portion of the helix; L = lobule; B = body of the antihelix; AT = antitragus; T = tragus; ITN = intertragic notch; SF = scaphoid fossa; TF = triangular fossa)



There are at least 40 descriptive and eponymous terms used to categorise congenital auricular anomalies.[1] This heterogeneous group of anomalies should be classified as either malformational (eg, auricular tags and sinuses, anotia, microtia and cleft ear) or deformational (eg, lop, cup, Stahl's, kinked and prominent ear).[1,2] Malformations are structural abnormalities that result from abnormal embryological development. Deformation is caused by abnormal physical forces applied to a normal structure, which may occur in utero or following birth. Similarly, a malformed ear may be subjected to deformational forces.[1] The majority of congenital auricular anomalies are deformational in nature.[1]

A deformational auricular anomaly can be simply defined as an ear having normal chondrocutaneous components but with an abnormal architecture; therefore, it can be manipulated digitally to a normal shape.[1,2] These auricular anomalies usually affect the helix and antihelix, although occasionally the deformation is confined to the conchal fossa.[2]

Conventionally, both malformational and deformational auricular anomalies are corrected surgically when the ear has adequately grown,[2] although with variable

results[3,4] and significant complication rates.[2] Moulding therapy is effective for deformational[2,5–8] and certain malformational[9] auricular anomalies. Although this simple, effective and inexpensive technique has been available for over 20 years, its wider acceptance in Western countries has occurred only relatively recently.[7,8]

For a satisfactory outcome, moulding therapy should be initiated within the first three months of life.[2,7] However, children with congenital auricular anomalies are normally referred 'routinely' to the plastic surgery service and the narrow 'window of golden opportunity' for moulding is often missed. Having demonstrated the value of auricular moulding therapy to our neonatal paediatricians, family doctors, and midwives, we have established a fast-track referral and treatment protocol for infants with deformational auricular anomalies. This report presents, prospectively, the results of our approach.

Methods

Protocol The protocol aimed at identifying newborn infants with deformational auricular anomalies with a view to early correction with moulding therapy. These patients were referred by our neonatal paediatricians, general practitioners, and community midwives through a fast-track referral service established at the Department of Plastic & Reconstructive Surgery, Radcliffe Infirmary, Oxford, England and the Wellington Regional Plastic, Maxillofacial & Burns Unit, Wellington, New Zealand. During the study period, several children with malformational auricular anomalies were referred for treatment. These children were excluded from this study.

The obstetric, perinatal and family history and associated anomalies, if present, were recorded and managed appropriately. The type and severity of the auricular anomaly were documented both clinically and photographically. Moulding therapy was offered to these children and was initiated promptly by one of four nurses who were familiar with the indications and technique of this treatment.

Technique Various materials have been used for auricular moulding.[2,5,7–10] We utilised a simple splint fabricated by inserting a piece of lead-free solder (Multicore Solders Ltd, UK) within an 8 French polyethylene suction catheter (Figure 2).[2,7] The splint was customised for each ear with its length determined by the extent of the deformity. It was applied to the eave of the helical rim and secured to the ear with Steri-Strips (3M, St Paul, MN) to maintain the ear in the corrected position (Figure 3). In addition, the ear was taped to the mastoid scalp if it was protruding (Figure 4). The parents of the infants under treatment were taught the moulding technique and were given an information sheet outlining the treatment protocol. They were instructed to inspect and reshape the splint and replace the adhesive tapes if necessary after each feed. The splint was replaced weekly and the parents were asked to observe for skin irritation or ulceration. Treatment was maintained until satisfactory correction was achieved and continued for a further week, or discontinued if no improvement was observed after four weeks of continuous moulding.

The infant was reviewed by a nurse weekly for two weeks, at one month and then monthly for up to three months. The nurses provided the point of contact for the parents and arranged for a routine plastic surgical review whenever necessary.

Figure 2. A simple splint consisting of a lead-free soldering wire and an 8 French suction catheter. The length of this device is dependent on the extent of the auricular deformity being corrected, a short splint being used to correct a localised deformity, and a longer splint required for a more extensive anomaly.

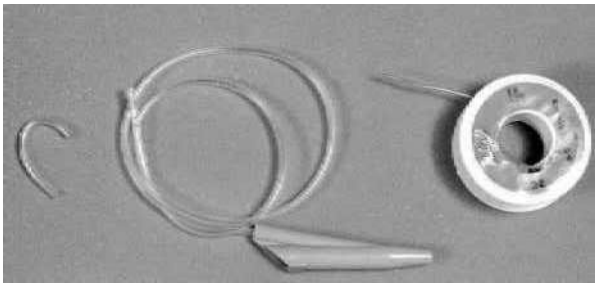


Figure 3. Bilateral cup ear anomaly in a one-week-old boy. (A) The more severely affected right ear was corrected (B) with a long splint. (C) Improvement after three months of moulding (result = 'marked improvement').

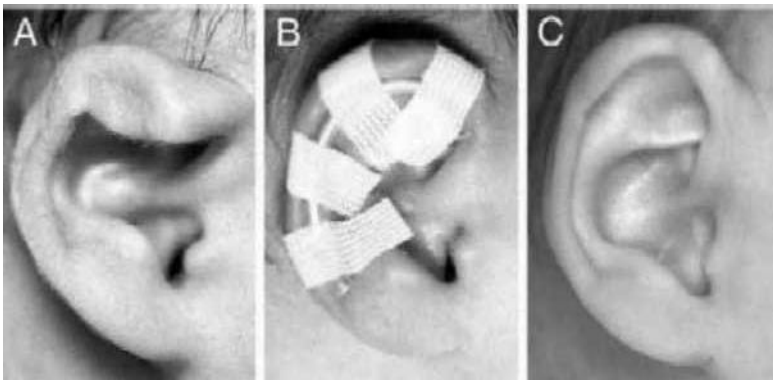
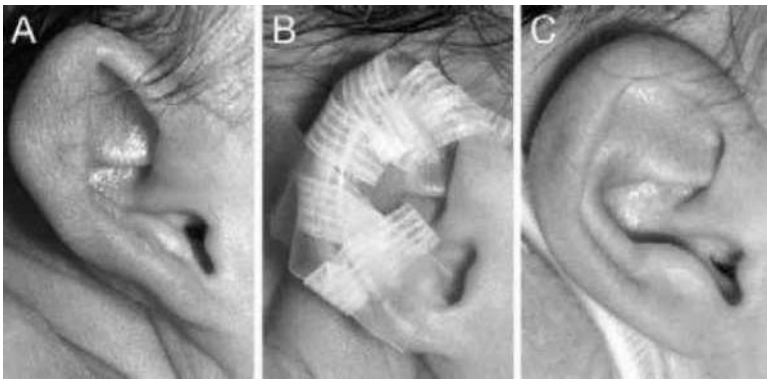


Figure 4. (A) Right-sided prominent ear with absent antihelical fold in a two-week-old child born five weeks prematurely (B) treated with a splint and taping of the ear to the mastoid scalp. (C) Excellent result (with creation of antihelical fold and reduction of distance between the helical rim and scalp from 3.0 to 1.2 cm) after 16 weeks of treatment (result = 'marked improvement').



Assessment Clinical and photographic documentation of the auricular anomaly was obtained prior to the commencement of treatment and three months following completion of moulding therapy. The result of treatment was assessed by comparing pre- and post-treatment photographs and graded as: 1 = complete correction; 2 = marked improvement; 3 = slight or no improvement. A postal questionnaire was also dispatched to the parents of the patients three months following cessation of therapy. The parents were asked to score the results using the grading described above. They were also asked to indicate whether the moulding technique was 'easy', 'difficult', or 'very difficult'. To help us evaluate parents' satisfaction with the therapy, they were asked if the treatment was worthwhile and whether they would recommend it to other children with a similar auricular anomaly.

Results

Thirty consecutive children (16 boys and 14 girls) with 44 deformational auricular anomalies were the subject of this report. The auricular anomalies affected the right side, left side and both sides in 9, 7 and 14 children respectively. There were 17 lop ears (11 patients), 14 prominent ears (10 patients), 8 cup ears (6 patients), and 5 kinked ears (3 patients).

Nineteen children were full term, 2 were one week overdue and 9 children were born prematurely (11, 5, 3 and 1 weeks premature in 1, 3, 2 and 3 infants respectively). Ten children had associated obstetric problems (mild gestational hypertension in 4, oligohydramnios in 1, gestational diabetes in 1, breech delivery in 2, and birth by Caesarean section in 2). Associated anomalies included distal hypospadias in one child and respiratory distress syndrome in another. Five of the 10 children with prominent ear(s) had a positive family history of the anomaly.

Moulding therapy was initiated between one day and 15 weeks (mean 24 days) after birth and treatment was maintained for one to 14 (mean 7) weeks. The children were followed up for 5 to 11 (mean 8) months. An excellent result was achieved in 13 children (19 ears) and marked improvement occurred in 13 children (19 ears) (Figures 3–6). Slight or no improvement occurred in 4 patients (6 ears). In the last group, treatment was interrupted by systemic illness in one child and was associated with poor compliance in the remainder. In two of these patients, treatment was initiated at 15 and 10 weeks respectively and these children removed the splints repeatedly.

Figure 5. (A) Left-sided lop ear in a three-day-old child moulded for three weeks (B) with improvement (result = 'marked improvement').

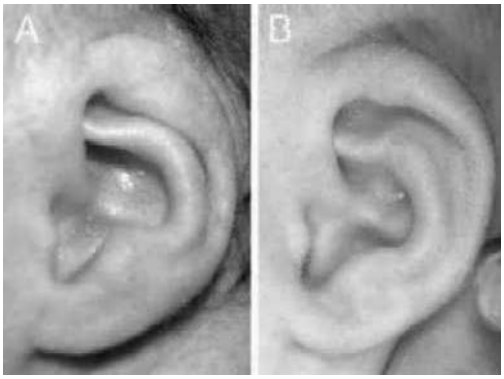
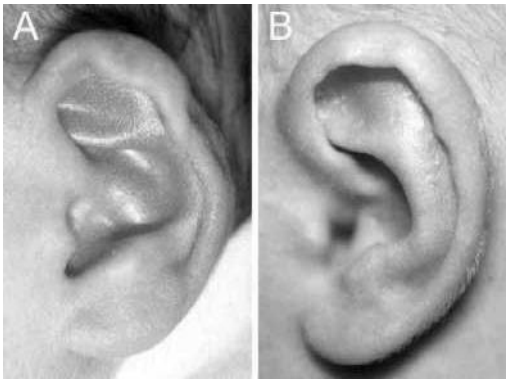


Figure 6. (A) The more severely affected left side of a three-day-old child with bilateral kinked ear deformity splinted for three weeks (B) with improvement (result = 'marked improvement').



Complications included skin irritation in 4 children (4 ears) requiring temporary cessation of moulding therapy. No skin ulceration occurred and no relapse of the anomaly was observed during the follow-up period.

Twenty four of the 30 questionnaires (80%) were returned by the parents of the children treated. According to the parents' assessment, 'excellent result' was achieved in 10 patients (14 ears), 'marked improvement' occurred in 10 patients (15 ears) and 'slight or no improvement' in 4 patients (6 ears). The parents of 19 children felt that the moulding technique was 'easy'; 4 found it 'difficult' while one indicated that the technique was 'very difficult'. All the parents of these 24 children felt that moulding therapy was worthwhile and would recommended the treatment for other children with similar auricular anomalies.

Discussion

Splinting has been successfully used for correction of congenital dislocation of the hip,[7] club foot,[11] and cleft lip nasal deformity.[12] The neonatal auricular cartilage is very pliable and lacks elasticity immediately after birth. However, within a few days the ears become more elastic and firm,[10] a fact that has been attributed to a decreasing circulating (maternal) oestrogen level in the neonate.[13] The levels of circulating free oestradiol are highest during the first 72 hours after birth and decrease rapidly thereafter, reaching the levels similar to those of older children by six weeks of age.[14] Cartilage elasticity is dependent upon its proteoglycan concentration.[15] Hyaluronic acid, an important constituent, is increased by oestrogen and is responsible for the malleable nature of the neonatal ear.[16] It is during this earlier neonatal period that deformational and certain malformational auricular anomalies can be moulded, so early treatment is critical for success.[2,7,10,12,16] We have noted that children who are breast-fed require an extended period of treatment, due to the ear cartilage remaining pliable for longer,[2] presumably because of persistent elevated levels of oestrogen.

Although pleasing results can be obtained with surgical correction of congenital auricular anomalies, significant complications and morbidity may occur including pain and emotional trauma associated with the anomaly and its surgical correction.[7] Many auricular deformities (such as lop ear, Stahl's ear, cryptotia, and kinked ear) are

difficult to correct surgically, and results are often disappointing.[7] Auricular moulding is the treatment of choice for deformational auricular anomalies.[1] However, the narrow window of opportunity for treatment is often missed because of late referral and hence this technique has not become widely accepted in Western countries.[7]

One of the reasons for late referral may be the impression that auricular anomalies in neonates correct spontaneously with age. Although there has been a Japanese longitudinal study showing that the incidence of some auricular anomalies decreases whilst that of some others increases with age, it was not possible to predict which of the anomalies would resolve spontaneously.[6] It is also not clear if very minor anomalies were included in the study. The authors of the present study have not observed complete spontaneous correction of auricular anomalies amongst the cohort of patients referred to the service. With our current knowledge, it seems reasonably to carry out non-surgical correction on all deformities that are significant and treatable.[7]

Parental persistence with the treatment is essential for a satisfactory outcome as shown in our series. Good results can be obtained, often within a short period if moulding is initiated soon after birth.[2,6–8,10] However, a longer duration of treatment is required for more complex anomalies or if the treatment is delayed.[2,6–8,10]

Although auricular moulding has been shown to be effective until up to six months of age in the one Japanese study,[6] our experience generally shows that it is largely ineffective if initiated after three months of age.[7] This is partly related to the less pliable nature of the auricular cartilage in older children and also partly because it is more difficult to apply and maintain the splint adequately in these children because of poor cooperation, as seen in two of our patients.

Moulding therapy can also be useful in certain malformational auricular anomalies that have been subjected to deformational forces,[1] although the treatment is unlikely to completely correct the anomaly. Nevertheless, it forms a useful adjunct that may minimise the extent of future surgery.

Different materials have been used to achieve auricular moulding.[2,5,7–10] The simple device used in this study is malleable and its large calibre reduces the risk of pressure necrosis. Skin irritation occurred in four children requiring temporary cessation of moulding. Once taught, the parents were happy to replace the splint and the majority of the parents managed the technique satisfactorily.

Congenital auricular anomalies may be associated with other abnormalities.[7] The auricular anomaly should not be treated in isolation and any associated anomalies should be evaluated and managed appropriately.

Auricular moulding is simple, non-invasive, effective, and it can be done without anaesthetic and at low cost. Deformational auricular anomaly should be treated non-surgically during the early neonatal period, long before the child becomes aware of the anomaly. It is hoped that the emotional disturbance[17] that may occur in these children and the need for surgical correction can be largely avoided in the future.

Deformational auricular anomalies are not a surgical problem but rather a paediatric public health issue.[1] Our neonatal paediatricians, obstetricians, family doctors and midwives should be encouraged to manage these anomalies so that the use of this technique will become widespread.[1]

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Acknowledgements: We thank Dr P Hope and his colleagues in the Paediatric Department at the John Radcliffe Hospital, Oxford, England, for their support.

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