Ear Deformations in Preterm Newborns: Non-Surgical Treatment

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Abstract: Approximately 30% of newborns have some degree of congenital ear anomalies, the minority will resolve spontaneously. Deformations can be treated non-surgically, when diagnosed early, whereas malformations surgically only. The authors use the EarWell system proven to achieve excellent results in treating deformations. Although prematurity might raise the risk of ear-deformations compared to term infants, in our experience, there is a longer time frame until effective treatment is initiated due to the cartilage malleability.

Treatment included splinting with retractors and taping or a custom-made silicone ear-mold if necessary. Patients were examined weekly, and treatment continued until appropriate ear shape was achieved (6–14 weeks).

The authors treated 8 preterm infants during 2018 to 2020 with the above method. Average age of application was 9.25 weeks; treatment was initiated in all patients before the age of 12 weeks. 5/8 had a right-side, 2/8 a left-side, and one a bilateral deformation. Average treatment duration was 10 ± 2.9 weeks. Assessment of satisfaction was made by parents via phone questionnaires; most were pleased with the overall result, while 62% were extremely satisfied.

The authors observed higher compliance and longer-lasting malleability of the cartilage in preterm compared to term-infants. They also had fewer complications than in the term group, maybe due to their older (actual age), and more resistant and durable skin compared to a term-infant of the same age. The authors recommend initiating treatment in preterm infants later than accepted practice as results were excellent, and despite the longer treatment duration, this is a better treatment option than surgery.

Key Words: Cartilage malleability, ear deformations, ear molding, non-surgical treatment, preterm newborns

Congenital ear malformations and deformations are common; approximately 30% of newborns will have some degree of auricle anomaly, 1 out of which 15% to 20% will resolve spontaneously. 2 While malformation is characterized by abnormal embryologic development of the auricle with missing or excess anatomic structures, or an otherwise anomalous pinna, deformation is characterized by fully developed auricular components (full pinna) and can be manually corrected into normal shape. 3 Malformations can be treated by surgical means, whereas deformations may be treatable using a nonsurgical approach.

Common deformations include helical rim anomalies, prominent ear, lidding/lop ear, Stahl ear, conchal struc/crus, and cryptotia 4; whereas common malformations include constriction, cleft ear and microtia. 5 When diagnosed early, the majority of ear deformations can be treated conservatively 6 by molding or splinting, with satisfactory results in the first weeks of life. Some believe this non-surgical treatment modality is possible up to age 3 months, 8 yet we know that estrogen, which is responsible for plasticity and malleability of the auricular cartilage through increased levels of hyaluronic acid in the newborn, peaks within 72 hours from birth, then decreases until returning to its baseline after 4 days. 9 Therefore, the ideal timing for this non-surgical treatment is in the first week of life, up to 2 weeks. Success rates decrease and length of treatment increases when initiation of treatment is delayed. 10

If, for any reason, treatment is delayed beyond 3 to 6 months of age, the non-surgical treatment is mostly ineffective; and surgical treatment should be delayed until the child is ≥6 years old, which still results in a higher rate of complications, psychological and social issues, recurrence, and greater cost. 11

With regard to conservative treatments, first described in 1980, 12 all require light, malleable, inexpensive, and non-irritating 13 materials; such as surgical tapes, foams, and wires. 6, 12 The authors use different, case specific techniques for nonsurgical treatment. In particular, the EarWell infant ear correction system (Becon Medical, Naperville, IL) has proven to achieve excellent results in treating deformations, 7 and reduces severity of some malformations. 8 This is a painless appliance that corrects infant ear deformations after 4 to 6 weeks of treatment. It is made of 4 interlocking components which together shape the ear, including: the posterior shell (large frame piece connected by adhesive to the scalp, which fits around the ear), conchal former (shapes the conchal bowl of the ear), retractors (smaller pieces of a soft rubber which gently shape the ear into the desired position/shape), and a lid (whose outer section consists of soft breathable rubber that snaps on to hold all components securely in place.

A preterm is an infant born before 37 weeks of gestation, which can be subdivided into: extremely preterm (weeks 22–27), very preterm (weeks 27–32), moderately preterm (weeks 32–35), and late preterm (weeks 35–37). 14 Prematurity might affect risk of ear deformations, though this has not been quantified. Statistically significant factors include vaginal birth compared to cesarean delivery, premature rupture of membranes, abnormal pregnancy, and neonatal weight over 4000 g. 15

In our clinical experience there is a longer time frame until effective treatment is initiated for premature infants with ear deformations, compared to term infants. In other words, it is possible to start later with premature infants and still achieve effective treatment. Based on clinical observations, we assume that preterm cartilage is more compliant and malleable than the cartilage in term newborns, and therefore easier to treat.
This clinical characteristic of ear cartilage is supported by other findings in the literature. It has been proven that trachea cartilage is extremely compliant in preterm lambs$^{16}$ and rabbits,$^{17}$ compared to adult cartilage. Both the ring complex and cartilage alone were found to be more compliant in preterm lambs compared to adult sheep. These age-related differences were also observed in tracheal smooth muscle and tracheal mechanics, which may reflect an increase in stiffness that occurs in both components with maturation.$^{18}$ Furthermore, clinically it has been observed that infants with tracheomalacia usually demonstrate clinical improvement in 6 to 12 months as the cartilage matures and become more rigid with age.$^{19}$

There are 3 different types of cartilaginous tissue in the human body$^{20}$: hyaline cartilage, found in the trachea, nose and ribs; elastic cartilage, found in the larynx, epiglottis and external ear; and fibrous cartilage, found in ligaments, joints and vertebral discs. Larynx cartilage, which resembles auricle cartilage, was found to change with age and is more elastic at younger age of prematurity.$^{21}$ We observed delay in cartilage maturation that could be explained by examining ossification points such as the humerus, where it was found radiologically that mineral accrual is mainly determined by development in utero and that prematurity induces a halt in the bone development process in the early post-natal period, which also correlates with severity of prematurity.$^{22}$ This finding has also been described in bones in general, with decreased bone loading in preterm infants,$^{23,24}$ also referred to as metabolic bone disease of prematurity.$^{25}$

**MATERIALS AND METHODS**

All preterm infants were screened by a pediatrician upon their hospitalization discharge, while referral criteria were evidence to an ear deformation, and discharge from the neonatal intensive care unit. Criteria for treatment were referral criteria and parents' consent (all patients' parents signed written informed consent forms).

In general, non-surgical treatment with the EarWell system starts as early as possible (Fig. 1), preferably in the first days of life and minimally during the first 2 weeks; but in our study cohort it was started later, at least 6 weeks from birth (preterm infants who started treatment before that were not included in the study cohort).

Based on the size of the auricle, a medium or large size system was selected for handling. We began by splinting with retractors according to the specific deformation, and subsequently, based on deformation improvement, decided if additional treatment with taping or a custom-made silicone ear mold (Azoft; Detax, Ettingen, Germany) was required. Custom-made molds were fabricated, applied, and contoured onto the ear once they became firm.

Patients were examined in our clinic weekly, mainly for follow up of deformation improvement and treatment adjustments, and to rule out adverse effects. Antibiotic ointment and local dressings were applied to any wounds or ulcers, and in most cases, treatment continued as planned. In cases of a significant ulcer, we recommended stopping the protocol and treating the wound (Fig. 2).

Treatment with the EarWell system continued until the ear shape was appropriate. In most cases, follow-up treatment was solely with retractors and taping, and if needed, followed by silicone molding or posterior taping, resulting in an aesthetic and natural appearance after a total treatment length of 6 to 14 weeks.

**RESULTS**

During 2018 to 2020, we treated eight preterm infant patients exhibiting congenital ear deformations with the method described above. Average age of application in our study cohort was 9.25 weeks (average corrected age 0.37 weeks) and treatment was initiated in all patients before the age of 12 weeks (corrected age 4 weeks). Aging premature infants is done using an adjusted or “corrected” age, by subtracting the number of weeks by which the infant was premature from the unadjusted (postnatal) age, to estimate the age of the infant had they been born at term.$^{26}$

Half of the infants were females; 5/8 had a right-side, 2/8 a left-side, and one a bilateral deformation. Average treatment duration was 10 $\pm$ 2.9 weeks.

There were no significant complications during the treatment period, excluding local dermatitis in some patients, which is an adverse effect of the treatment rather than a complication (Supplementary Digital Content, Table 1, http://links.lww.com/SCS/B594).
Assessment of satisfaction was made by parents via phone questionnaires; most were pleased with the overall result, while 62% were extremely satisfied (Fig. 3).

**DISCUSSION**

Auricular congenital deformations are common and it is crucial to diagnose them early, preferably in the first few days of life, in order to avoid unnecessary surgeries and distress for the families, and later for the patients. Since only 30% of deformations resolve spontaneously, health care providers examining newborns should be able to diagnose and explain to the parents the conditions and the importance in treating it immediately following birth. Cases should be referred as soon as possible in order to preserve the possibility of a non-surgical treatment approach and achieve desired results in shorter treatment periods. This can be explained by the malleability of the premature infant cartilage, due to the initial high estrogen and hyaluronic acid levels. But in preterm infants we observed the application age was significantly older compared to when treatment was initiated in term infants (9.25 versus 2 weeks) which illustrates the higher compliance and longer-lasting malleability of the cartilage. However, preterm infants had fewer complications than in the term group, maybe due to their older (actual age), and more resistant and durable skin compared to a term infant of the same age.

When questioning parents why have they waited so long (compared to term infants’ parents in our experience and other studies), it appears that while they noticed the deformation as early as term infants’ parents, it was very low in their priorities (aesthetic problem), compared to other health issues of their preterm infant. We assume that a great deal of parents have ignored the pediatrician referral for treatment, since they did not understand the significance of early treatment and they assumed the deformations will resolve spontaneously even though the pediatrician explained them the low chance for it.

Based on our results, it is possible to initiate treatment in preterm infants later than accepted practice (ie, beyond the age of 1–2 months) as results were excellent with few adverse effects (Fig. 4). Despite the longer treatment duration, this is a better treatment option than surgery.

**REFERENCES**


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