Lop Ear to Conchal Microtia

An Algorithmic Surgical Approach

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Background: The lop ear deformity is defined by a deficient helix and scapha, underdeveloped anthelix, and downfolding of the helix. The terminology used is still confusing, and the treatment is not entirely structured. The aim of this study was to provide a new systematic surgical approach of this deformity based on our center's experience.
Materials and Methods: All patients undergoing surgical correction of lop ears between 2007 and 2019 at Great Ormond Street Hospital were included. Patients' data, surgical techniques, and postoperative complications were recorded.
Results: Based on our records, we identified 3 surgical techniques for the correction of lop ears, based on the degree of deformity encountered. In a mild lop ear, correction was achieved with a modified otoplasty technique by improving the definition of the antihelix and superior crus. In a moderate deformity, additional remodeling of the lidded helix was performed (extended otoplasty), whereas for the severe lop ear, the amount of cupping and the deficient cartilage required formal reconstruction using a carved rib cartilage framework. There were a total of 109 patients and 146 lop ears: 58 mild, 27 moderate, and 61 severe lop ears.
Conclusion: We feel that there is a point in the spectrum of congenital ear deformity when a severe lop ear becomes a conchal microtia and recommend this approach to simplify the management of these cases. This is intended to bring greater clarity to how to deal with lop ears, based on the severity of the deformity and the surgical techniques used.

Key Words: lop ear, extended otoplasty, modified otoplasty, cartilage reconstruction

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The lop ear refers to a congenital malformation of the ear defined by the downward folding of the helix at the level of the tuberculum auriculae (Darwin tubercle), as well as the deficiency of the helix and scapha. These findings are usually accompanied by an underdevelopment of the antihelix, especially affecting the superior crus.[1] The terminology used for this type of malformation has been confusing, and there are still medical professionals using the term lop ear for many congenital malformations. However, the fact that the underdeveloped antihelix is a common feature found in lop ears, cup ears, and protruding ears is recognized by many authors.[2–5] This might explain why these terms have been used interchangeably for such a long period. We feel that there is a point in the spectrum of congenital ear deformity when a severe lop ear becomes a milder conchal microtia, and this can lead to confusion in nomenclature, classification, and how to approach these cases.

One of the most used classification of lop ears was proposed by Tanzer.[6] He recommended the term *constricted ears* and classified them based on the involved structures: type I, helix only; type II, helix and scapha (A, sufficient skin; B, supplemental skin needed); and type III, extreme cupping of the ear. Although type I appears to involve only the helix in the original description, there is always a certain degree of anomaly of the scapha and the superior crus of the antihelix. Even though authors like Cosman[7] disregard type III and exclude it from the lop ear classification, we, along with Nagata,[8] consider it the most severe form of lop ear, treating it as a form of conchal microtia. Park and Park[9] refer to the most severe cases of lop ears as microtias with constricted ear features and treat them accordingly.

The aim of this study was to ratify a new systematic surgical approach for the treatment of the lop ear deformity based on the experience from our center.

PATIENTS AND METHODS

All the patients undergoing surgical correction of lop ears between 2007 and 2019 at Great Ormond Street Hospital were included in this study. Patients' demographic data and preoperative photographs were recorded, including surgical technique and postoperative complications like wound healing problems, relapse, suture extrusion, and hypertrophic or keloid scars. Revision rate was also recorded. These data were used to create a surgical algorithm for the treatment of lop ears based on the surgical techniques used. The study was conducted according to the Declaration of Helsinki principles and was approved by the local Research Ethics Committees.

Surgical Techniques

Modified Otoplasty

A cartilage-suturing technique, based on a modified Mustardé technique, accompanied sometimes by modified Furnas sutures was used. The technique was described extensively by the senior author.[10] We will just briefly mention the important steps: the Mustardé-type sutures were placed between concha and scapha to define the antihelix and especially the superior crus. The Furnas type conchal-mastoid sutures were normally used, and the decision was made intraoperatively based on the need for a setback of the ear. The suture used was nonabsorbable braided 4-0 Ethibond (Ethicon, Inc., Sommerville, NJ). At the end of the procedure, the skin was closed with a running 5-0 Vicryl Rapid (Ethicon, Inc., Sommerville, N.J.), leaving the last 5 mm of the wound open to act as a passive drain. The postoperative dressing with nonadherent gauze, cotton wool padding, and circumferential head bandage was removed 2 to 4 days after the procedure.

Extended Otoplasty

When the lop ear deformity also involved lidding of the helix, additional steps were taken to address this deformity. The modified otoplasty technique was used, with slight modifications. The extent of lateral dissection of the skin off the cartilage was carried out over the

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FIGURE 1. A, Lidded helix exposed after soft-tissue dissection. B, Excision of the lidded helix. C, Reinforcement of the helix with the excised cartilage (the white arrow indicates the excised cartilage used to reinforce the helix). full color online

helical rim, until the entire lidded helix was exposed (Fig. 1A). The additional cartilage causing the lidding was excised from the edge of the helix, ensuring a smooth contour of the helix with the surrounding cartilage (Fig. 1B). In cases where the structural support offered by the remaining cartilage was too weak, the excised cartilage was used to supplement and reinforce the remaining helix. The piece of cartilage was sutured to the soft cartilage with polydioxanone (PDS, Ethicon, Inc., Sommerville, NJ) 4-0 suture, being placed on the lateral side of the helix, in front of the remaining framework (Fig. 1C). In these cases, the postoperative dressing included additionally a tie-over bolster in the new helical sulcus with nonadeherent gauze fixed with Prolene 4-0. This was removed 2 to 4 days postoperative, along with the normal dressing.

Cartilage Reconstruction

In cases where the auricular cartilage was not enough for the remodeling of the lop ear, a new cartilage framework was used for the reconstruction of the ear. The harvesting of the autologous cartilage and the reconstruction of the donor site, which was performed in each patient to minimize the morbidity, have been described before.[11,12] A type II (no tragus) or III (no tragus and no antitragus) framework similar to Firmin and Marchac[13] was carved, depending on the necessity to include the antitragus or not, because the tragus is normally present. A Firmin type 3a skin approach was used, if there was sufficient skin and retroauricular sulcus was therefore preserved. The skin and soft tissues were dissected carefully from the cartilage. The deformed cartilage was excised, and the newly carved cartilage framework was inserted in the pocket. When the skin envelope was insufficient, the patients underwent a formal ear reconstruction using a high Firmin type 2 skin approach with the second-stage being performed 6 months later. During this surgery, the ear was lifted to recreate a retroauricular sulcus. A cartilage block banked during the first stage subcutaneously under the skin incision of the donor site was used to elevate the ear. After covering the cartilage with a galeal flap, a split-thickness skin graft from the scalp was applied and secured with resorbable sutures. The postoperative management resembles the regimen used for all microtia cases.[14]

RESULTS

From 2007 to 2019, 109 patients underwent surgical correction for lop ear deformity. The modified otoplasty technique was used in mild cases of lop ears to straighten the scapha and define the antihelix, especially the superior crus (Fig. 2). In a moderate lop ear, the addition of helix remodeling is required by the lidded helix (Figs. 3, 4). For severe cases, the amount of cupping and the deficient cartilage requires formal reconstruction using a carved rib cartilage framework to reconstruct an aesthetically pleasing ear (Figs. 5, 6). The main results for each technique are presented in Table 1, and a schematic description of our surgical approach is depicted in Figure 7.

Modified Otoplasty

Forty-three patients underwent modified otoplasty for 58 lop ears and were therefore classified as mild lop ears. Fifteen patients had bilateral mild lop ears, and 2 patients had mild deformity of the left ear, whereas the contralateral ear underwent the extended otoplasty technique. Three of the patients relapsed, and the deformity was corrected again 3 years after the initial surgery. Two patients developed postauricular keloid scars. One was treated with intralesional excision and corticosteroid injection under local anesthetic and settled at the 12-month follow-up. The other patient underwent only corticosteroid injection, and the keloid flattened after 4 serial injections. Extrusion of the Ethibond suture

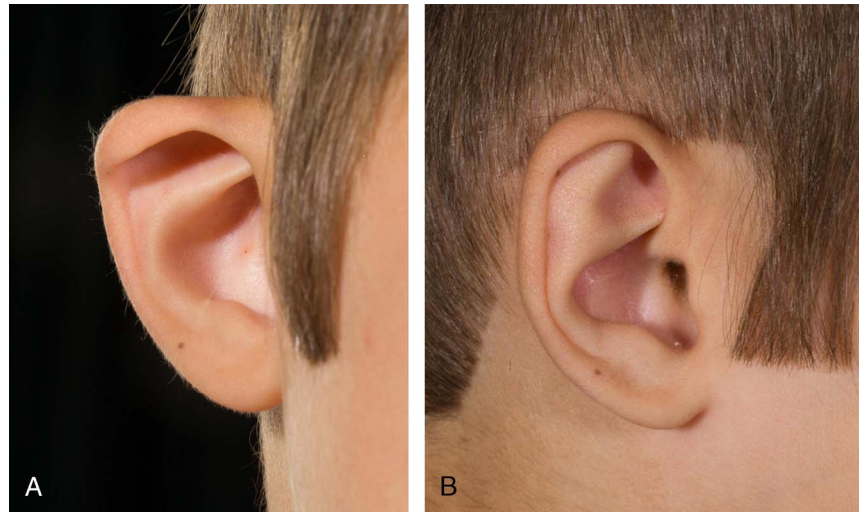

FIGURE 2. A, Modified otoplasty — preoperative photo. B, Modified otoplasty — postoperative photo. full color online

FIGURE 3. A, Extended otoplasty — preoperative photo. B, Extended otoplasty — postoperative photo. full color online

was recorded in 2 patients. After removal of the suture, the wounds healed by secondary intention.

Extended Otoplasty

There were a total of 17 patients with 27 lop ears where the extended otoplasty was performed. In this moderate deformity, the lidding of the helix required additional correction that could not be achieved only by the modified otoplasty. Ten cases were bilateral, whereas the other 7 cases involved 4 left and 3 right ears (2 of these patients had a type I lop ear deformity of the left ear). In this series, the only complication was the persistence of excess helical rim skin after correction and excision of the deformed helix in 1 patient. The excess skin was removed through direct excision 15 months after the initial surgery and healed uneventfully.

Cartilage Reconstruction

In 58 patients, a cartilage framework was carved, summarizing 61 cases: 27 left and 28 right ears. There were 10 bilateral cases, with 3 patients with severe lop ear bilaterally, whereas the other 7 patients had different types of lop ears: 6 cases where the left ear underwent reconstruction with a new cartilage framework, whereas the right ear was corrected with the modified otoplasty technique. The other patient had a left mild lop ear, whereas the right one underwent reconstruction with a new cartilage framework. Of the 58 cases, only 5 patients completed the ear reconstruction process in 1 stage, in 1 of the patients with bilateral deformity. There were 2 complications involving the lateral aspect of the ear with minimal wound healing problems with cartilage exposure, which were resolved by outpatient cartilage shaving and secondary healing. Out of the 53 cases where a 2-stage ear reconstruction was performed, there were 2 cases where the split-thickness skin graft contracted and obliterated the newly created retroauricular sulcus. They underwent revisional second stage resulting in a well-defined retroauricular sulcus.

DISCUSSION

Hinderer et al.[1] stated in 1987 the surgical principles for the correction of lop ears, which are still used today: correction of the constricted

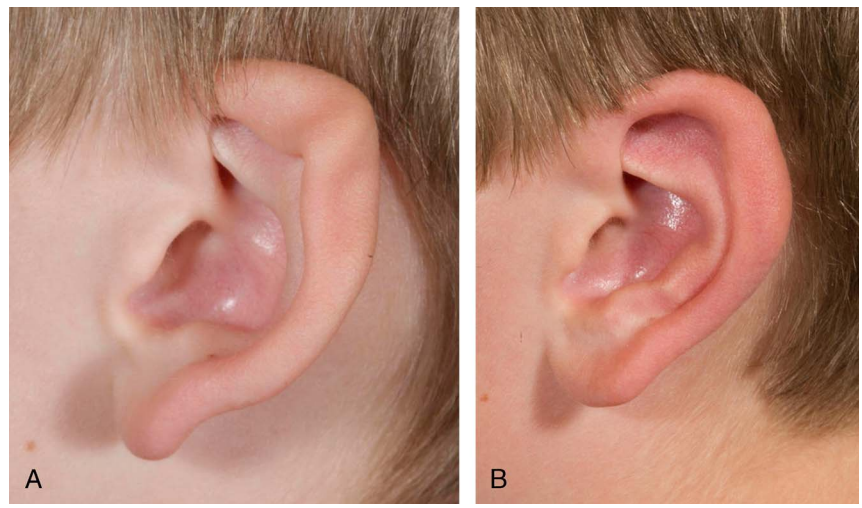

FIGURE 4. A, Extended otoplasty — preoperative photo. B, Extended otoplasty — postoperative photo. full color online

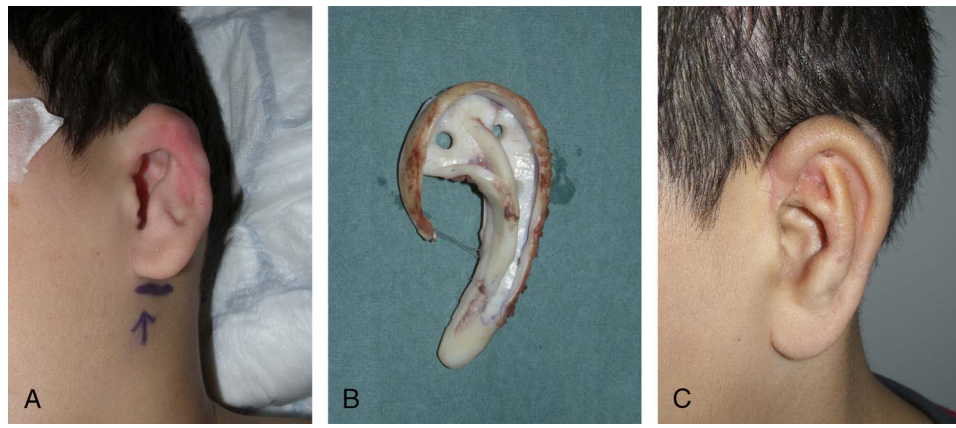

FIGURE 5. A, Cartilage reconstruction — preoperative photo. B, Cartilage framework. C, Cartilage reconstruction — postoperative photo.
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and overhanging upper auricular pole and straightening of the scapha. Our surgical algorithm is based on the same principles, with different techniques applied based on the degree of deformity present. This simplified surgical approach is intended to allow the surgeon to better identify the specific deformity preoperatively and to have a standardized approach before entering the operating theater. A mild deformity can be corrected through a modified otoplasty technique, with definition of the superior crus. In these cases, the lidded scapha and the lack of definition of the anthelix's superior crus can easily be corrected through this technique. The presence of a lidded helix, apart from the lack of definition of the antihelix, requires an extended otoplasty technique, where the lidded helix is shaped after the dissection of the cartilage from the skin. The severe lop ear is characterized by a deficient cartilage framework and severe cupping. Its remodeling would not be enough for obtaining a good result; therefore, it requires the addition of a newly carved framework from rib cartilage as in cases of microtia. We feel that, in the spectrum of congenital ear deformity, the severe lop ear becomes similar to a conchal microtia because of the deficient and constricted cartilage.

Apart from the deformities described by Hinderer et al.,[1] there are authors concerned about the height deficiency in patients with lop ears. Kislov[15] described the correction of the cupped ear in 2 stages, focusing on the height difference and the overhanging helix. Although the postoperative photos had a pleasant aesthetic result, the 2-stage procedure, the anterior scars, and the possible instability of the lateral helix where the cartilage is lacking are disadvantages of this technique. Grotting[16] also focused on correcting the deficient height of the malformed ear, but without addressing other issues. Moreover, he also used a technique involving anterior scars. Further techniques used to improve the height was the addition of cartilage-based flaps, such as the one described by Davis,[17] the chondrocutaneous postauricular flap,[18] the rearrangement of the lidded helix as single or double pedicled banner flaps,[6,19] or even free helical,[6] conchal,[8,20,21] and costal grafts.[8,22,23] Park[24] also described a tumbling concha-cartilage flap to correct the position of minor lop ear. The rectangular or T-shaped cartilage flap harvested from the concha was bent back on itself and sutured to the lidded scapha to hold its position upright. The mastoid hitch was also envisioned to maintain the helical elevation after reshaping of the lidded scapha.[19] Banner flaps, such as the one described by Grotting,[16] have also been used as soft tissue transposition to augment the deficient skin cover after rearranging the cartilage. Expansion of the lateral auricle by performing V-Y plasty[25–27] or composite grafts[25,28] from the contralateral ear is also a way of addressing this deformity. Although successful in achieving an aesthetic result, the number of scars and the need to operate on the contralateral ear represent disadvantages that cannot be overlooked.

One of the most known techniques for correction of lop ears was originally described by Stephenson.[4] She was not convinced that there is a shortage of tissue in the lop ear, acknowledging only the abnormal shape of the helix and scapha and the folding of them, which only made the ear appear smaller. Through an anterior approach, she performed radiating incisions of the helix and scapha. She also added a rib cartilage on the posterior surface of the expanded cartilage to avoid the contracture of the expanded cartilage. Moreover, Stephenson reported the presence of contracture at the cephalohelical junction, which she managed

FIGURE 6. A, Cartilage reconstruction — preoperative photo. B, Cartilage framework. C, Cartilage reconstruction — postoperative photo.
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TABLE 1. Demographics and Complications

	Modified Otoplasty	Extended Otoplasty	Cartilage Reconstruction
Total lop ears	58	27	61
Mean age at operation (range), y	9 (7–16)	9 (7–17)	10 (9–17)
Patients with bilateral cases	15	10	3
Right ear	20	3	28
Left ear	8	4	27
Complications			
Relapse	3		
Wound healing problems			2
Keloid scars	2		
Suture extrusion	2		
Remaining deformity		1	
Skin graft contracture			2

with a transposition flap from the skin superior to the ear. Musgrave[3] further modified Stephenson's technique, adding a strip of concha taken from the same ear through a posterior approach. Although he used a posterior approach for the definition of the antihelical fold and the harvest of the concha graft, he fanned the helix and scapha by making cross-hatching incisions through an anterior approach. Although the anterior approach is safe and easy, we consider the risk of visible scars, including hypertrophic and keloid scars, much higher with this approach, compared with the posterior one.[29] In our series, we recorded only 2 cases of keloid scars in the patients where the modified and the extended otoplasty was performed, accounting for 2.3% of the 85 cases. Even though our mild and moderate cases are approached through a posterior incision, the anterior approach in the severe forms is guided by the need for additional soft tissue from the mastoid region that cannot be recruited if the incision would be placed behind the ear.

Park and Park[30] classified constricted ears into 4 categories, depending on the number of preoperative tests applied, which were able to correct the deformity, apart from the microtia cases.[9] Although we agree with the type I classification and the need for definition of the antihelix,

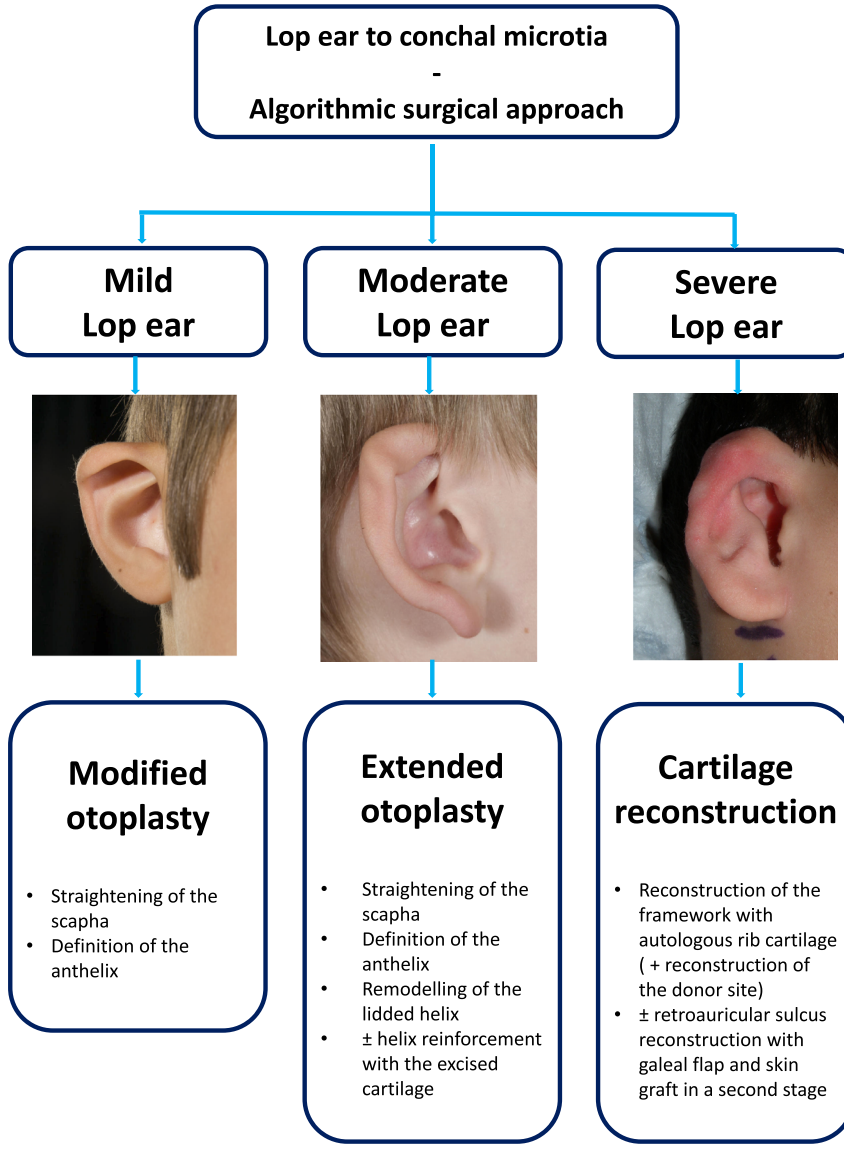

FIGURE 7. Schematic description of the systematic surgical algorithm. full color online

we consider the addition of cartilage for wrapping unnecessary, eliminating therefore the morbidity of the donor site. The modified Mustardé sutures are enough to hold the cartilage in the desired shape. Moreover, when approaching the deficient cartilage, autologous cartilage seems to be the best solution for long-term results when looking at extrusion and fracture rate. Park and Park[30] recorded a 63% complication rate when Mepore was used. Moreover, the various flaps[9] harvested from the posterior aspect of the ear to supplement the lack of skin of the superior and anterior pole seem quite unaesthetic. After incision and dissection of the deformed cartilage from the undersurface of the skin, the skin flap is further dissected cranially and posteriorly in our series to gain the skin coverage necessary for the anterior surface of the new cartilage framework. In the cases where the skin envelope was too tight for the retroauricular sulcus to be preserved, the skin was used for the lateral surface of the ear, and the retroauricular sulcus was created in a second stage with banked cartilage from the first stage, as well as galeal flap and skin graft from the scalp. In this way, the lateral surface of the ear had fewer scars and was more aesthetically pleasing. In their series, Park and Park[9] state that their cartilage-saving techniques used before 2000 did not produce consistent results; therefore, they changed their technique and now they are only using cartilage-replacing techniques. We support this approach, because we also believe that the best results are obtained with a newly carved cartilage framework that completely replaces the deficient auricular cartilage.

Even though many authors disregard the extreme cases of lop ears and consider them mostly microtia cases, we acknowledge the inclusion of these cases in the lop ear classification, as the most severe cases. Even Rogers[2] in his original description recognizes the extreme cases as severe microtia-lop ears. Although the surgical approach depends on the amount of skin available, most of our cases underwent 2-stage ear reconstruction, with only 5 of the patients being amenable to a 1-stage ear reconstruction. Our approach resembles the one described by Nagata,[31–35] with slight modifications.[11,36] Acknowledging that there are authors describing expander implantation for the supplementation of the skin envelope,[37,38] we prefer not to use them because of the added surgical procedure and the regular expansion of the device, which can be a traumatic experience for the children.

At 6 years of age, the cartilage starts to harden. Therefore, we offer correction of mild and moderate lop ear deformities starting at 7 years of age. Because the modified and extended otoplasty do not involve cartilage harvesting, these operations are less complicated than the severe cases of lop ears. We offer autologous reconstruction at the minimum age of 9 years and consider the psychological maturity of the children for them to decide if they want this surgery or not. Moreover, the costal cartilage is sufficient for the fabrication of the framework.[14]

In the earliest part of our series, we did record 3 patients with relapse after modified otoplasty, but this happened before changing the type of suture material from polydioxanone to nonabsorbable braided suture.

CONCLUSION

This new systematic surgical algorithm for the correction of lop ears based on the severity of the deformity is a simplified and reliable method, which is intended to bring greater clarity to how to deal with this condition. We feel that this approach achieves pleasing and acceptable results using simple and reproducible techniques, as with our modified and extended otoplasty techniques used for the mild and moderate cases. It is also essential to recognize that the severe lop ear, which is similar to a conchal microtia, requires a more stable cartilage framework, as it cannot be replaced by the remodeling of the soft and insufficient auricular cartilage. We feel that there is a point in the spectrum of congenital ear deformity when a severe lop ear becomes a conchal microtia and recommend this approach to simplify the management of these cases.

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