Otoplasty: The Belfast Experience. A 10-Year Review of 2333 Ear Outcomes

Prominent auris, the condition of protruding ear(s), is a common congenital anomaly, with an estimated global incidence of 5%. The recognized anatomical causes of prominent ear include any combination of excess conchal width, inadequate formation of the antihelical fold, or a conchomastoid angle greater than 90 degrees. The significant psychological impact of deformity has been confirmed in multiple previous studies.3,4 The goal of addressing the abnormal shape of the auricular cartilage framework causing the described deformities can be achieved through a number of means. Cartilage scoring, bending, and suturing are but a few of the more commonly described techniques.5 The vast range of operative options attests to the lack of consensus of a singular optimal approach.

Background: “Prominent ear” remains one of the most common referrals to pediatric plastic surgery. The perceived deformity has been corrected using a multitude of techniques for over a century, and significant variation in practice still exists. Recent studies suggesting that cartilage-scoring techniques are associated with more major complications than suture techniques may have led to an adverse international perception of the technique. Thus, waning use of anterior scoring prominent ear correction appears to be occurring. For appropriate cases, the authors have used anterior scoring for over 20 years, with high patient satisfaction and low complication rates. They present a review of all cases and outcomes from 2005 to 2015. The authors believe this is the largest case series of anterior scoring otoplasty published to date.

Methods: All pediatric cases undergoing prominent ear correction from 2005 to 2015 were included in this retrospective case note analysis and follow-up study. Patient demographics, operative details including early and late complications, and postoperative results were analyzed.

Methods: Over a 10-year period, 1199 otoplasties were performed (1134 bilateral, 65 unilateral), for a total of 2333 ear corrections. A total of 1575 ears were corrected using the anterior scoring technique. The remaining cases underwent correction by means of suture only, cartilage reduction, or combination techniques. There was a significantly lower all-cause reoperation rate for anterior scoring compared to suture-only techniques (P = 0.0059; significant at P < 0.025). There were no reported cases of cartilage necrosis.

Conclusions: This study demonstrates that in appropriately selected patients, anterior scoring otoplasty is a low-morbidity procedure. In the authors’ institution, when compared to suture techniques, it was associated with a lower rate of complications and reoperation rate than suture-only techniques. (Plast. Reconstr. Surg. 151: 388e, 2023.)

Clinical Question/Level of Evidence: Therapeutic, IV.
Surgery for ear prominence dates from the mid-1800s, with a number of single and staged techniques described to remodel the cartilage framework of the ear into a more aesthetically pleasing shape. Luckett is credited with recognizing the importance of reestablishing the lacking antihelical fold, minimizing undesirable projection. Initially, this was achieved through cartilage-scoring techniques relying on the Gibson and Davis principle that cartilage bends away from a cut surface. More recent literature, however, has suggested a shift, to suture-only techniques, based on reported adverse outcomes and the difficulty in addressing those deformities arising from alteration of the cartilage framework.

The Belfast experience of a variety of otoplasty techniques from 1199 patients over a 10-year period is reviewed with an accompanying video supplement demonstrating our modified anterior scoring technique. The results of this review support our collective experience that in a high-volume center with appropriately selected cases, anterior scoring is a safe technique with low complication rates.

PATIENTS AND METHODS

All pediatric cases undergoing correction of prominent ear(s) from 2005 to 2015 were included in this retrospective case note analysis and follow-up study. There were no predetermined case exclusion criteria. Prominent ear surgery in Northern Ireland is carried out in a single tertiary pediatric plastic surgery training unit by a team of consultant plastic surgeons routinely performing otoplasty.

Data collection included current patient age, sex, age at referral and consultation, indication for referral, laterality, family history, and anatomical cause of prominence. Also collected were age at surgery, method of anesthesia, surgeon seniority (grade) and supervision, surgical technique, hospital stay and duration, and compliance with head bandage. Early complications (including bleeding requiring early dressing change, hematoma requiring drainage on the ward or in the operating room, wound dehiscence, skin/pressure necrosis, and cartilage necrosis) and long-term complications (ie, hypertrophic scar, keloid scar, asymmetry, residual deformity, recurrence, and revision surgery) were recorded. Given that hematoma rates and all-cause return to the operating room rates drew historical criticisms of the anterior scoring technique, these parameters were compared using chi-square statistical subgroup analysis of the anterior scoring versus suture-only patients.

Operative Technique for Anterior Scoring Cases

At this institution, modified anterior cartilage scoring with a small cartilage excision is the predominant otoplasty technique for patients with an absent or deficient antihelical fold as the primary cause of ear prominence. [See Video (online), which demonstrates anterior scoring otoplasty technique.] This modification expands on the approach first reported by Tolhurst in 1972 that builds on earlier descriptions by Stenstroem and Chongchet.

The senior author’s (B.F.) approach commences with cartilage tattooing to define the planned limits of scaphal cartilage incision. Inferior marking is made at the antitragal junction with the future antihelical fold, and superiorly, it is marked near the superior end of the future superior crus of the antihelical fold as visualized by folding the ear posteriorly. Preincision local anesthetic tumescence to the anterior auricular skin with bupivacaine 0.25% and adrenaline 1:200,000 aids subsequent dissection of the anterior skin during the procedure. A posterior dumbbell-shaped skin excision is then carried out to gain access to the auricular cartilage.

We have found this design allows judicious removal of the mild skin excess that arises in the retrtopositioned ear, good access of the scaphal cartilage, and a well-placed inconspicuous scar. It also reduces the risk of “telephone ear” deformity (ie, overcorrection of the middle third of the helix because of excess skin resection that can occur with a standard elliptical skin excision). A full-thickness cartilage incision is designed as an anterior facing curve placed between the two tattooed points. A plane is then developed between the anterior surface of the scaphal cartilage and its overlying soft-tissue attachments using either sharp dissection with a blade or blunt dissection with gauze. Following anterior skin dissection off the cartilage, a small rim (1 to 2 mm) of the scaphal cartilage complex is excised to facilitate the retropositioned cartilage being accommodated within its skin envelope and prevent it from overlapping the helical rim cartilage. Anterior scoring of the cartilage surface using a scalpel is then performed. Cartilage scoring with multiple largely longitudinally oriented, shallow incisions then commences using a number 15 scalpel blade. Care is taken to ensure each score is as shallow as possible to avoid visible indentation and cartilage “breaks” with consequent unnatural appearance. Scoring is guided by palpation of the residual cartilage recoil, with scoring effort directed at those areas that are palpably resistant to being folded backward. In this manner, one is able
to recreate a natural antihelical fold and superior crus. Scoring can be considered complete once the cartilage assumes the desired shape with a persisting antihelical fold and superior crus. If there is concern that the cartilage has a tendency to recoil to its original position despite adequate scoring, a single 4-0 Monocryl suture may be used to tack the cartilage in its new position. After ensuring hemostasis, the skin is closed with a running dissolvable subcuticular suture (4-0 Monocryl), and once tightened, the cartilage returns to its native skin pocket.

The subcuticular suture is not knotted and thus will allow egress of any blood that may emanate in the postoperative period. In the event of hematoma formation, the suture need not be removed but can be loosened, the hematoma evacuated, and any vessels diathermized. Use of an absorbable material also allows the suture to be painlessly cut flush to the skin, which is especially of benefit in the pediatric population.

Dressing gauze is applied anterior and posterior to the ear and a soft head bandage applied. It is imperative that the head dressing applied no pressure on the head and ears, as this could result in ischemic necrosis of the thin anterior skin. The crepe head bandage can then be secured with adhesive tape applied to both the bandage and the adjacent exposed skin. Alternatively, a prefabricated postsurgical head garment is used. Dressings remain in situ until the first dressing change, which occurs from day 2 to day 7 postoperatively in the clinic (Fig. 1). Following dressing removal, a padded night bandage for sleep is desirable for up to 6 weeks postoperatively.

Decision-Making in Otoplasty

Our approach to assessing the child seeking otoplasty centers on a child-focused encounter, rather than a parent-driven consultation. The child must have some insight and a desire to undergo a general anesthetic procedure. With the patient and parent(s), we expand on what part of the ear(s) is causing social embarrassment. Using this approach, we find that in the vast majority of cases, it is excess helical mastoid projection that leads to presentation. We do not impart our assessment onto the child until we have heard their concerns. Our surgical strategy is then outlined in the office before admitting the child. For isolated antihelical deficiency in the prepubescent child, the anterior scoring technique described is our primary approach. Alternative operative strategies to anterior scoring include suture correction or conchal reduction surgery. Indications for each can overlap and may depend on the attending surgeon’s preference. (See Figure, Supplemental Digital Content 1, which shows a decision-making flowchart for management of prominent ear; http://links.lww.com/PRS/F614.)

Suture correction techniques may address either a deficient antihelical fold and/or antihelical superior crus using Mustardé sutures, or reduce an excessive conchomastoid angle using Furnas sutures. Conchal resection also has a role where excess conchal width contributes to overprojection of the ear in the presence of a well-defined nonpliable antihelical fold. We have found from experience that when the antihelical fold is present but deficient, anterior scoring will not only exaggerate the fold but, in the presence of pliable cartilage, the fold will migrate medially, thus reducing the conchal width. This is not the case when the cartilage is stiff and noncompliant, as the antihelical fold is fixed and will not migrate medially despite any attempts to do so with anterior scoring. We have found that stiff/rigid cartilage is more likely in the adult population and thus suture correction techniques would be more beneficial in this population of patients should an antihelical fold be present to some degree. Thus, conchal reduction surgery is rarely necessary in the younger age group, where pliant cartilage and anterior scoring will allow medialization of the antihelical fold. Antihelical fold deficiency, cartilage pliability (seen commonly in the pediatric population), and conchal width excess are thus the main determinants for technique selection. Where anterior scoring was felt to be the optimal technique but cartilage pliability was found to be less than expected intraoperatively, sutures were added to maintain the new position in a combination suture/scoring technique.
**RESULTS**

Over a 10-year period (2005 to 2015), 1199 otoplasties were performed, of which 1134 were bilateral and 65 were unilateral. This equates to a total of 2333 ear corrections. Seven hundred seven patients (59%) were male, and 494 patients (41%) were female (Table 1).

**Preoperative Findings**

Mean age at referral was 7 years, as was mean age at first consultation. A positive family history was present in 108 cases (9%), absent in 107 cases (9%), and not recorded in 984 cases. Reason for referral was documented as “teasing” in 59% of cases, “self-consciousness” in 24% of cases, parents’ request in 16% of cases, and for secondary otoplasty because of unsatisfactory primary results or recurrence in 1% of cases. Causes of prominence were documented as absence of antihelical fold in 73%, deep conchal bowl in 8%, mixed in 16%, and other causes in 3%.

**Perioperative Findings**

Age at surgery was a mean of 9 years (median, 9 years; range, 2 to 14 years). Surgery was performed under combined general anesthetic with local anesthetic for postoperative analgesia in 98% cases, and local anesthetic only in 2% of cases. Surgery was performed by a consultant (attending physician) in 29% cases, supervised middle grade trainee in 68% of cases, and a supervised junior trainee in 3% of cases. Day case surgery was performed in 96%, with hospital stay of 1 night in 3% and 2 or more nights in 1%. Our standard practice is planned surgical admission on the day of surgery, with discharge 4 hours after the end of the general anesthetic session. Those patients requiring inpatient admissions were primarily as a result of concomitant medical issues, or for management of significant postoperative nausea and vomiting. Our criterion for discharge was pain that is managed on oral acetaminophen and ibuprofen, and retention of oral solids and liquids.

Surgical techniques in this series included conventional anterior scoring in 1575 cases (68%), suture only in 215 cases (9%), conchal cartilage reduction in 82 cases (3%), combined conventional anterior scoring and suturing in 444 cases (19%), and combined suturing and conchal reduction in 17 cases (1%) (Table 2).

**Postoperative Findings**

All patients were reviewed at the outpatient clinic early (range, 7 to 14 days) and late (mean, 3 months). Head bandage compliance was present in 97% of cases, with 7 mean days worn (median, 7 days; range, 1 to 30 days). Overall patient, parent, and surgeon satisfaction was 96% for all techniques.

**Statistical Analysis**

The presence of an association between occurrence of hematoma following anterior scoring and suture-only correction, and the association between all-cause return to the operating room in the operative subgroups were assessed using Pearson chi-square tests. The conventional threshold for statistical significance is $P < 0.05$; however, because we carried out two statistical tests, a Bonferroni correction was applied to this threshold; thus, we adopted $P < 0.025$ as the threshold for declaring statistical significance. Fisher exact $P$ values for these tests were also calculated on the advice of medical statistics given the low expected count in some cells; this did not affect our findings. Calculations were carried out using Stata 16 software (Tables 3 and 4).

There was no significant difference in hematoma rate between anterior scoring and suture-only groups found, and the suture-only group demonstrated a statistically significantly higher all-cause return to the operating room rate than the anterior scoring group ($P < 0.025$).

**DISCUSSION**

Anterior scoring has proven to produce good results for patients and surgeons alike in our
We continue to stress the importance of individualized patient assessment and adapting surgical technique to address the presenting deformity. In otoplasty surgery, “one size does not fit all”; therefore, anterior scoring is not the panacea for all prominent ear presentations. Review of the attached flowchart highlights our basic decision-making process that guides initial assessment. Techniques may be combined based on individual patient presentation (eg, a combination of conventional cartilage scoring and cartilage sutures) to address multiple anatomical issues. In some settings, suture-only correction and conchal reduction are the operations of choice (eg, in a patient presenting with rigid partially developed antihelical folds or isolated wide conchae, respectively). Examples of ear morphology and technique suitability based on flowchart (Figures 2 through 6), include anterior scoring, conchal reduction, and suture reduction (Tables 2 and 3).
Additional examples are shown in Figure 7. (See Figure, Supplemental Digital Content 4, which demonstrates an additional preoperative example of a young female patient lacking antihelical for whom anterior scoring was planned, http://links.lww.com/PRS/F617. See Figure, Supplemental Digital Content 5, which demonstrates the postoperative appearance of the patient in Supplemental Digital Content 4 following modified anterior scoring technique described at 2-year follow-up without obvious sharp ridges of the neoantihelical fold, http://links.lww.com/PRS/F618.)

Anterior cartilage scoring has previously received criticism because of perceived increased postoperative risks of hematoma, necrosis (skin and/or cartilage), scarring, and cartilage destruction. Tan, in the first comparative outcome study for anterior scoring (n = 101), stated the following incidences: bleeding, 2%; pathologic scarring, 2%; and residual deformity, 9.9%.17 Interestingly, their study supported our results that reoperation with the Mustardé suture techniques was higher, stating “The use of non-absorbable material
(white silk) was the cause of stitch complications in this method.” Although silk is no longer the suture of choice, it is likely that the issues of suture sinus and wound breakdown persist with the same technique.

Calder and Nassan, in 1994, reviewed a case series of anterior scoring in their patients ($n = 562$) and reported the following: bleeding incidence, 8%; skin necrosis, 1.4%; pathologic scar, 2.1%; and residual deformity, 8%.

In their discussion, they report that the majority of complications were attributable to failure of design of the cartilage incisions. We suggest this may be avoided using the steps described and reviewing the video supplement provided.

Jeffery presents the highest combined complication rate of 23.75% for anterior scoring ($n = 76$). The reported complication incidence in the latter study was increased if anterior scoring was combined with suture techniques (38.1%). In the latter, there was no breakdown of each procedural complication rate and thus no indication of complication severity.

A notable finding in this study is that junior surgical trainees (senior house officers) were more likely to have complications, prompting the authors’ institution to no longer allow junior trainees to perform the operation unsupervised, which reflects contemporary practice in our own unit.

Caouette-Laberge et al. provided evidence that anterior scoring is a successful technique when carried out in a high-volume center. In their consecutive case note review, 500 patients underwent correction by means of anterior scoring and had a reported low complication rate. In comparing their complication rate relative to that reported in our series, they state early complications of postoperative hemorrhage in 2.6% (our incidence, 1%), hematoma requiring evacuation in 0.4% (our incidence, 1.5%),

Fig. 4. Preoperative example of a young female patient with antihelical fold deficiency and pliable cartilage suitable for antihelical scoring.

Fig. 5. Example of an older male patient with antihelical fold deficiency, less pliable cartilage, and wide concha suitable for conchal reduction surgery.
skin necrosis in 0.6% (our incidence, 1.7%), and wound dehiscence in 0.2% (our incidence, 0.32%). For late complications, they reported pathologic scars in 0.4% (our incidence, 0.63%), residual deformity in 4.4%, asymmetry in 5.6% (our incidence, 0.69%), and secondary surgery in 1.2% (our incidence, 2.73%).

We would suggest the close clustering of our low complication rates with this study more accurately reflects actual complication rates associated with anterior scoring rather than those suggested by the earlier studies. This acts to refute smaller, more recent studies that suggest anterior scoring is fraught with complication. Mandal et al., for example, stated that anterior scoring resulted in significant complications when compared with cartilage-sparing techniques. This included a recurrence rate of 11%, a reoperation rate of 8.8%, and a pathologic scar and residual pain rate of 1.4%. However, the series included only 68 patients; therefore, it is difficult to comment on whether the complications of a few patients have negatively skewed the study outcome and conclusion. Smittenberg et al. in 2018 reported an overall complication rate of 20% for all techniques, with no statistical difference between the cartilage-cutting versus cartilage-preserving groups.

As the literature above highlights, each procedure comes with a subset of benefits and potential tradeoffs that should be considered.
for every patient. Our results demonstrate that a lower recurrence rate occurs with anterior scoring, with high long-term satisfaction. Previous criticisms of “overcorrection,” were not borne out in our population. We surmise that overcorrection arises, in the vast majority of cases, from skin insufficiency rather than cartilage deformity. This has been described in the literature before as telephone ear deformity.9 This deformity describes the overcorrection of the middle third of the ear because of skin deficiency from overexcision of the postauricular skin. By adapting the dumbbell-shaped posterior skin excision with a narrow middle third as described and demonstrated in the accompanying video, we have managed to mitigate this risk. Arguably, no skin excision is needed, only skin incision, as only access to the cartilage is required to carry out cartilage modification; however, we have limited experience of this within this series.

We also have had no significant experience of abnormally prominent or “sharp” cartilage edges, as we ensure that all cartilage cuts are smooth. Any residual ridges can be addressed primarily with the small cartilage excision described. We find the immediate postoperative (Fig. 1) result very closely resembles the eventual long-term result (see Figure, Supplemental Digital Content 2, http://links.lww.com/PRS/F615). We therefore do not conclude the operative procedure until we are completely happy with the resulting aesthetic outcome.

In contrast with the previous studies and using the approach that we have described and demonstrated in the video supplement, we have found that in our practice, these complication rates and severity are minimal. Thus, when skillfully executed, we would commend anterior scoring as a valid, reliable technique for prominent ear correction that is widely applicable for the majority of pediatric patients in particular.

CONCLUSIONS

Current trends and opinion among ear reconstruction surgeons appear to promote suturing techniques for primary otoplasty compared to anterior scoring. This is likely because of the aforementioned studies leading to perceived higher frequency of complications. These critics suggest that if secondary otoplasty following anterior scoring is required, the irreversible auricular cartilage contour deformities are difficult to manage.24,25 This has not been our experience in the limited number of cases requiring revision discussed above.

At our institution, we feel that immediately excluding anterior scoring as a primary means of otoplasty would be injudicious. Our results using the technique are comparable if not superior to those prior studies using anterior scoring. We conclude that in a high-volume institution, otoplasty by means of anterior scoring in appropriately selected cases is a safe procedure. Requirement for reoperation in the anterior scoring subgroup was lower overall, suggesting that it may be a success from not only a surgical perspective but also an economic one.

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