Correction of Protruding Ears (Weerda Grade I Deformity) Using Knotless Bidirectional Barbed Absorbable Sutures

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Abstract

Objective. To introduce a variant of the Furnas technique using a knotless bidirectional barbed absorbable suture for the correction of Weerda grade I prominent ears.

Study Design. Comparative study between groups of patients and literature review.

Setting. Tertiary care teaching hospital.

Subjects and Methods. Review of 25 patients who underwent otoplasty by the technique described by Furnas and 23 patients who underwent otoplasty by this modified technique using knotless bidirectional barbed absorbable sutures. Postoperative complications and level of satisfaction were measured.

Results. The postoperative complication rate was low regardless of the suture technique used. We observed statistical significance in relation to the pain caused by the suture knots (P < .001). The reoperation rate was on the limit of statistical significance (P = .051). In the group with bidirectional barbed absorbable sutures, no reoperation was required. In the group with classic sutures, reoperation was necessary in 5 cases to correct recurrence and in 1 case to correct asymmetry. Furthermore, in 4 cases of this group, sutures were removed due to pain or extrusion. The overall long-term satisfaction rate was 91.6% in the group operated with classic suture techniques and 95.7% in the group operated with knotless bidirectional barbed absorbable sutures.

Conclusion. The use of knotless bidirectional barbed absorbable sutures in the Furnas technique is simple and fast and presents few complications. The major advantages that we obtained with the use of this technique were the absence of discomfort caused by the type of suture and the fact that no reoperation was required to correct relapses.

Keywords

protruding ears, otoplasty, bidirectional barbed absorbable sutures

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Protruding ears are one of the most common abnormalities observed in the face. Approximately 5% of adults suffer to some extent from the stigma of having prominent ears, along with the accompanying psychological effects. The origin of this malformation is unknown. The most frequent cause of protruding ears is an abnormality in the development of the antihelix fold produced during embryogenesis due to an alteration in the development of the second branchial arch. However, the etiopathogenic origin of these congenital malformations is unknown in most cases. Only a few cases are associated with well-known congenital syndromes or have been linked to environmental factors during pregnancy such as exposure to X-rays and hypoxia.

Weerda¹ proposed a classification of auricular deformities. Grade I includes minor deformities of the auricle. In these cases the basic auricular architecture is preserved. Prominent ears, macrotia, cryptotia, colobomas, mild cup ear deformities, and absence of the antihelix fold are included in this group. Grade II includes malformations of the basic architecture of the cartilage, such as severe cup ear deformities and the mini-ear. Grade III is assigned when there are no normal auricular structures. Only isolated remains of the cartilage are apparent. Anotia is the most extreme form of this grade. When the cephaloauricular angle exceeds 30° degrees, a patient is considered to have “protruding ear.”²

A great number of surgical techniques have been developed to correct auricular deformities. Their basic concepts

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originated from Mustardé’s suture\textsuperscript{3}; the scoring techniques described by Chongchet, \textsuperscript{4} Stenström, \textsuperscript{5} and Cricelair and Cosman\textsuperscript{6}; the combined suture and scoring technique described by Converse et al\textsuperscript{7}; cartilage thinning described by Weerda\textsuperscript{1}; the technique with cartilage excisions by Pitanguy et al.\textsuperscript{9} Furnas\textsuperscript{10} and Spira et al\textsuperscript{11} described a concha-mastoid fixation suture technique intended to reduce the helix-mastoid distance, which is used in combination with an antihelix plasty.

Complications include hematomas, wound infections, pain, postoperative bleeding, cartilage-skin necrosis, suture material rejection with granulomas/extrusion, asymmetry, unilateral or bilateral recurrence, hypertrophic scars, and keloids. Cutting or scoring techniques can be a cause of more unaesthetic consequences than are suture techniques.\textsuperscript{12}

The suture material is highly variable.\textsuperscript{13} Complications in the form of visible sutures and discomfort caused by suture knots have been observed. To avoid this, we propose the use of a similar technique using a knotless bidirectional barbed absorbable suture (BBAS). A BBAS is a knot-free surgical closure device. It is designed with tissue retainers (barbed) arranged helically around a monofilament suture in opposite directions on either side of a transition segment without retainers. It is equipped with a needle in each direction that allows the barbs that penetrate tissue to apply traction in one direction and block it in the other direction (Figure 1).

The main factors considered in this study were long-term satisfaction rates and early and late complications. Furthermore, we include a detailed description of the surgical technique proposed.

Methods

The review board of the Complexo Hospitalario Universitario de Santiago de Compostela (CHUS) Surgery Department approved the study design, and all the patients included signed a specific informed consent form. Forty-eight patients with prominent ears were included in the study.

A group of 25 patients underwent otoplasty by the surgical technique described by Furnas\textsuperscript{10} with 3 polypropylene suture stitches between the mastoid peristium and the conchal perichondrium from 2000 to 2005 inclusively. A second group of 23 patients underwent otoplasty by the surgical technique described below using BBAS from 2006 to 2009 inclusively.

The study was carried out via check-ups at clinic and telephone surveys. Telephone surveys were focused exclusively on measuring satisfaction rates using a 10-point scale where 0 represents the worst satisfaction rate and 10 points indicates the best satisfaction rate. Surveys were conducted by an objective observer (the administrative staff of the clinic). In all cases, the surveys were conducted at least 3 years after the operation.

All patients included in our study were reviewed after 6 months, 1 year, and 3 years, and all patients responded to the telephone survey.

Surgical Technique

With the patient sitting, the retroauricular skin ellipse that was to be removed was marked, and the new position of the ear was determined by pressing the ear backward (Figure 2a). All patients were operated under local anesthesia (bupivacaine with epinephrine), sedation, and prophylactic antibiotics. The skin ellipse and all retroauricular tissue, including the retroauricular muscle, were excised to fully release the pinna from its cranial inserts (Figure 2b). In this way, we identified the conchal perichondrium and mastoid peristium (Figure 2c). In group 1 (classic suture technique), we proceeded to 3 single suture stitches (1 central, another in the upper segment, and another in the lower segment) with a 3/0 nonabsorbable polypropylene suture (Prolene, Ethicon Inc, NJN, New Brunswick, New Jersey) between the mastoid peristium and the conchal perichondrium. In group 2 (BBAS technique), with any type of suture we marked the middle point (reference) from where we would start the final suture with a 3/0 BBAS absorbable suture\textsuperscript{14} (Quill Monoderm, Angiotech Pharmaceuticals Inc, Vancouver, Canada) (Figure 2d). From this point we started the suture between the mastoid and the conchal, usually above the level of the antihelix (Figure 2e, 2f). Once we reached the top and bottom margins, we went back with the same BBAS suture toward the middle point, making an intradermal skin closure (Figure 2g). We left a Penrose drain, which we maintained for 2 to 3 days (Figure 2h). The wound was dressed using gauze pads soaked with antiseptic solution, a large amount of cotton, and a compression bandage. With these measures, we attempted to keep the shape of the newly formed auricle. The first dressing change was usually performed 2 or 3 days after the operation. At this time, the Penrose drain was removed and a new dressing was applied. At 7 or 8 days after the operation, the dressing was

Figure 1. Image of bidirectional barbed absorbable suture. Note the small barbs along the suture that provide traction in the sutured tissues.
replaced by a headband during nights in group 1, whereas group 2 received no subsequent dressing. The headband (used only in group 1) was to be worn for 2 months.

Statistical Analysis
Data were analyzed with software for statistical analysis (SPSS v.21.0.0, IBM, Armonk, New York). The significance of the difference was tested using Fisher’s exact test. Statistical significance was set at $P < .05$.

Results
Forty-eight patients aged between 15 and 23 years (average 17.3 years) with prominent ears were included in the study. There were 34 males and 14 females, and there were 43 bilateral and 5 unilateral ears (91 ears) (Table 1).

From 2000 to 2005, 25 patients underwent otoplasty with the surgical technique described by Furnas with 3 suture stitches between the mastoid periosteum and the conchal perichondrium. Five cases were unilateral and 20 were bilateral. From 2006 to 2009, 23 patients underwent otoplasty by the surgical technique using BBAS. All cases included in this group were bilateral. Surgical time from incision to the end of skin closure decreased 5.75 minutes for each operated ear (Table 2).

In both groups, all the complications appeared within the first year after surgery. No complications were detected at the 3-year postoperative check-up and none of the patients demanded a new consultation due to complication of the procedure after this time. The complication rate was low regardless of the technique used. We observed statistical significance in relation to the pain caused by the suture knots ($P < .001$). The reoperation rate was on the limit of statistical significance ($P = .051$). However, no statistically significant differences were found between the 2 techniques with regard to the other factors we took into account (Table 3).

In group 1, reoperation was necessary in 5 cases to correct recurrence and in 1 case to correct asymmetry. Furthermore, in 4 cases the polypropylene sutures were removed under local anesthesia approximately 1 year after the operation (Figure 3). In group 2, no reoperation was required in any case. The overall long-term satisfaction rate was 91.6% in group 1 and 95.7% in group 2. Surveys were completed at an average of 39.54 months after the operation (minimum, 36.36 months; maximum, 41.36 months). Nonappreciable differences were noted between both groups regarding long-term cosmetic results (Figures 4-6; Supplemental Figures S1 and S2, available at otojournal.org).

Discussion
We present our current technique for the correction of Weerda grade I prominent ears using the self-anchoring suture invented by Gregory Ruff. Barbed sutures have
shown better results with regard to breaking strength both in vivo and in vitro.\textsuperscript{15,16} Furthermore, this type of suture distributes tension on both sides of the wound and along the suture line, which facilitates healing.

In accordance with other authors,\textsuperscript{12,17} we use suture techniques because these methods, as opposed to others (cutting or scoring), do not cause permanent deformities.

To our knowledge, there is no publication along these lines (using BBAS) for the surgical treatment of patients with prominent ears. A larger number of patients and a blinded prospective study could enhance the results of this series.

The complication rate we obtained in group 1 patients was similar to that described in the literature.\textsuperscript{18-20} However, in our study the hypertrophic scar or keloid rate was higher (approximately 10\%) than in other published series. For example, Ribeiro and da Silva\textsuperscript{21} reported 0\% in 897 patients. It strikes us that no patients in the published literature mentioned the discomfort caused by the suture knots, which in our group was the most frequent patient complaint (48\%).

When using this technique (a variant of Furnas) we observed an overcorrection in 3 patients. However, we do not consider this to be a complication because it was not the subject of complaint by the patients or their family members. Furthermore, we did not receive any complaints regarding the disappearance of the retroauricular area.

Furthermore, given that postoperative complications decreased with the use of BBAS, the final aesthetic results seem to be similar in both suture techniques.

### Conclusions

For prominent ears with type I deformity, the technique that we propose is that described by Furnas with a variation of the type of suture used. This technique is simple, fast, and reliable; presents few complications; and provides a high degree of satisfaction. The major advantages that we obtained with the use of BBAS were the absence of discomfort caused by the type of suture and the fact that no

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**Table 1. Distribution of the Patients with Both Techniques.**

<table>
<thead>
<tr>
<th>n</th>
<th>Male, n</th>
<th>Female, n</th>
<th>Unilateral, n</th>
<th>Bilateral, n</th>
<th>Suture Technique</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>25</td>
<td>19</td>
<td>6</td>
<td>5</td>
<td>20</td>
</tr>
<tr>
<td>Group 2</td>
<td>23</td>
<td>15</td>
<td>8</td>
<td>0</td>
<td>23</td>
</tr>
</tbody>
</table>

3 simple polypropylene stitches

Our technique with bidirectional barbed absorbable suture (BBAS)

**Table 2. Surgical Time per Ear (in minutes).**

<table>
<thead>
<tr>
<th>n</th>
<th>Mean</th>
<th>Maximum</th>
<th>Minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>25</td>
<td>37.51</td>
<td>52</td>
</tr>
<tr>
<td>Group 2</td>
<td>23</td>
<td>31.76</td>
<td>37</td>
</tr>
</tbody>
</table>

**Table 3. Complication Rates between the 2 Groups.**

<table>
<thead>
<tr>
<th></th>
<th>Group 1 (n = 25)\textsuperscript{a}</th>
<th>Group 2 (n = 23)\textsuperscript{a}</th>
<th>P Value\textsuperscript{b}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hematoma</td>
<td>4 (1)</td>
<td>8.9 (2)</td>
<td>.601</td>
</tr>
<tr>
<td>Bleeding</td>
<td>8 (2)</td>
<td>0</td>
<td>.490</td>
</tr>
<tr>
<td>Granuloma/extrusion</td>
<td>12 (3)</td>
<td>0</td>
<td>.235</td>
</tr>
<tr>
<td>Unilateral recurrence</td>
<td>8 (2)</td>
<td>0</td>
<td>.490</td>
</tr>
<tr>
<td>Bilateral recurrence</td>
<td>8 (2)</td>
<td>0</td>
<td>.490</td>
</tr>
<tr>
<td>Asymmetry</td>
<td>12 (3)</td>
<td>4.3 (1)</td>
<td>.610</td>
</tr>
<tr>
<td>Pain caused by suture knot</td>
<td>48 (12)</td>
<td>0</td>
<td>\textless .001</td>
</tr>
<tr>
<td>Hypertrophic scar/keloid</td>
<td>12 (3)</td>
<td>4.3 (1)</td>
<td>.610</td>
</tr>
<tr>
<td>Reoperation</td>
<td>20 (5)</td>
<td>0</td>
<td>.051</td>
</tr>
</tbody>
</table>

\textsuperscript{a}Values are % (n).

\textsuperscript{b}Bold italics indicate statistical significance.

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**Figure 3.** Extrusion of nonabsorbable polypropylene sutures 8 months after the operation.
Figure 4. Preoperative and 6 month-postoperative views of an otoplasty carried out with the bidirectional barbed absorbable suture (BBAS) technique.

Figure 5. Preoperative and 1-year-postoperative views of an otoplasty carried out with the bidirectional barbed absorbable suture (BBAS) technique.

Figure 6. Preoperative and 3-year-postoperative views of an otoplasty carried out with the bidirectional barbed absorbable suture (BBAS) technique.
reoperation was required to correct relapses even though patients did not use headbands in the postoperative period.

Author Contributions
Antonio Taboada-Suárez, design of the study, data analysis, critical review; Beatriz Brea-García, design of the study, acquisition and data analysis, critical review; Ivan Couto-González, acquisition and data analysis, critical review; José Luis Vila-Moriente, data acquisition, critical review.

Disclosures
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Supplemental Material
Additional supporting information may be found at http://otojournal.org/supplemental.

References