The course of the facial nerve in evaluation of Congenital aural atresia repair candidacy

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Abstract

Objectives: We hypothesized that the path of the facial nerve, and specifically the course of the vertical facial nerve relative to the glenoid fossa, was an important factor in determining the patient’s candidacy for atresia repair. Study design: Retrospective chart review.

Methods: CT scans from 33 atretic ears (26 patients) were evaluated using the Jahrsdoerfer grading scale. These scores were compared to the measured distance between the vertical facial nerve and the posterior limit of the glenoid fossa at the level of the basal turn of the cochlea. Regression analysis showed no correlation between the Jahrsdoerfer score and the facial nerve-glenoid fossa distance. (R^2 = 0.006)

Conclusion: While not correlating specifically with standard aural atresia evaluation scales, the facial nerve-glenoid fossa distance is a surgically relevant consideration that can impact the anterior-posterior dimension of the reconstructed ear canal and tympanum.

Background & Significance

Surgical repair of congenital aural atresia (CAA) is controversial due to variable long-term hearing out comes and the risk of facial nerve damage. However, good hearing results can be obtained with minimal risk in the hands of an experienced surgeon if appropriate patient selection and preoperative evaluation are employed. The Jahrsdoerfer grading scale is the current standard by which most otologic surgeons determine fitness for surgical repair of CAA. The Jahrsdoerfer grading scale is based on the relative normality of 9 anatomic structures in the atretic ear based on high resolutions CT scan. One point is awarded for a relatively normal oval window, middle ear space, facial nerve, malleus-incus complex, mastoid pneumatization, incus-stapes connection, round window, and external ear with a present stapes receiving 2 points for a possible total of 10 points.1, 2

Although the Jahrsdoerfer grading system has been validated independently 1, 3 Shorka et al suggested that it may be unnecessarily complex. Shorka et al found that middle ear space is the only single component of the Jahrsdoerfer scale that is a statistically significant predictor hearing outcome, though facial nerve score approached statistical significance (p<0.08). 3

The course of the facial nerve may be important in predicting hearing outcomes by determining the feasibility of surgery. A larger space makes drilling a wider canal easier and safer and having a wider canal likely prevents complications (such as restenosis or recurrent conductive hearing loss). This is important since postoperative complications have been cited as major hurdles to a successful surgery. TM lateralization is one common problem, but the single most commonly cited post-operative complication is canal stenosis 4, 5. To prevent this, a wider than physiologic canal is recommended.

Placement of this canal is restricted by the dura superiorly, the glenoid fossa anteriorly, and the facial nerve posteriorly. The facial nerve may also block access to the oval window, preventing ossicular chain reconstruction/manipulation. For these reasons, among others, the path of the facial nerve may influence surgical outcome and fitness for surgery.

Methods & Results

We measured the distance between the posterior limit of the glenoid fossa and vertical facial nerve and tabulated those data. The compared that distance to the Jahrsdoerfer score. CT scans of 33 ears (26 patients) were analyzed and the Jahrsdoerfer scoring system was used to evaluate each ear and candidacy for surgery. The CT scans were independently graded by both authors to ensure accuracy. Using transverse cuts on CT scan, the distance between the facial nerve and the glenoid fossa was measured using AMCAS PACS software. This distance was measured at the level of the basal turn of the cochlea. In instances where the glenoid fossa was not visible in the same slice as the basal turn of the cochlea the next inferior slice was used. Statistical analysis was performed using Excel and StatPlus software.

Jahrsdoerfer scores ranged from 3 to 10 with a median score of 8. Facial nerve to glenoid fossa distances ranged from 12.7 mm’s to 1 mm, averaged 7.2 mm’s, and had a standard deviation of 3 mm. Regression analysis (Graph) showed no correlation (R^2 =0.006) between the facial nerve distance and the Jahrsdoerfer scale. Similarly, hearing outcomes had no correlation with facial nerve-glenoid measurements. (These data were compiled under an IRB exempted protocol using de-identified data).

Hearing Results

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<thead>
<tr>
<th>Preoperative Mean Prep SRT</th>
<th>Preoperative Mean Prep SRT%</th>
<th>Postoperative Mean Postop SRT</th>
<th>Postoperative Mean Postop SRT%</th>
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<tbody>
<tr>
<td>62.5 dB</td>
<td>92%</td>
<td>26.5 dB</td>
<td>94%</td>
</tr>
<tr>
<td>(range 45-75 dB)</td>
<td>(range 81-100%)</td>
<td>(range 10-68 dB)</td>
<td>(range 84-100%)</td>
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<tr>
<td>SD 1.5 dB</td>
<td>SD 4.67</td>
<td>SD 4.74</td>
<td>SD 6.24</td>
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Preoperative pure tone audiograms and speech audiometric data were tabulated and analyzed for all patients included in this study (n =33 ears, 26 patients) while postoperative audiologic results were captured for those patients having undergone atresia repair and in whom at least 3 months postoperative data were available. For patients with longer term audiologic data, the last recorded data were utilized. Mean timeframe after CAA surgery for postoperative data was 6.5 months, range 3 months – 4.5 months.

Hearing data were analyzed with facial nerve-glenoid measurements, however no significant correlations could be demonstrated.

Discussion

The path of the facial nerve has been well-documented to be altered in patients with CAA and that path is particularly abnormal in patients with cranio-facial malformations.6, 7 The horizontal facial has been reported as being inferiorly displaced (relative to typical temporal bones) and the vertical portion of the nerve to be more anterior and lateral than anticipated in patients with CAA compared to controls.6 The nerve can be so far anterior that it actually exits through the glenoid fossa.7 These aberrant facial nerves have certainly been encountered clinically and spurred our interest in analyzing this anatomic feature in greater detail. We hypothesized that the course of the facial nerve would be more abnormal in patients with more poorly developed middle ears as measured by the Jahrsdoerfer scale and would contribute to a poorer hearing outcome. If this were true, it would still be unclear whether the location of the never itself led to the poor hearing outcome, or whether the location of the nerve made the surgery unlikely to be successful.

The facial nerve-glenoid fossa distance was chosen as a marker because it was an easily measurable, objective marker on CT scan. This distance also gives a clue as to whether or not it is possible to drill an adequate canal. If the nerve is less than 6 mm from the genoid fossa, it is unlikely that an adequate canal can be drilled in the traditional location. The basal turn of the cochlea was chosen for the level of the measurement because it corresponds to the level of the medial canal and thus, was an easily identifiable marker where the distance could be consistently identified. In scans where the glenoid fossa was not visible at the basal turn of the cochlea the next inferior slice was used.

Given our data, FN-distance does not appear to be related to the Jahrsdoerfer score. Hearing outcomes also seemed to be independent of this measured distance. However, we continue to pay particular attention to this facet of CAA repair on preoperative evaluation as well as intraoperative repair. In our series of patients, the sample of patients with severely compromised facial-glenoid distances was small and we suspect that we may have had insufficient power to detect a significant effect. We continue to collect data on these CAA patients and subtleties in their imaging and anatomic characteristics that will ultimately lead to better outcomes for these challenging patients.

References