The Side of Choice in Pediatric Cochlear Implantation

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Abstract

Introduction: Cochlear implants are the main option for rehabilitation of severe to profound hearing loss patients. Binaural stimulation is the most adequate modality, but the side of choice of cochlear implant surgery on young deafened children has not been completely clarified.

Objective: To investigate the influence of choice of side on cochlear implant surgery, whether the right or the left side, on speech perception and listening skills in a pediatric group.

Materials and Methods: A retrospective study was conducted to analyze listening skills performance of children submitted to cochlear implantation between 2003 and 2010. Fifty-three patients were submitted to cochlear implant surgery (28 in the right ear and 25 in the left ear), by the same surgical team. Oral communication was classified as insufficient, satisfactory, and excellent, according to a subjective evaluation. The MacArthur-Bates Communicative Development Inventory was used for all patients to evaluate the development of listening skills.

Results: The mean age at the time of the activation was 38.35 months (range, 14 to 69.53). The mean age in the right ear implanted group was 37.42 months (range, 15 to 60.42), and in the left ear implanted group 39.72 months (range, 14 to 69.53; \( P = 0.59 \)). The median time of use was 73.63 months in the right ear group, and 55.03 months in the left ear group (\( P = 0.051 \)). Regarding oral communication skills, no statistical differences were found. Average score for the MacArthur-Bates Inventory was 476 in the right ear and 576.5 in the left ear (\( P = 0.659 \)).

Conclusion: We found no differences regarding listening skills after cochlear implantation in the right or the left side, which may imply that the side of choice in cochlear implantation is not crucial for listening skills development.

INTRODUCTION

Cochlear implants (CI) are accepted as the gold standard treatment for severe to profound hearing loss, and their benefits depend on the anatomy, severity, cognition, etiology of hearing loss, duration of hearing impairment, and psychological maturity [1-4]. Despite the fact that the literature has shown the importance of the left hemisphere in speech processing, the effect of side of CI on prelingually deafened children has not been completely clarified [1,5,6].

Recent studies focused on the medial olivocochlear bundle in infants, showed that the right ear is dominant for speech, while left ear is dominant for tonal information [4]. Interestingly, it is classically known that the left cerebral hemisphere is responsible for speech process, and while the right cerebral hemisphere is responsible for the emotional and tonal aspects of speech and music [7].

It is known that binaural hearing reduces the shadow effect of the head and provides the squelch effect, leading to binaural summation leading to central auditory processing and integration when auditory stimulus arrives from both ears [8].

This present study assessed the effect of choosing the side of cochlear implant surgery, whether the right or the left side, on speech perception and listening skills in a pediatric group of patients.

MATERIALS AND METHODS

This study retrospectively evaluated the listening skills performance of children who underwent to cochlear implantation.
surgery and were accompanied at our Department between 2003 and 2010.

Fifty-three patients were included in the study. Twenty-eight of them underwent to cochlear implantation in the right ear and 25 in the left ear. All patients were operated under general anesthesia by the same surgical team, using the same technique. The speech processor was fitted after one month of the surgery.

Oral communication was assessed in regard to their cognitive style and comparisons between groups were performed by means of hearing categories, classified as insufficient, satisfactory, and excellent, according to a subjective evaluation performed by a single Audiologist, as follow: “insufficient” (no comprehension of speech, no auditory attention); “satisfactory” (understanding of speech with no need of visual clues, but eventually need to use lip reading. Use of short sentences and eventually incomplete); and “excellent” (understanding of speech with no need of visual clues, use of oral communication with proper use of connective terms) [9,10].

The MacArthur-Bates Communicative Development Inventory was used for all patients in order to assess the development of listening skills. All children included in this study had bilateral profound hearing loss prior to the cochlear implantation. They had no established oral communication (pre-lingual hearing loss), and were evaluated post-operatively after activation. Intergroup comparisons (between right and left implanted ears) were performed.

Statistical analysis
For the data normally distributed, we used Chi-square test, Fisher’s exact test, and the independent t-test. The Mann-Whitney U-test was used for the data not normally distributed. We used the software SigmaXL version 8.09 for PC (SigmaXL Inc., Canada) for statistical analyses. Findings were considered statistically significant when \( P < 0.05 \).

Ethics
This is a retrospective study with a chart review, so there was no informed consent form to be filled by any patient. The institutional review board approved this project.

RESULTS
The mean age of children at the time of the activation of the CI was 38.35 months (range, 14 to 69.53). The mean age in the right ear implanted group was 37.42 months (range, 15 to 60.42), and in the left ear implanted group 39.72 months (range, 14 to 69.53; \( P = 0.59 \)). Twenty-five patients were male and 31 patients were female. All patients were implanted with Cochlear devices (Cochlear LTD, Australia).

The median time of use of CI was 73.63 months in the right ear implanted group, and 55.03 months in the left ear implanted group (\( P = 0.051 \)).

Regarding oral communication skills, no statistical differences were observed, as demonstrated in Table 1.

Post-operatively, the mean MacArthur-Bates Inventory score was 476 in the right ear and 576.5 in the left ear, with no difference between both groups (\( P = 0.659 \)).

DISCUSSION
Sürmelioglu et al., found that the choice of CI side is not critical to develop the listening skills among their 63 implanted patients [1]. Sharpe et al., found a subtle right ear advantage instead [7]. However, the first study evaluated children from 1 to 5 years of age, while the second study evaluated young adults from 18 to 52 years of age. The same way, we found that the side of implantation was not critical to improve listening skills in our groups.

The “left-hemisphere dominance” is found in about 96% of right-handed and 70% of left-handed persons, and it is responsible for speech perception [7]. As Jiwani et al., demonstrated, early cochlear implantation promoted cortical asymmetries in 34 adolescents with over 10 years of right-sided CI experience [11]. The first CI resulted in more lateralized activity to the contralateral left hemisphere than normal. Our study, however, showed no differences regarding communication skills between right ear and left ear implanted groups. These findings may suggest that the earlier the CI surgery is performed, the better are the acquired communication.

Our study is in accordance with Zanetti et al., They performed cochlear implantation in 82 children aged 1 to 9 years-old and found no statistical differences when compared left to right side implanted ears [12]. Furthermore, D’Alessandro et al., investigated binaural squelch and head shadow effects in 19 children with unilateral CIs and contralateral hearing aids in a noisy environment. They found statistically significant differences between listening conditions, but with no differences when the side of implantation or hearing aid use was compared [13]. On the other hand, Kraaijenga et al., performed a literature review regarding the effect of side implantation of CI among patients with sensorineural hearing loss. They found little evidence on the effect of side implantation – due to heterogeneity of population and outcomes measured within the studies – but a little advantage for a right ear cochlear implantation in prelingually deafened children [14].

It is also very important to mention that despite the fact that we found no differences between both groups (right and left ear implanted ears), we found a slight trend of better listening skills at the right side. As stated by McKinnon, pediatric unilateral and simultaneous bilateral CI is felt to be cost effective [15]. In our understanding, if it is critical any financial issues for the family or for the health system, the surgeon is permitted to choose the right side to perform the surgery.

Lastly, it is widely spread that CI provides central auditory nervous system stimulation of deaf children. Nevertheless, it is important to take place within a brief period during childhood to be maximally effective [16,17]. Despite well-defined factors related to good performance of the CI, like early age at implantation and

<table>
<thead>
<tr>
<th>Oral communication skills between groups (Chi-Square test)</th>
<th>Insufficient</th>
<th>Satisfactory</th>
<th>Excellent</th>
<th>( P )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right ear</td>
<td>8</td>
<td>13</td>
<td>7</td>
<td>0.8359</td>
</tr>
<tr>
<td>Left ear</td>
<td>9</td>
<td>10</td>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>

Table 1: Comparison of communication skills between groups.

lesser time of hearing deprivation [10], laterality in prelingually deafened children is still discussed.

CONCLUSION
This study showed no differences regarding listening skills after cochlear implantation in the right or the left side. This may imply that the side of choice in cochlear implantation is not crucial for listening skills development.

REFERENCES
3. Francis HW, Yeagle JD, Bowditch S, Niparko JK. Cochlear implant outcome is not influenced by the choice of ear. Ear Hear. 2005; 26: 7-16.