Quality of life in hearing-impaired children with bilateral hearing devices


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Key-words. Hearing loss; child; cochlear implants; hearing aids; quality of life

Abstract. Quality of life in hearing-impaired children with bilateral hearing devices. Objective: To evaluate the quality of life (QOL) of hearing-impaired children fitted with either a cochlear implant and a hearing aid or bilateral hearing aids, and to compare their outcomes with those of normal-hearing peers. We also investigated the impact of demographic, clinical, and audiological results on QOL.
Methodology: Cross-sectional study using a generic QOL questionnaire. Questionnaires were completed by children and their parents. Eighty-eight children were divided into three groups: bilateral deaf children with a cochlear implant and a contralateral hearing aid (bimodal group), bilateral deaf children with bilateral hearing aids (hearing aid group), and normal-hearing children. The Spanish version of the KINDLR test was used. Responses were correlated with demographic, clinical, and audiological data.
Results: The questionnaires revealed a high health-related QOL with a total self-rating score for the children and a proxy score for the parents of 75 or higher in five out of six domains. No significant difference was found in the QOL among the three groups. Additionally, there was no significant difference between the self-rating and the proxy total scores, and no significant association was found between the QOL and the variables of the study.
Conclusion: Our results indicate a high level of QOL in hearing-impaired children and their families following treatment with either bilateral hearing aids or bimodal stimulation. Children and their parents reported a QOL similar to that of normal-hearing children.

Introduction

Hearing impairment in children greatly affects their oral language development and related experiential learning, thus affecting their behavioral and social development. Early auditory rehabilitation provided by hearing aid devices enables children to substantially improve their verbal language learning and integrate into the hearing world. Both hearing aids (HAs) and cochlear implants (CIs) are well-established treatment methods for children with different levels of hearing loss (HL). Moreover, multiple studies show that children benefit substantially from bilateral HAs, bilateral CIs, and bimodal stimulation (CI and contralateral HA) and improve in speech recognition in noisy environments and in sound localization. However, most earlier studies focused primarily on measuring the clinical efficacy of these treatments, and their results thus represent only a small portion of the effects that HAs and CIs have on the lives of children and their families. The evaluation of treatment success includes not only objective measures of speech perception and production, but also subjective changes in auditory, language, and educational skills, as well as in quality of life (QOL). There are few reports on the QOL or health-related quality of life (HRQL, a medical definition of QOL) of children with HL; these reports are usually based on poorly validated questionnaires and only occasionally refer to normal-hearing (NH) children. Measuring HRQL in children is complicated due to conceptual, methodological, and developmental issues: on the one hand, an appropriate instrument for measuring all domains of HRQL that are relevant to the target population is required. On the other hand, questionnaires are frequently completed by parental proxy, although

previous studies demonstrated a poor correlation between the scores of parents and their children.4,13

The objective of this study was to evaluate the QOL of hearing-impaired children following bimodal stimulation or bilateral HAs, and to compare their results with those of their NH peers using the adapted Spanish KINDLr questionnaires, which were designed for children, adolescents, and their parents. This questionnaire consists of six subscales that assess the main components of child and adolescent QOL, and it has been validated in Spanish.13,14

Materials and methods

Patients

The study included 88 children divided into two groups of hearing-impaired children and one group of 30 NH children. The hearing-impaired groups consisted of 2-16-year-old children with bilateral mild to profound sensorineural HL and either bilateral HAs (HA group, 28 children) or a CI with contralateral HA (bimodal group, 30 children). All patients were diagnosed and treated in our department from January 2002 to December 2009 and had a minimum of 12 months of device experience. All of them went to school with NH peers and use oral language only. Patients with incomplete information, follow-up, or treatment data, as well as patients with additional disabilities, were excluded from this study. All selected NH children were classmates of their hearing-impaired peers and had normal auditory thresholds without any health problems. All children showed a normal, age-appropriate development with no cognitive issues.

Audiological measurements

Pretreatment audiological tests included tonal and speech audiometry and, in very young children, auditory evoked potentials. Posttreatment audiological tests consisted of free-field speech audiometry with bilateral HAs or CI and HA under standardized conditions at a sound pressure level (SPL) of 65 dB. We used open-set bisyllabic words with visual cues depending on the age of each child.

KINDLr questionnaire

Parents and children older than 4 years were surveyed with the adapted Spanish version of the KINDLr questionnaire for HRQL.13,14 This questionnaire includes three self-reporting questionnaires for children and two proxy (person authorized to act on behalf of someone else) questionnaires for parents. The self-reporting questionnaires consist of the Kiddy-KINDL for children aged 4-7 years, the Kid-KINDL for children aged 8-12 years, and the Kiddo-KINDL for teenagers aged 13-16 years. The two proxy questionnaires for parents comprise the Kiddy-KINDL for parents of children aged 4-7 years and the Kiddo-KINDL for parents of children aged 8-16 years. The Kid and Kiddo questionnaires for parents and children include 24 items based on a five-point Likert scale. The version for 4-7-year-old children includes 12 items based on a three-point Likert scale to adjust the questionnaire to younger children. The Kiddy version for parents contains 24 items plus 22 extra items to obtain information not provided by the children. The KINDLr questionnaires are divided into six dimensions including physical well-being, emotional well-being, self-esteem, family, friends, and everyday functioning (school). A score was obtained for each dimension, as well as a total score for the entire questionnaire (KINDL-total QOL). Scores were transformed into a 0-100 scale, in which 0 is the minimum and 100 the maximum HRQL score.

Statistical analyses

Baseline demographic and audiological data are presented as mean, standard deviation, and range (minimum and maximum). The KINDLr scores of the HA and bimodal groups were both compared to the scores of the NH group using the nonparametric Mann-Whitney U-test. The Wilcoxon signed-rank test was applied to look for an association between the self-rating scores and the proxy scores. Additionally, the total scores, the self-rating scores, and the proxy scores were correlated with demographic, clinical, and audiological data using Spearman’s correlation. Prior to statistical analysis, the Kolmogorov-Smirnov test was conducted to check the data distribution. Statistical significance was set to $p < 0.05$. All data were analyzed using SPSS 13.0 for Windows (Chicago, IL, USA). This study was approved by the Hospital Review Board.

Results

The HA group included 18 males (64%) and ten females with a mean age of 7 years (range: 2-16 years). The mean age at diagnosis was 2 years. The mean duration of
deafness was 16 months (range: 1-63 months), and the mean duration of HA use was 3.5 years (range: 1-16 years). The severity of deafness in this group included a mild-to-severe HL with a mean pure tone audiometry (PTA) threshold of 75 dB (range: 45-115 dB) in the worst ear. All patients used bilateral HAs and had a mean score of 70% (standard deviation [SD]: 36) on bisyllabic recognition in free-field audiometry.

The bimodal group included 16 males (53%) and 14 females with a mean age of 8 years (range: 2-16 years) and a mean age at diagnosis of 1 year. The mean duration of deafness was 42 months (range: 46-160 months), and the mean duration of CI use was 3.5 years (range: 1-9 years). All patients had a bilateral severe-to-profound HL using unilateral CI (26 MED-EL and four Cochlear) and HA with a mean PTA threshold of 103 dB (range: 90-110 dB). They achieved a mean score of 80% (SD: 26) on bisyllabic recognition. The etiology of deafness in patients in both groups is shown in Table 1. The group of NH children included 17 males (57%) with a mean age of 7 years (range: 4-16 years).

The self-rating scores of the KINDLr questionnaires were 75 or higher in five out of six domains (Tables 2 and 3). No difference was found in the QOL rating among the three groups (HA, bimodal, and NH). Only the "everyday functioning" domain, which had the lowest scores in all three groups, was slightly higher in the HA group compared to the bimodal and NH groups. The differences, however, were not significant. In contrast to the very low self-rating scores in the "everyday functioning" domain, all three groups reached a total score of 75 or higher in the parental proxy rating (Table 3).

Apart from the "everyday functioning" domain, which was significantly lower in the self-rating group (p = 0.03), there was no significant difference between the self-rating scores and the proxy scores in any other domain. No significant association was found when comparing the total self-rating score and the total proxy score with demographic (age and sex), clinical (age at treatment, length of deafness, and length of wearing a hearing device), or audiological variables (HL and speech perception results). Similarly, no significant association was found when we compared demographic, clinical, and audiological variables with the QOL scores reported by children and their parents.

**Discussion**

Early restoration of auditory input provided by HAs or CIs can reverse the adverse effects of HL in children. These treatment methods enable hearing-impaired children to improve not only in audiological aspects, but also in other areas of life. It is important to evaluate the global effectiveness of HAs or CIs beyond hearing and speech development and, additionally, with more general objectives concerning QOL. Ideally, a valid QOL or HRQOL measurement would capture the general effects of treatment upon different aspects of a child’s life. However, measuring HRQOL in children is complicated, as young children have a limited ability to answer questionnaires. In addition, the factors influencing QOL differ according to age. For these reasons, it is very important to use previously validated instruments to interpret the results. To our knowledge, there are no validated, specific questionnaires that include hearing-impaired children with CIs and HAs. Moreover, questionnaires dealing with hearing impairment do not usually apply to NH children.

In our study, the majority of hearing-impaired children and adolescents reported a high HRQOL, and there was no significant difference between the hearing-impaired and NH groups. These findings are in contrast with previous studies, which found a poorer HRQOL in children with HL.
and treatment compared to NH peers. Using KINDLr, Huber demonstrated that 8–12-year-old CI users had lower self-rated HRQL scores than NH children. Wake et al., using the Child Health Questionnaire on children with congenital HL, showed that parents of deaf children reported a significantly poorer HRQL compared to the parents of NH peers.

We believe that the parent-child agreement in the present study may be explained by the benefits offered by the rehabilitation program, which commenced immediately after HL identification. This rehabilitation program contributes to the overall benefit provided by the hearing device(s) and provides support to family members, who also play an active role in rehabilitation.

The KINDL self-rating and proxy total scores in this study were not correlated with demographic, medical, and audiological variables. The lack of a correlation between HA or CI user satisfaction and audiological and speech results was reported previously by multiple authors. In a recent study, Chmiel et al. asked children to rate some aspects of their own QL (e.g., peer acceptance and overall problems). Wake et al. used the Child Health Questionnaire with children who had congenital HL and demonstrated that parents of deaf children reported a significantly poorer HRQL compared to the parents of NH peers.

### Table 2
**KINDLr self-rating scores**

<table>
<thead>
<tr>
<th></th>
<th>Physical well-being</th>
<th>Emotional well-being</th>
<th>Self-esteem</th>
<th>Family</th>
<th>Friends</th>
<th>Everyday functioning</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hearing aid</td>
<td>93</td>
<td>80</td>
<td>87</td>
<td>81</td>
<td>78</td>
<td>34</td>
<td>81</td>
</tr>
<tr>
<td>Bimodal</td>
<td>79</td>
<td>80</td>
<td>75</td>
<td>78</td>
<td>81</td>
<td>26</td>
<td>76</td>
</tr>
<tr>
<td>Normal hearing</td>
<td>83</td>
<td>80</td>
<td>84</td>
<td>75</td>
<td>89</td>
<td>30</td>
<td>83</td>
</tr>
</tbody>
</table>

Scores are transformed into a 0–100 scale; 0 = minimum, 100 = maximum health-related quality of life scores.

### Table 3
**KINDLr proxy (parental) scores**

<table>
<thead>
<tr>
<th></th>
<th>Physical well-being</th>
<th>Emotional well-being</th>
<th>Self-esteem</th>
<th>Family</th>
<th>Friends</th>
<th>Everyday functioning</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hearing aid</td>
<td>89</td>
<td>86</td>
<td>81</td>
<td>79</td>
<td>84</td>
<td>75</td>
<td>80</td>
</tr>
<tr>
<td>Bimodal</td>
<td>86</td>
<td>84</td>
<td>79</td>
<td>82</td>
<td>82</td>
<td>78</td>
<td>79</td>
</tr>
<tr>
<td>Normal hearing</td>
<td>81</td>
<td>84</td>
<td>75</td>
<td>81</td>
<td>86</td>
<td>82</td>
<td>78</td>
</tr>
</tbody>
</table>

Scores were transformed into a 0–100 scale; 0 = minimum, 100 = maximum health-related quality of life scores.
study, Loy et al. reported an association between QOL scores and earlier implantation. A child's communication outcomes, audiological benefits, and language capacities may influence the assessment of QOL to such an extent that parents and children may report a higher QOL rating for children with higher communication performance abilities than for children with poor speech perception and production. Our findings suggest that, in addition to improved speech recognition, HL treatment has a positive impact on several other domains, such as psychological well-being, behavior, self-esteem, social functioning, and life-style.

Conclusion

Our results indicate that deaf children and their families feel a high level of satisfaction following HL treatment. Using a generic QOL questionnaire, we found that children with HL who are treated with bilateral HAs or bimodal stimulation may achieve a QOL similar to that of NH children. Furthermore, QOL depends not only on audiological performance, but also on factors such as family support, education, and communication abilities.

References