Effects Of Tonsillectomy On Acoustic Parameters
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Citation

Abstract
The vocal tractus from the glottis to the lips is considered to be a resonator and any change in its shape may cause voice changes. Since tonsillectomy causes a shape and volume difference in supraglottic area, it is assumed that acoustic characteristics may change postoperatively. In this study, the effects of tonsillectomy over voice parameters is examined. 20 patients (13 males, 7 females), aged between 21 and 39 were included to the study. They all went tonsillectomy for recurrent episodes of tonsillitis under regional anesthesia. Voice samples to measure F0 (fundamental frequency) and F1, F2, F3 formants were recorded 1 week before and 3 months after the surgery. These parameters were analyzed on a sustained [a:] using the CSL main program with the Computerized Speech Lab CSL 4300B (Kay Elemetrics Ltd., Lincoln Park, NJ, USA). The patients were also asked, whether they perceived any change in their voices postoperatively. None of the patient perceived any change in his/her voice postoperatively. F0 did not show any significant change postoperatively. F1 formant has a tendency to decrease, F2 and F3 formant has a tendency to increase after surgery. But this is statistically not significant. Although changes in formants after surgery is not significant, in cases for vocal performing artists, they should be warned for the possible changes in voice colors after surgery.

INTRODUCTION
Tonsillectomy is a common surgical procedure performed to treat upper respiratory tract infections and/or obstructive disease. This procedure is one of the most performed surgical procedures worldwide. The vocal tractus from the glottis to the lips is considered to be a resonator and any change in its shape may cause voice changes. Since tonsillectomy causes a shape and volume difference in supraglottic area, it is assumed that acoustic characteristics may change postoperatively. But the question is whether these changes are minimal or they have a crucial effect over voice parameters? The answer to this question is important for the vocal performing artists, since any change in vocal quality may interfere performing their jobs.

In this study, the effects of tonsillectomy over voice parameters is examined.

MATERIAL & METHOD
20 patients (13 males, 7 females), aged between 21 and 39, mean age 29, were included to the study. They all went tonsillectomy for recurrent episodes of tonsillitis under regional anesthesia. Voice samples to measure F0 (fundamental frequency) and F1, F2, F3 formants were recorded 1 week before and 3 months after the surgery. These parameters were analyzed on a sustained [a:] using the CSL main program with the Computerized Speech Lab CSL 4300B (Kay Elemetrics Ltd., Lincoln Park, NJ, USA). The patients were also asked, whether they perceived any change in their voices postoperatively. Statistical analysis was carried out using Paired Sample T-Test procedure.

RESULTS
Results were shown in table 1. The means and the standard deviations of the study groups were shown in table 2. Fundamental frequency (F0) did not show any statistically significant change postoperatively. F1 formant has a tendency to decrease, F2 and F3 formants has a tendency to increase after surgery. But this is also statistically not significant. None of the patients perceived any change in his/her voice postoperatively.
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DISCUSSION

The effects of tonsillectomy on the voice have not been studied extensively from the perspective of acoustic changes, other than its effect on nasalance \((*)\). A few studies have examined potential changes in vocal quality after tonsillectomy. In general, minimal changes were found \((**\text{add refs.})\). Tonsillectomy can affect the voice by enlarging the resonating chamber and altering the formant frequencies or by altering the conformation of the tonsillar fossae \((*)\). Potentially, part of the soft palate musculature can be removed or disturbed. This could theoretically lead to scarring and subsequent limitation of fine motor control or even velopharyngeal closure \((*)\).

It is not expected that fundamental frequency (F0) change after tonsillectomy. Because it is an operation that did not directly affect larynx and not influence the rate at which vocal folds open and close during phonation.

With respect to supralaryngeal factors, if extirpation of soft tissue from the oropharynx altered the anatomy of the

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**Figure 1**

Table 1: The vocal analysis results of the patients. Any perceived voice change by the patients themselves is also marked. (N= No), f=female; m=male

<table>
<thead>
<tr>
<th>Patient</th>
<th>Pre-op F0</th>
<th>Pre-op F1</th>
<th>Pre-op F2</th>
<th>Post-op F0</th>
<th>Post-op F1</th>
<th>Post-op F2</th>
<th>Perceived voice change</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>194, 64</td>
<td>1342, 22</td>
<td>232, 12</td>
<td>224, 66</td>
<td>185, 8</td>
<td>254, 2</td>
<td>N</td>
</tr>
<tr>
<td>2</td>
<td>218, 2</td>
<td>1433, 22</td>
<td>218, 12</td>
<td>172, 72</td>
<td>134, 2</td>
<td>218, 2</td>
<td>N</td>
</tr>
<tr>
<td>3</td>
<td>164, 446</td>
<td>1513, 22</td>
<td>203, 12</td>
<td>442, 117</td>
<td>111, 2</td>
<td>321, 2</td>
<td>N</td>
</tr>
<tr>
<td>4</td>
<td>255, 21</td>
<td>1394, 22</td>
<td>321, 12</td>
<td>240, 801</td>
<td>111, 2</td>
<td>321, 2</td>
<td>N</td>
</tr>
<tr>
<td>5</td>
<td>221, 56</td>
<td>932, 22</td>
<td>216, 12</td>
<td>559, 1002</td>
<td>394, 2</td>
<td>394, 2</td>
<td>N</td>
</tr>
</tbody>
</table>

**Figure 2**

Table 2: The means and standard deviations of the study groups.

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-op FO</td>
<td>150,70</td>
<td>57,64</td>
</tr>
<tr>
<td>Post-op FO</td>
<td>152,25</td>
<td>54,42</td>
</tr>
<tr>
<td>Pre-op F1</td>
<td>530,95</td>
<td>161,12</td>
</tr>
<tr>
<td>Post-op F1</td>
<td>529,95</td>
<td>162,90</td>
</tr>
<tr>
<td>Pre-op F2</td>
<td>1219,70</td>
<td>254,10</td>
</tr>
<tr>
<td>Post-op F2</td>
<td>1225,50</td>
<td>246,01</td>
</tr>
<tr>
<td>Pre-op F3</td>
<td>3087,65</td>
<td>428,00</td>
</tr>
<tr>
<td>Post-op F3</td>
<td>3139,20</td>
<td>377,10</td>
</tr>
</tbody>
</table>
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supralaryngeal acoustic transmission pathway and possibly the dynamics of physiologic function, the acoustic measures related to vocal tract resonances could be changed (1). If viewed from the vowel structures’s point, some vowels may show a change in their structure after tonsillectomy, but since the structures of vowel /a/ remained basically unchanged postoperatively, it may partly explain the statistically indifferent changes in formants in our study (1).

Chuma et al. reported that tonsillectomy had only minor quantitative and qualitative effects on various acoustic parameters (1). Saida et al. and Hori et al. also reported similar observations in their studies (2,3). In general, it was reported that after tonsillectomy, fundamental frequency and F1 and F2 formant frequencies remained unchanged whereas F3 decreases and F4 increases postoperatively (1). But some other reports doesn’t support this findings (4,5).

Patients may ask about the possibility of voice changes after tonsillectomy. Patients' perception of voice is an important treatment outcome measure, especially in the case of benign disease where the greatest impact is on the quality of life (6). They should be advised of potential voice changes, especially professional voice users who may be particularly sensitive to changes in resonant characteristics. However, according to Behrman et al., one fifth of the patients perceived their voices to be improved after surgery and none thought that the voice to be worse (1). Therefore, it is concluded that patients are unlikely to perceive a change in voice as a result of surgery, but in those cases where a difference is perceived, it is likely to be a positive change.

For children, anectodal accounts of some parents suggest that tonsillectomy changes sometimes voice production within the first few weeks after surgery. These parental concerns may in part reflect short-term acoustic changes associated with hyponasal speech improving to normal, normal speech becoming more hypernasal (1). In our study, the subjects were not asked to come just after surgery, since it was expected that during the healing process some voice parameters be changed and limitation in singing or performing be noted (1). The focus of our study was to research any permanent voice change after surgery.

In a retrospective study among the performing artists done by Jarboe et al. it was stated that patients' voices were not impaired after tonsillectomy. The majority of the patients also reported that they perceived an improvement in their singing, but this should not be discussed as an indication for surgery, simply a possible coincidental outcome. The expression of improvement in voices after surgery could be related to the reduction of discomfort in throat and to the enlarged resonating chamber.

The gathered information in this study suggests that tonsillectomy can be performed safely in vocal performing artists despite their specialized requirements for pharyngeal function (1).

CONCLUSION

Based on our study, tonsillectomy does not have any effect over fundamental frequency. Although changes in formant frequencies after surgery is not significant, in cases for vocal performing artists, they should be warned for the possible subtle changes in voice colors after surgery, though it is presumably positive.

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