INTRODUCTION

Advances in magnetic resonance imaging (MRI) and computed tomography (CT) technology have opened new dimensions for understanding anatomy and physiology of head and neck lesion. However, practical application of these technologies is limited in some situations because of its cost, accessibility, and complexity. Furthermore, evaluation of 3-dimensional (3D) glottic insufficiency is difficult because of the required scanning time or resolution of the images while understanding of 3D pathology is important to select proper surgical procedure to treat glottic insufficiency. Fiberoptic or rigid laryngoscopy is an handy diagnostic procedure to understand the 3D pathology but these endoscopic evaluations are unsatisfactory to provide vertical information of the diseased larynges. Cone beam CT technology (CBCT) was developed for the office-based quick and precise 3D visualization of maxillofacial region at relatively modest cost. This technology applies cone beam x-rays to the head and neck, providing 2D and 3D images. CBCT requires short scanning time of less than 10 seconds and provides isotropic 3D image with significantly high resolution. In addition, this novel device has several potential advantages such as lower cost compared with conventional CT or MRI and the ability to conduct scans with the patient in the sitting position (Table 1). Recent reports suggest the advantages to utilizing CBCT in the maxillofacial lesion or temporal bone for precise imaging of these lesions. However, utility of CBCT to visualize the laryngeal area has not yet been reported. Quick 3D visualization utilizing this novel device could provide critical information to better understand the glottic insufficiency. In this study, we measured the shape/size of paralyzed larynx in Japanese patients with multiple parameters using CBCT, and examined as a tool for 3D evaluation of the glottal insufficiency.

Table 1. Potential Advantages of CBCT compared to conventional CT or MRI

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<thead>
<tr>
<th>Advantage</th>
<th>CBCT</th>
<th>Conventional CT</th>
<th>MRI</th>
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<tbody>
<tr>
<td>Scanning position</td>
<td>Sit-down</td>
<td>Supine</td>
<td>Supine</td>
</tr>
<tr>
<td>Definition</td>
<td>0.08-mm</td>
<td>0.5-mm</td>
<td>0.5-mm</td>
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<tr>
<td>Scanning time</td>
<td>9.6sec</td>
<td>20-sec</td>
<td>4-min</td>
</tr>
<tr>
<td>Radiation exposure</td>
<td>Lower</td>
<td>Higher</td>
<td>—</td>
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<tr>
<td>Cost</td>
<td>Modest</td>
<td>Expensive</td>
<td>Expensive</td>
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</tbody>
</table>

RESULTS

Figure 2. Scatter diagram representing the lengths of bilateral vocal folds. Mean lengths of non-diseased vocal folds (females, 12.9mm; males, 18.5mm) were significantly longer compared with diseased side (females, 12.4mm; males, 17.7mm) either in females (p=0.001) and males (p=0.011). These results were slightly longer than previous data using Japanese cadavers.

Figure 3. Posterior and center horizontal gaps. Data were normalized with the lengths of non-diseased vocal folds. Posterior glottal gaps of non-diseased vocal folds were significantly larger compared with diseased side (p<0.001). However, there were no significant difference at the center, possibly representing the bowing deformity of the paralyzed vocal folds.

Figure 4. Horizontal glottal angles. Angles were significantly wider in normal site (16.1° ±2.7°) compared with diseased site (9.4° ±5.3°, p=0.0011) (a). Paralyzed vocal folds sit in various angles compared with non-diseased sites. However, position of the diseased vocal folds peaked approximately half for the angles measured in normal sites. These results showed that paralyzed vocal folds tend to locate in paramedian position (b).

Figure 5. Posterior and center vertical gaps. Data were normalized with the lengths of non-diseased vocal folds. As compared with the center gap, vertical gaps tended to be large in the posterior gap (a). Actual values of posterior vertical gaps were shown. Sixty-two % of posterior vertical gaps were less than 1 mm (b).

CONCLUSIONS

• CBCT evaluation of larynges was successfully performed on 89 patients with vocal fold paralysis.
• Our study provided the first demonstration of the correct measurement of paralyzed larynx in live Japanese patients.
• Both the horizontal, as well as the vertical gaps varied between patients showing the multiple pathology of diseased larynges.
• Our data showed that CBCT might enable the precise assessment of diseased larynges for proper therapeutic procedures.
• Future studies combined with either laryngeal functions or therapeutic outcomes are warranted.

REFERENCES