Calcium hydroxylapatite injection laryngoplasty outcomes in irradiated and non-irradiated unilateral vocal fold paralysis patients

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INTRODUCTION

Objectives: To evaluate the effect of radiation therapy on the voice outcome and duration of effect of calcium hydroxylapatite (CaHA) injection laryngoplasty in unilateral vocal fold paralysis (UVFP) patients.

Study Design: Retrospective case series

Methods: UVFP patients treated with CaHA injection laryngoplasty at the UCSF Voice and Swallowing Center were identified. Examinations were analyzed for laryngostroboscopic and CAPE-V parameters.

Results: 4 non-irradiated and 5 irradiated patients underwent 6 and 9 injection laryngoplasties, respectively. Time to additional procedures was longer in irradiated patients (p = 0.02). Prior to injection, non-irradiated patients had more severe glottic insufficiency (p=0.007, 0.002) than irradiated patients. Post-injection, irradiated patients demonstrated improvement in overall voice quality, breathiness, and loudness, while non-irradiated patients demonstrated improved overall quality, breathiness, pitch, and loudness. Voice quality was not statistically different between patient groups.

Conclusion: CaHA injection laryngoplasty improved voice quality in both irradiated and non-irradiated patients. Non-irradiated patients experience greater vocal improvement compared to irradiated patients. Vocal cord stiffness due to radiation-induced changes may be responsible for the lack of improvement in pitch. Time to additional procedures was longer in irradiated patients and may be secondary to effects of prior radiation on graft resorption. Vocal fold mediation with CaHA injection remains a safe and efficacious treatment for UVFP in both irradiated and non-irradiated patients.

METHODS AND MATERIALS

A retrospective series of 4 non-irradiated and 5 irradiated patients undergoing 6 and 9 laryngoplasties respectively for UVFP was assessed.

Pre- and postoperative voice and laryngostroboscopic recordings were evaluated:

- CAPE-V parameters included overall voice quality, roughness, breathiness, strain, pitch, and loudness.
- Pre- and postoperative voice values within 12.5 points (1/2 of the span of “mild disorder” in the CAPE-V system) were considered equivalent.

Laryngostroboscopic parameters included glottic insufficiency, salivary pooling, ventricular contraction, volitional arytenoid adduction, vocal process contact, arytenoid stability and position, and vocal fold bowing, tone, atrophy, shortening, and height mismatch.

Multiple observers rated each of the measures to allow calculation of inter and intra-rater reliability.

RESULTS

- No complications were recorded in either patient group.
- Time to additional procedures was 5.0 mo in non-irradiated patients and 13.7 mo in irradiated patients (p = 0.02).
- Preoperatively, irradiated patients had less severe glottic insufficiency than non-irradiated patients (p = 0.007, 0.002).
- Both patient groups had improvement in voice: Voice parameters with improvement (based on the 12.5 point threshold) include:
  - Both patient groups: Overall quality, breathiness, and loudness
  - Non-irradiated only: Pitch
- There were no statistically significant differences between irradiated and non-irradiated groups in either pre- or postoperative voice parameters.

DISCUSSION

- Increased time to additional procedures in irradiated patients may be explained by:
  - Decreased vascularity in irradiated tissue which may result in decreased absorption of injected CaHA and carrier materials.
  - Desire to delay instrumentation in irradiated patients.
- Lack of improvement in voice parameters, excluding overall quality, breathiness, and loudness, in irradiated patients seems consistent with baseline radiation-induced vocal fold stiffness.
- Improvement in voice parameters approached but did not reach statistical significance likely due to small sample size.
- Less severe pre-injection glottic insufficiency in irradiated patients may be due to vocal fold medialization from radiation induced fibrosis.
- Selection bias may limit our study; because type I thyroplasty is generally offered to non-irradiated patients, non-irradiated patients who opt for CaHA injection may be patients with poor prognosis.

CONCLUSIONS

- The purpose of this study was to determine whether radiation to the larynx affects voice outcome and duration of voice improvement following CaHA injection laryngoplasty.
- Radiation effects may contribute to less severe glottic insufficiency at baseline, as well as increased duration of effect and lack of improvement in pitch following injection.
- Vocal fold medialization with CaHA injection remains a safe and efficacious treatment for UVFP in both irradiated and non-irradiated patients.

REFERENCES


Table I. Inter- and Intra-rater Reliability

<table>
<thead>
<tr>
<th>Voice Parameter</th>
<th>ICC</th>
<th>Pearson's Coefficient (r)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>0.87</td>
<td>0.92</td>
</tr>
<tr>
<td>Roughness</td>
<td>0.85</td>
<td>0.91</td>
</tr>
<tr>
<td>Breathiness</td>
<td>0.79</td>
<td>0.98</td>
</tr>
<tr>
<td>Strain</td>
<td>0.51</td>
<td>0.79</td>
</tr>
<tr>
<td>Pitch</td>
<td>0.70</td>
<td>0.88</td>
</tr>
<tr>
<td>Loudness</td>
<td>0.74</td>
<td>0.91</td>
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</table>

Table II. Proportion of Abnormal Stroboscopic Parameters

<table>
<thead>
<tr>
<th>Time Point</th>
<th>Grittish Insufficiency</th>
<th>Salivary Pooling</th>
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<tbody>
<tr>
<td></td>
<td>nonRT</td>
<td>RT</td>
</tr>
<tr>
<td>Preop</td>
<td>Grader 1</td>
<td>82%</td>
</tr>
<tr>
<td></td>
<td>Grader 2</td>
<td>87%</td>
</tr>
<tr>
<td>6 mo</td>
<td>Grader 1</td>
<td>82%</td>
</tr>
<tr>
<td></td>
<td>Grader 2</td>
<td>83%</td>
</tr>
</tbody>
</table>

Table 2. Preoperatively, non-irradiated patients had higher proportions of moderate to severe (versus mild to absent) glottic insufficiency than irradiated patients (Fisher’s Exact, p = 0.05).

* Statistically significant based on both graders (p<0.05).

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