Dysphonia and dysphagia after anterior cervical decompression

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Object. In this paper, the authors investigate the effects of anterior cervical decompression (ACD) on swallowing and vocal function.

Methods. The study comprised 114 patients who underwent ACD. The early group (50 patients) was examined immediately pre- and postoperatively, and the late group (64 patients) was examined at only 3 to 9 months postoperatively. Fifty age- and sex-matched patients from the Department of Otorhinolaryngology—Head and Neck Surgery who had not been intubated in the previous 5 years were used as a control group. All patients in the early and control groups were examined by a laryngologist; patients in the late group were examined by a laryngologist and a neurosurgeon. Videolaryngostroboscopy was performed in all members of the patient and control groups, and the function of the ninth through 12th cranial nerves were clinically evaluated. Data were collected concerning swallowing, voice quality, surgery results, and health-related quality of life. Patients with persistent dysphonia were referred for phoniatric evaluation and laryngeal electromyography (EMG). Those with persistent dysphagia underwent transoral endoscopic evaluation of swallowing function and videofluorography.

Results. Sixty percent of patients in the early group reported dysphonia and 69% reported dysphagia at the immediate postoperative visit. Unilateral vocal fold paresis occurred in 12%. The prevalence of both dysphonia and dysphagia decreased in both groups 3 to 9 months postoperatively. All six patients with vocal fold paresis in the early group recovered, and in the late group there were two cases of vocal fold paresis. The results of laryngeal EMG were abnormal in 14 of 16 patients with persistent dysphonia. Neither intraoperative factors nor age or sex had any effect on the occurrence of dysphonia, dysphagia, or vocal fold paresis. Most patients were satisfied with the surgical outcome.

Conclusions. Dysphonia, dysphagia, and vocal fold paresis are common but usually transient complications of ACD. Recurrent laryngeal nerve damage detected by EMG is not rare. Pre- and postoperative laryngeal examination of ACD patients should be considered. (DOI: 10.3171/SPI-07/08/124)

Key words • anterior cervical decompression • dysphagia • dysphonia • vocal fold paralysis

Anterior cervical decompression is widely used for nerve root decompression for herniated discs and spondylosis.2,3,21 This surgical approach necessitates some distension of tissue to reach the damaged anterior part of the cervical spine.1,3,6,10,22,23,25 The vagus and recurrent nerves are not visualized during surgery, but are known to suffer from this distension; dysphonia and dysphagia are also known complications.1,4,6,8,11,13,15,17,18,26,29,32,33 The damage caused by the cranial nerve distension in the neck area is usually reversible. Smith-Hammond and colleagues6 compared swallowing difficulties in 38 patients after ACD, 19 patients after posterior cervical decompression, and 26 patients after posterior lumbar decompression, and showed that 47% had swallowing difficulties after ACD, 21% after posterior cervical decompression, and none after posterior lumbar decompression. Most of their patients recovered within a few weeks postoperatively. They also demonstrated that intubation seems to have no adverse effect on the voice or on swallowing. The authors of a report on 23 patients demonstrated that swallowing and speech dysfunction after ACD correlate with the number of disc spaces operated on in one surgical session, and that these side effects were mostly caused by soft-tissue swelling.22 Although the use

Abbreviations used in this paper: ACD = anterior cervical decompression; EMG = electromyography; HRQOL = health-related quality of life; HUCH = Helsinki University Central Hospital; VAS = visual analog scale.
Dysphonia and dysphagia after ACD

of a right-sided surgical approach causes more recurrent nerve distension because of the anatomy, the side of the surgical approach does not seem to affect the incidence of dysphonia.

In these earlier studies the patient groups were small, and many lacked a control group. We examined a larger group of patients who underwent ACD with a control group to determine the duration and severity of dysphonia and dysphagia after the procedure. Moreover, laryngeal EMG was performed to evaluate recurrent laryngeal nerve damage.

Clinical Material and Methods

Patient Population

All patients underwent surgery at HUCH. The first 100 consecutive patients who underwent ACD at the Department of Neurosurgery in 2004 were invited by letter for a postoperative visit 3 to 9 months (median 6.1 months) postoperatively. Of these, 64 patients agreed and entered the study (the “late group”). Their mean age was 51 years (range 29–84 years, median 51 years). To evaluate the immediate pre- and postoperative signs and symptoms we invited by letter, later in 2004, another series of 196 consecutive patients who had undergone ACD, and 50 of those invited entered the study (the “early group”). Their mean age was 52 years (range 23–80 years, median 53 years). The preoperative examination in this group was performed 1 day before or on the day of surgery, and the postoperative examination was performed on the day of discharge, usually the first postoperative day (range 1–7 days, median 1 day). A questionnaire was sent to these patients 3 months postoperatively. The patients in whom there were clinical findings at the first postoperative visit and who had reported persistent dysphonia or dysphagia on the questionnaire were invited for a second follow-up visit (Fig. 1).

Control Group

As a control group for the patients in the early group, we examined 50 age- and sex-matched patients at the Department of Otorhinolaryngology—Head and Neck Surgery. These patients were being seen for reasons other than dysphagia or dysphonia, and had not been intubated in the past 5 years. Patients with acute infections or head and neck malignancies were excluded. The control group mainly comprised patients with vertigo, nasal polyposis, cholesteatoma, and sleep apnea.

Clinical Protocol

Members of the patient and control groups were examined by an ear, nose, and throat specialist (L.M.A.) or by an experienced resident (H.T.). Videolaryngostroboscopy was performed, and the functions of the ninth through 12th cranial nerves were clinically tested in all patients. Data on vocal and swallowing ability, the subjective quality of voice and speech, and surgery results were collected via structured questionnaires and the VAS. In the VAS, the patients are asked to draw a vertical line crossing a 100-mm horizontal line where 0 indicated no symptoms, and 100 indicated very intensive symptoms. Patients in the late group were also examined by a neurosurgeon (M.N.). Patients with persistent dysphonia 3 to 9 months postoperatively were referred for laryngeal EMG (T.S.) and phoniatric examination (E.R.L.), and those with dysphagia were examined by a speech pathologist (A.J.). Structured questionnaires were used, and transoral endoscopic evaluation of swallowing was performed. Patients with pathological findings or subjectively evaluated severe symptoms were referred for videofluorography. All members of the control group underwent the same research protocol. Informed

![Flow chart demonstrating patient groups and the research protocol.](image-url)
consent was obtained from all individuals and the human experimentation guidelines of HUCH were followed. The study was approved by the Ethics Review Board of the Helsinki and Uusimaa University Hospital District.

Health-related QOL was assessed using the 15D instrument, a generic 15-dimensional, standardized, self-administered, HRQOL measurement useful both as a profile and a single index score measure. The 15D questionnaire surveys patient opinion on 15 aspects of everyday function: moving, seeing, hearing, breathing, sleeping, eating, speaking, eliminating, usual activities, mental functioning, discomfort (and symptoms), depression, distress, vitality, and sexual activity. For each dimension, the respondent must choose one of the five levels that best describes his or her state of health at the moment (1 = best level; 5 = worst). The valuation system of the 15D instrument is based on an application of the multiattribute utility theory. A set of utility or preference weights, elicited from the general public through a three-stage valuation procedure, is used in an additive aggregation formula to generate the utility score, such as the 15D score (a single index number) over all the dimensions. The best score is 1 (signifying no problems with any dimension), and the worst score is 0 (dead). A minimally important difference 0.03 or greater is considered clinically significant. In most of the important properties, the 15D compares favorably with other instruments of its kind. The 15D questionnaire has also been used to evaluate HRQOL for patients with spinal disorders.

**Surgical Technique**

All ACDs were performed via the Smith–Robinson approach by neurosurgeons or experienced residents at the Department of Neurosurgery at HUCH. All patients were in a state of general anesthesia with the endotracheal cuff inflated at all times. The endotracheal cuff was not deflated during the surgery because of the increased risk for aspiration and to achieve better and more controlled ventilation, but low-pressure cuffs were used, and the cuff pressure was monitored throughout the operation. After the incision, self-retraining retractors (CCR, B. Braun Medical) were installed. Discectomy was always followed by interbody fusion with a carbon cage (CESPACE, B. Braun Medical) or a titanium cage (Rabea, Fuchs Medical Oy) without a plate; patients with corpectomies were excluded. The side of approach was chosen according to the preference of the neurosurgeon. The tracheae in all patients were extubated in the operating theater immediately after the procedure. There were no cases of postoperative hematoma, and the patients were discharged without collar immobilization.

**Statistical Analysis**

Descriptive statistics were calculated to describe the distribution of variables. The Fisher two-tailed exact test served to determine whether any associations existed between two categorical variables. The Student t-test was used to compare differences in mean values of continuous variables. Logistic regression models allowed analysis of the association between dichotomous dependent and continuous independent variables. Statistical analysis was performed using commercially available software (SAS version 8.02, SAS Institute Inc.). The data from the 15D survey were analyzed using SPSS software version 11.0 for Windows (SPSS, Inc.). The results are given as means ± standard deviations. The significance of the differences in 15D scores and dimension level values between baseline status and the 3-month follow-up score were analyzed using the Student paired t-test for dependent samples. Probability values less than 0.05 were considered statistically significant.

**Results**

No marked dysphonia, dysphagia, or pathological clinical signs appeared in either the control or patient group preoperatively.

**Immediate Postoperative Results in the Early Group**

Of the 50 patients in the early group, 30 patients (60%) reported dysphonia and 34 (68%) of 49 patients reported dysphagia at the immediate postoperative examination (measured with the VAS; results under 20 were considered insignificant and were therefore eliminated). One patient did not answer the VAS question concerning dysphagia. Unilateral vocal fold paralysis was found in six patients (12%). All instances of paralysis occurred on the operated right side. In the control group, 12 participants (24%) reported dysphonia and four (8%) reported dysphagia. A significant difference appeared in the incidence of dysphonia (Fisher exact test, p < 0.0005) and dysphagia (Fisher exact test, p < 0.0001) between the early group and the control group. On clinical examination, a few patients had signs of irritation in the posterior third of the vocal folds due to intubation. However, neither marked saliva aspiration nor abnormalities in cranial nerve function other than the laryngeal recurrent nerve were evident.

**Results 3 to 9 Months Postoperatively**

Patients in the early group received a questionnaire 3 months postoperatively. Those with clinical findings at the first postoperative visit or who reported severe subjective symptoms on the questionnaire were invited for another visit. All patients in the late group were examined 3 to 9 months postoperatively. Seven percent (3 of 44) of those in the early group and 21% (13 of 62) of the patients in the late group who responded reported persistent dysphonia 3 to 9 months postoperatively. Missing results are from those who did not answer the question. In the early group, all six patients with vocal fold paresis had recovered. In the late group, two patients (3%) had unilateral vocal fold paresis on the right side. In one of these, this deficit was well compensated for, but in the other phonosurgery (vocal fold medialization) was required. The median subjective handicap of persistent dysphonia measured by the VAS was 47 (in eight patients when results under 20 were eliminated, early and late groups combined).

Twelve percent (5 of 43) of respondents in the early group and 15% (9 of 62) of respondents in the late group had persistent dysphagia. The median subjective handicap of persistent dysphagia measured on the VAS was 51 (11 patients; results under 20 were considered not significant and were eliminated, with both groups combined) (Fig. 2).

In line with immediate postoperative results, no marked saliva aspiration, intubation granuloma, or abnormalities of
Dysphonia and dysphagia after ACD

![Graph](Image)

**Fig. 2.** Box plot of subjective handicap of persistent dysphonia and dysphagia as measured on the VAS, with the early and late patient groups combined.

Other cranial nerve function other than recurrent laryngeal nerve dysfunction appeared in either patient group.

**Recovery From Dysphonia and Dysphagia**

Results in both early and late groups were combined in reporting the results for appearance and recovery from dysphonia and dysphagia. In most patients, dysphonia and dysphagia appeared during the first postoperative week, and the majority recovered from these complications by the end of 3 months (Table 1).

**Surgical Results**

In reporting the surgical data of ACD we combined the patient groups (Table 2). Operative data were unavailable in four patients. The median duration of the operation was 80 minutes (range 35–205 minutes), and 18 attending neurosurgeons or experienced residents performed the operations. No statistically significant difference appeared between immediate or persisting dysphonia or dysphagia and disc-space level, number of operated disc spaces, approach side of the surgery, operation duration, individual surgeon, patient age or sex, or whether the diagnosis was spondylosis or disc herniation. This was also true in the patients with vocal fold paralysis. None of the patients with dysphonia or dysphagia had a postoperative hematoma requiring removal. Patients were asked to rate their satisfaction with the outcome of surgery considering pathological symptoms (pain, numbness, muscle weakness) 3 to 9 months postoperatively. Patients evaluated the results of surgery (rated as excellent, good, average, or poor) and were generally satisfied with the outcome (Table 3). The percentage of excellent or good results was lower in the patients who suffered from dysphonia and dysphagia than in those without these symptoms (two-tailed Fisher exact test, p = 0.02).

**Laryngeal EMG and Phoniatric Findings**

Laryngeal needle EMG of both thyroarytenoid muscles was successfully performed in 16 patients with dysphonia (11 in the early group and five in the late group). A moderate neurogenic abnormality in EMG existed in nine patients (including two patients with permanent vocal fold paresis), and some neurogenic signs and asymmetry in five.

A phoniatrician examined nine patients with hoarseness but no clinical paresis. Of these, the findings in seven patients were normal, and in two mild vocal fold movement asymmetry was shown on videolaryngostroboscopy. One patient had moderate and the other some neurogenic abnormalities on laryngeal EMG. Grading of the damage on EMG was based on a quantitative turn analysis and visual scale.

**Functional Studies of Swallowing**

Functional studies of swallowing were performed in two patients in the early group, and in six patients in the late group of the 14 total patients who reported persistent dysphagia 3 to 9 months postoperatively. The Dysphagia Distress Index questionnaire for evaluation of the subjective dysphagia complaints demonstrated pathological results in one patient. Six patients had normal and two patients pathological findings on transoral endoscopic evaluation of swallowing function. Videofluorography was performed in four patients (all from the late group). Results were normal in three patients, and in one patient bolus movement was noted to have slowed slightly.

**Health-Related QOL**

In the early group, the mean ± standard deviation 15D score increased from the preoperative 0.869 ± 0.097 to 0.890 ± 0.079 at 3 months. This difference was not statistically significant (Student t-test, p = 0.199). With regard to discomfort and symptoms, however, the patients experienced significant improvement (p = 0.017) (Fig. 3). Compared with the control group, the baseline 15D scores in patients who underwent cervical decompression were significantly worse (p = 0.028). At the 3-month follow-up

**Table 1**

<table>
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<tr>
<th>Complication</th>
<th>Postop Time to Appearance</th>
<th>Postop Time to Recovery</th>
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<tr>
<td></td>
<td>0–3 days</td>
<td>0–7 days</td>
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<tr>
<td>dysphonia</td>
<td>76% (31:41)</td>
<td>78% (32:41)</td>
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<tr>
<td>dysphagia</td>
<td>91% (58:64)</td>
<td>97% (62:64)</td>
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**Table 2**

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<th>Characteristic</th>
<th>No. of Patients (%)</th>
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<tr>
<td>no. of operated levels</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>81 (74)</td>
</tr>
<tr>
<td>2</td>
<td>28 (25)</td>
</tr>
<tr>
<td>3</td>
<td>1 (1)</td>
</tr>
<tr>
<td>operated level</td>
<td></td>
</tr>
<tr>
<td>C6–7</td>
<td>33 (30)</td>
</tr>
<tr>
<td>C5–6</td>
<td>30 (27)</td>
</tr>
<tr>
<td>C5–7</td>
<td>26 (24)</td>
</tr>
<tr>
<td>side of operation</td>
<td></td>
</tr>
<tr>
<td>rt</td>
<td>75 (68)</td>
</tr>
<tr>
<td>lt</td>
<td>32 (29)</td>
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**Table 3**

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<td>no. of operated levels</td>
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<td>operated level</td>
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<tr>
<td>side of operation</td>
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<td>rt</td>
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<tr>
<td>lt</td>
<td>32 (29)</td>
</tr>
<tr>
<td>not specified</td>
<td>3 (3)</td>
</tr>
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</table>
examination, the patients’ improved 15D scores no longer differed significantly from those of the general population or the control group (p = 0.519). In the late group, the mean 15D score 0.836 ± 0.105 was significantly worse (p < 0.001) than for the age- and sex-matched general Finnish population (Fig. 4). The general Finnish population HRQOL data were obtained from the Health 2000 Health Examination Survey conducted by the Finnish National Public Health Institute, and included 5122 participants.

Discussion

To our knowledge this study is the largest concerning the incidence, appearance, and recovery from dysphonia and dysphagia after ACD. The literature on this topic is scarce, and many of the existing studies are retrospective, have small patient groups, and lack control groups. No previous study has made use of laryngeal EMG to identify the degree of nerve damage. All members of both patient groups received letters inviting their voluntary participation in this study. For patients in the late group, the arrangements were not difficult because the operation was performed a minimum of 3 months before their visit. For patients in the early group, participation required two extra visits to the Otorhinolaryngology Clinic, which is not located in the same hospital area as the Neurosurgery Clinic. This required much effort on the part of the patients and research group members. Sixteen patients in the early group also chose not to appear for their immediate postoperative visit, and they have been excluded from the study. This explains why we had to invite 196 patients to accumulate 50 patients examined both pre- and postoperatively. The weakness of the study was that patients in the early and late groups were not the same population, and those in the late group lacked a preoperative examination. On the other hand, patients in the late group were very similar to those in the early group; they were consecutive and examined 3 to 9 months (mean 6.1 months) postoperatively to evaluate possible adverse effects of ACD on vocal function and swallowing. Members of the late group had more persistent problems than those in the early group. The reason is unclear, but one possible explanation is that patients suitable for the late group but without any symptoms chose not to participate in the study.

In earlier studies the prevalence of permanent dysphonia after ACD ranges from 0.07 to 11%, whereas in our study the range was 7% in the early group and 21% in the late group. Roy and colleagues recently reported that 6.6% of

<table>
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<th>Patient Outcome Rating</th>
<th>Total (102 patients)</th>
<th>w/o Dysphonia or Dysphagia (87 patients)</th>
<th>w/ Dysphonia or Dysphagia (15 patients)</th>
</tr>
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<tbody>
<tr>
<td>excellent</td>
<td>40 (39)</td>
<td>38 (44)</td>
<td>2 (13)</td>
</tr>
<tr>
<td>good</td>
<td>36 (35)</td>
<td>31 (36)</td>
<td>5 (33)</td>
</tr>
<tr>
<td>average</td>
<td>14 (14)</td>
<td>9 (10)</td>
<td>5 (33)</td>
</tr>
<tr>
<td>poor</td>
<td>12 (12)</td>
<td>9 (10)</td>
<td>3 (20)</td>
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* Twelve patients were excluded because they failed to answer the survey question regarding satisfaction with surgical outcome.

Fig. 3. Graph demonstrating the 15D profile of the early group before and 3 months after ACD. (Asterisk denotes significant improvement from baseline at the p < 0.05 level.)
the general population suffers from dysphonia. In our control group, 24% of the patients reported dysphonia. This incidence was surprisingly high, and the reasons behind it are not clear; one explanation may be that they were hospital outpatients. Moreover, in the early group, none of the patients reported preoperative dysphonia. We assume that immediately before the surgery such mild dysphonia may have been overwhelmed by pain and other more severe symptoms. In line with earlier studies, incidence of dysphagia immediately after ACD in our patients was 69%. Although 12% of the early group and 15% of the late group patients had dysphagia 3–9 months postoperatively, functional studies of swallowing showed good results, with only minor findings on the Dysphagia Distress Index, videofluorography, and transoral endoscopic evaluation.

Because the degree of recurrent nerve damage evaluated by laryngeal EMG varied widely in patients with clear clinical symptoms, it would be interesting to repeat this examination in a larger group of patients. The clinical relevance of the minor EMG changes is unknown, and it is questionable whether these have any impact on future vocal qualities of the patients. Laryngeal EMG is a minimally invasive and easily performed examination that provides detailed information on nerve damage. As evaluated on the VAS, the subjective handicap caused by dysphagia varied widely, with dysphonia reported on a smaller scale. That the median reported handicap showed no significant difference between these symptoms may be due to the small number of patients, although the highest VAS scores were in patients with dysphagia. The use of the VAS has been confidently recommended as a reliable method for reporting pain and other symptoms and has been used in earlier studies to evaluate swallowing and hoarseness.

The incidence of vocal fold paresis in our patients was 12% (6 of 50 patients in the early group). All incidences of paresis were on the right side, supporting previous findings about anatomical factors increasing the risk for damage to the right-sided recurrent nerve. All six patients with paresis in the early group, however, did recover during the follow-up period of 3 months. In the late group, there were two cases of permanent right-sided vocal fold paresis; both patients had undergone operations 9 months earlier. In one patient, the paralysis was well-compensated, whereas in the other a vocal fold medialization was needed to improve voice quality. These two patients had not been examined preoperatively, but neither had reported hoarseness before the operation.

In line with many previous studies, none of the surgical variables evaluated (such as operated disc level, number of operated disc spaces, operated side, surgeon, operation duration, patient age or sex, or the specific diagnosis) had a significant impact on the risk of dysphonia or dysphagia. Moreover, the majority of patients were satisfied with the surgical results. Unlike the overall HRQOL measured on the 15D survey, and the separate dimensions of eating and speech included in the questionnaire, the discomfort and symptoms dimension improved significantly. In evaluating the qualities of eating and speech, the 15D instrument was suitable for the present study, although it is not disease specific.
incidence of vocal fold paresis in our patients was similar to that reported in studies of patients after thyroidectomy, laryngeal examination pre- and postoperatively should be considered.

Conclusions
In both of our treatment groups, swallowing and vocal problems related to ACD surgery were common but usually transient complications often present even months after surgery. The majority of patients were satisfied with their neurological outcome. Careful patient selection, proper preoperative information, and referral to an ear, nose, and throat specialist in cases of persistent dysphonia and dysphagia are recommended.

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References

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