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Persistent swallowing and voice problems after anterior cervical discectomy and fusion with allograft and plating: a 5- to 11-year follow-up study

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Abstract Anterior cervical discectomy and fusion is commonly performed for cervical disc disease. Most studies report that swallowing and voice problems after such surgeries tend to resolve with time and are often of minor significance except in the rare cases of recurrent laryngeal nerve palsies. A retrospective review was performed on patients who had anterior cervical discectomy and fusion by a single surgeon more than 5 years prior, to determine the persistence of swallowing and voice problems in them. Seventy-four patients who had anterior cervical discectomy and fusion with allograft and plating an average of 7.2 years prior responded to an invitation to return for a follow-up clinical review. Emphasis was placed on the symptoms of dysphagia and dysphonia, as related to the index surgery. At final review, persistent dysphagia was present in 26 patients (35.1%). This occurred

more frequently in females and in younger patients. Dysphonia at final review persisted in 14 patients (18.9%). This also occurred more commonly in females and in patients in whom possible non-union is present in at least one of the levels operated upon. Problems with singing were present in 16 patients (21.6%) postoperatively, occurring more frequently if the C3/4 disc was included in the surgery and in patients who have had a greater total number of anterior cervical surgeries at the time of review. Dysphonia and dysphagia are persistent problems in a significant proportion of patients, even beyond 5 years after anterior cervical spine surgery.

Keywords Anterior cervical discectomy and fusion · Dysphagia · Dysphonia

Introduction

Anterior cervical discectomy and fusion is commonly performed for symptomatic cervical disc disease. The anterior approach to the cervical spine is considered generally safe despite rare occurrences of serious and even life-threatening complications. Presently, there is some consensus that swallowing and voice problems after such surgeries may be underreported [8, 16]. Most studies in the orthopaedic and neurosurgical literature

report that such problems tend to resolve with time and are often of minor significance except in the rare cases of recurrent laryngeal nerve palsies [4–9, 18, 20, 22, 23]. Most studies also involve a follow-up of one year or shorter [2–5, 8, 11, 16, 20, 22, 26], or did not specify the follow-up period [6, 9, 18]. Little is known of what become of these symptoms in the long term.

This study aims to assess the significance of swallowing and voice problems in patients who have undergone anterior cervical discectomy and fusion with

allografts and plate fixation more than 5 years after the surgery; and to identify possible risk factors associated with these complications.

Materials and methods

Between 1 January 1992 and 31 December 1997, 176 patients had anterior cervical discectomy and fusion with allograft and plating by a single surgeon (T.R.H.). As several of the patients had more than one operation to their cervical spine during and since the study period, the index surgery for each patient was taken as their first during the period.

The index surgery was performed with the same technique and consisted of a standard Smith-Robinson approach to the cervical spine [19, 20] under general anaesthesia, with endotracheal intubation. The approach was via the left side preferentially, as well as through any previous surgical scar, if present. Deep retraction of the soft tissue was achieved with self-retaining retractors, the tips of the blades of which were placed deep to the longus colli muscles on either side. Similar retractors were also used to retract the tissue longitudinally in surgeries involving two intervertebral discs or more. Thorough discectomy and removal of any offending osteophytes as identified on the preoperative studies was performed. A segment of freeze-dried fibular allograft, cut according to the post-discectomy defect, was then inserted. A plate was then applied across the disc spaces and secured to adjacent vertebral bodies with unicortical screws.

The charts and radiographs were reviewed to confirm the preoperative complaints and clinical findings, intraoperative findings, levels operated, duration of surgery, any intraoperative and early postoperative complications, the plating system used and prior surgeries in the neck region. During the interview, the information obtained from the charts was verified with the patients.

Six patients had died of unrelated causes, one patient was too ill with cancer to return, 22 patients had no forwarding address while 73 patients did not wish to return due to the travelling required, and also felt that they did not have any significant problems that required a follow-up visit despite being offered a free examination. Seventy-four returned for a follow-up examination by two independent reviewers (W.M.Y., W.B.). Lateral, flexion and extension radiographs of their cervical spines were also obtained to confirm whether union was achieved and the presence of any late implant complications. There were 39 females and 35 males. The number of levels operated is shown in Table 1. Dysphagia was assessed based on score proposed by Bazaz et al. [2] (Table 2). Dysphonia with speech was assessed as none, mild (only noticeable by the patient), moderate (noticed by the patient's family) and severe (obvious to

Table 1 Number of levels operated on

Number of levels	Number of patients (%)
1	30 (40.5)
2	27 (36.5)
3	14 (18.9)
4	3 (4.1)

Table 2 Grading system for dysphagia [2]

Severity	Liquid	Solid
None	None	None
Mild	None	Rare
Moderate	None/rare	Occasionally (only with specific foods)
Severe	None/rare	Frequent (majority of foods)

any examiner). The patients also described the symptoms they experienced preoperatively, in the early postoperative period and at the time of the review. Singing ability was assessed by the patients themselves, comparing their status preoperatively with that at the time of review. These were correlated with the clinical and radiological results of the cervical spine surgery, as well as the demographics of the patients.

This report focuses on the long term swallowing and voice problems after anterior cervical discectomy and fusion with allograft and plating. The clinical and radiological findings will be detailed in a separate report.

Statistical analysis

Analysis was done using the SPSS program Version 9.05. The *t*-test for independent samples was used to compare the presence of dysphagia, dysphonia and singing difficulties with continuous variables such as the age. The Chi-square test was used to compare the presence of symptoms with nominal variables, such as sex. When the expected count was less than 5 in any cell, the Fisher's exact test was used. Statistical significance was deemed when the *P*-value was less than 0.05. When the order of significance was higher, it was indicated as so.

Results

The average follow-up period of the patients was 7.2 years (5.4–11.1 years). In 68 patients (91.9%), the index surgeries were primary surgeries on their cervical spines. In the remaining six (8.1%), the index surgeries

Table 3 Total number of surgeries in the anterior neck at final review

Number of surgeries	Number of patients (%)
One	53 (71.6)
Two	18 (24.3) ^a
Three	2 (2.7)
Four	1 (1.4)

^aThese include two cases of carotid endarterectomy and one case of thyroidectomy, in addition to anterior cervical discectomies and fusions

were revision surgeries. Axial neck pain and radiculopathy secondary to acute disc herniation or chronic spondylotic osteophytic impingement was the principal diagnosis in 70 patients (94.6%). Cervical spondylotic myelopathy was the diagnosis in the remaining four (5.4%). The left sided approach was utilized in 72 (97.3%) while the right sided approach was utilized in two (2.7%). Both the latter were performed through pre-existing surgical scars, one from a previous anterior cervical fusion and the other from a previous carotid endarterectomy. The plating systems used were CSLP (Synthes Spine, Paoli, Pa., USA) in 63 patients (85.1%), Aline system plate (Surgical Dynamics, Norwalk, Conn., USA) in ten patients (13.5%) and Orion plate (Sofamor-Danek, Memphis, Tenn., USA) in one patient (1.4%). The total number of surgeries in the anterior neck region is summarized in Table 3.

Dysphagia

The findings on dysphagia are summarized in Table 4. Two patients experienced mild dysphagia preoperatively. One patient had previous surgery to the cervical spine and pre-existing reflux oesophagitis. An obvious cause could not be identified in the other patient. In both, dysphagia remained unchanged in the early postoperative period and at final review.

Dysphagia was common in the early postoperative period, occurring in 34 patients (45.9%). The exact duration of symptoms in those with resolution of their symptoms by final review could not be determined as this was not routinely recorded in the charts and the

patients had difficulty recalling the fact. The presence of dysphagia in the early postoperative period was not related to the sex, age, smoking status, duration of surgery, number of levels operated upon, plating system used, previous anterior neck surgeries or the presence of any implant problems.

At final review, dysphagia was still present in 26 patients (35.1%), including 12 patients with moderate dysphagia (16.2%) and one patient with severe dysphagia (1.4%). No type of food consistently produces dysphagia in all the patients. Needing to make sure foods are well chewed before swallowing; and difficulty with swallowing pills or bread were the commonest descriptions given. Swallowing studies were performed in only four patients. The results were the presence of reflex oesophagitis, hiatus hernia, minimal mid-oesophageal dysmotility (well remote from the site of surgery) and normal function, respectively. Dysphagia at final review occurred more frequently in females (18/39 patients, 41.2%) than males (8/35 patients, 22.9%; $P < 0.05$). It also tended to occur in younger patients rather than in older patients (average age 48.3 years versus 54.9 years at surgery, $P < 0.05$). The presence of dysphagia at final review was not related to the smoking status, duration of surgery, number of levels operated, plating system used, total number of anterior neck surgeries or the presence of possible non-union. Except for three patients, those who continue to experience moderate or severe dysphagia did not think that this negated the positive effects of the surgery and would elect to undergo the same procedure again.

Dysphonia

The findings with regard to dysphonia are summarized in Table 5. Two patients had preoperative dysphonia, both of moderate severity. One patient had dysphonia since a previous thyroidectomy. The approach for the index surgery was made in the left half of the previous thyroidectomy scar for a single level surgery. Her dysphonia remained moderate in the early postoperative period and progressed to severe at final review. The other patient complained of a "painful throat with speaking" before surgery. Surgery was performed on three levels and his dysphonia was completely relieved

Table 4 Preoperative and postoperative dysphagia

	Preoperative (%)	Early postoperative (%)	At review (%)
None	72 (97.3)	40 (54.1)	48 (64.9)
Mild	2 (2.7)	11 (14.9)	13 (17.6)
Moderate	0	18 (24.3)	12 (16.2)
Severe	0	5 (6.8)	1 (1.4)

Table 5 Preoperative and postoperative dysphonia

	Preoperative (%)	Early postoperative (%)	At review (%)
None	72 (97.3)	51 (68.9)	60 (81.1)
Mild	0	8 (10.8)	5 (6.8)
Moderate	2 (2.7)	13 (17.6)	6 (8.1)
Severe	0	2 (2.7)	3 (4.1)

both in the early postoperative period and at final review.

Dysphonia occurred in 23 patients (31.1%) in the early postoperative period. Again, the exact duration of symptoms in those with resolution of their symptoms by final review could not be determined. The presence of dysphonia in the early postoperative period was not related to age, sex, smoking status, duration of surgery, number of levels operated, number of anterior neck surgeries or the plating system used.

Dysphonia at final review persisted in 14 patients (18.9%), including six patients with moderate (8.1%) and three with severe symptoms (4.1%). The majority of patients with moderate to severe dysphonia complained of hoarseness and weakness of their voices except for one who complained of inability to vary the tone of his voice. Only two patients had otolaryngological examinations, which found normal vocal cord function in both. Dysphonia at final review occurred more commonly in females (11/39 patients, 28.2%) than males (3/35 patients, 8.6%; $P < 0.05$). It was also significantly more common in patients in whom possible non-union of at least one of the levels was present (4/9 patients; 44.4%) compared to those with definite complete union (10/65 patients, 15.4%; $P = 0.03$). The presence of dysphonia at final review was not related to age, smoking status, duration of surgery, number of levels operated, plating system used or the total number of anterior neck surgeries. Except for one patient, those who continue to experience moderate or severe dysphonia did not think that this negated the positive effects of the surgery and would elect to undergo the same procedure again.

Problems with singing

Problems with singing were present in one patient (1.4%) preoperatively and in 16 patients (21.6%) at final review. The former experienced difficulties with singing, correlating to the onset of his neck and arm symptoms. He had no previous neck surgeries and suffered from 2-level disc degeneration and osteophytosis, resulting in left upper limb weakness and pain. After his index surgery, his neck and upper limb symptoms improved markedly but he continued to have difficulty singing. The common complaints were inability to hit high notes and to vary pitch, as well as weakness of their singing voices. Singing difficulties at review occurred more frequently if the C3/4 level was included in the surgery (4/7 patients; 57.1%) than if it was not (12/67 patients, 17.9%; $P = 0.01$). This was also a problem in patients who have had a greater total number of surgeries in the anterior neck region (1.63 in those with singing difficulties compared to 1.26 in those without, $P = 0.003$). The presence of singing difficulties at final review was not related to sex, age, smoking status, duration of

surgery, number of levels operated or the plating system used.

Limitations

The chief limitation of this study is that this is a retrospective review, subject to the patients' recall lapses. It is regrettable that a proportion of patients did not return for the study. However, even if it is assumed that all those who did not return had no dysphagia or dysphonia, the rates of dysphagia and dysphonia more than 5 years after anterior cervical spine surgery are still significant, at 15 and 8%, respectively. Finally, only subjective criteria were used in the study. Otolaryngological evaluation and barium swallow studies could not be obtained for all the patients with symptoms to further delineate the cause of the symptoms. However, it should also be noted that even in studies with swallowing studies performed [11, 21], correlation between subjective symptoms and the swallowing assessment techniques used was not perfect.

Discussion

The anterior approach to treatment of cervical disc disease was first described by Robinson and Smith [19] and popularized by Cloward [5, 6] in the 1950s. Early cases series tended to focus on the feasibility of the approach and the lack of major complications. The presence of hoarseness postoperatively was reported to occur at the rate of 2.2–7.1% [5–7, 9, 18, 20, 22, 23]. These were all reported to be transient and in those reports which cited a time frame, recovery occurred within 4 months. Except for Cloward [5] who reported that all his initial 47 patients developed some degree of swallowing difficulties postoperatively, all of which recovered within 48 h; Connolly et al. [7], who reported two cases of transient dysphagia; and Robinson et al. [20], who reported two cases of severe dysphagia out of 93 patients; no other early report cited dysphagia as a postoperative problem.

The earliest significant series on vocal cord problems following approaches to the anterior cervical spine was by Heeneman [12], who found that transient palsies occurred in 11% and permanent palsies in 3.5%. The earliest paper focussing on dysphagia following cervical spine surgery [24] reported on five such cases. Following these, a number of authors, especially in the otolaryngological literature, reported on the incidence of hoarseness, which ranged from 0.3 to 51% [4, 16, 26], and dysphagia, which ranged from 1.7 to 60% [4, 14, 16, 25, 26] following anterior cervical spine surgery. There was a trend in those reports comprising only patients with postoperative dysphonia and dysphagia to have

fewer patients with subsequent symptom resolution [3, 15, 17] while those involving a large cohort of patients undergoing anterior cervical surgery tend to report fewer permanent deficits [1, 13, 16]. This may simply reflect that those comprising only symptomatic patients were studying patients with more severe symptoms, necessitating further evaluation and treatment.

The gravity of these complications was recognised by Flynn [10] who found that though recurrent laryngeal nerve palsies were uncommon (52/69, 590 cases), they comprised the largest number of neurological complications (16.7%) of anterior cervical interbody fusion and frequently resulted in litigation. However, even in the CSRS report on complications published in 1997 [27], problems with swallowing were not specifically addressed. The reported incidence of recurrent laryngeal palsy among members was 0.2%. In perhaps the most comprehensive review of the literature on the otolaryngological complications of the anterior approach to the cervical spine, Winslow and Meyers [25] found that the incidence of hoarseness was 0.06–11%, with persistence occurring in 0–3.5%; and the incidence of dysphagia was 2–48%, with the majority being mild and transient.

There have been three prospective studies on the subject to date. Frempong-Boadu et al. [11] examined 23 patients undergoing anterior cervical discectomy and fusion preoperatively and postoperatively with barium swallow and videolaryngoscopy. Preoperative swallowing abnormalities were detected in 48%; postoperatively, new onset swallowing abnormalities occurred in 35% of the patients on barium swallows but none of the patients had swallowing complaints. These were more common in those undergoing multi-level surgery and in whom soft tissue swelling was significant; they resolved by 1 month. Vocal cord paresis occurred in two patients postoperatively; one resolved by 1 month, the other was persistent. Bazaz et al. [2] interviewed 249 patients and found that dysphagia occurred in 50.2% of patients 1 month after surgery and decreased to 12.5% by 12 months, with only one patient still experiencing moderate or severe symptoms. Smith-Hammond et al. [21] compared the incidence and risk factors of dysphagia after anterior cervical, posterior cervical and posterior lumbar spine procedures and found that 47% of anterior cervical patients demonstrated dysphagia on postoperative video fluoroscopic swallow evaluation and 10% still required some level of compensatory swallowing behaviour up to 10 months following surgery.

There has been no study on the long-term persistence of dysphagia and dysphonia after anterior cervical spine surgery. Our study shows that more than 5 years after surgery, persistent dysphagia was present in 35.1%; persistent dysphonia in 18.9%; and problems with singing in 21.6%. Similar to the findings of Bazaz et al. [2], postoperative dysphagia and dysphonia were more common in female patients. Postoperative dysphagia

also was more common in younger patients. No such observation has been made previously. Dysphonia was more common in patients with possible non-union in at least one level and singing difficulties in those in whom with more surgeries to the anterior neck region. These suggest some mechanical cause to the symptoms. Regrettably, otolaryngological examination and swallowing studies could not be performed on all the patients to further delineate the causes.

It has to be recognized that not all cases of hoarseness are the result of recurrent laryngeal nerve injury and not all cases of recurrent laryngeal nerve injury result in clinical hoarseness [4]. The recurrent laryngeal may rarely be damaged by direct trauma but is more likely to be injured by stretching during retraction [17] and pressure of the endotracheal tube balloon against the deep retractor blades [1, 13]. Other suggested mechanisms include oedema from retraction [3, 8, 15, 23, 24], infection [24], injury to the superior laryngeal nerve [15], and pharyngeal branches of vagus nerve [8, 17]. The causes of dysphagia after anterior cervical surgery are even more difficult to define [25]. Graft protrusion [3, 14], implant protrusion [25], infection [3], haematoma [3], injuries to the pharyngeal plexus or vagus nerve [25], glossopharyngeal nerve [3, 15] or hypoglossal nerve [3, 15] have been suggested as causes. In our study, those patients with dysphagia at final review were more likely to also experience dysphonia at final review (13/14 patients, 92.9%) than not (13/60 patients, 21.7%; $P < 0.0001$). This suggests that both symptoms have similar origins in patients after anterior discectomy and fusion. However, except for two patients, none of the above aetiological factors could be confirmed as the dominant cause of the symptoms in our patients. One patient developed a postoperative haematoma after surgery and the other was the only patient who had a broken plate in the series, which was discovered only 5 years after the index injury when her neck symptoms recurred. Both suffered from moderate dysphonia, dysphagia and singing difficulties at final review.

Problems with singing may be a more sensitive symptom in cases of subtle voice problems or compensated unilateral recurrent laryngeal nerve palsies. The common complaint in our symptomatic patients about difficulties in achieving high notes and the significantly greater proportion of such patients to have the C3/4 disc operated upon suggest that injury to the superior laryngeal nerve as a cause for the symptoms. This nerve runs with the superior thyroid artery and is frequently encountered in approaches to the proximal cervical spine. It is mainly a sensory nerve but does give motor supply to one muscle of the vocal cord, the cricothyroid muscle. This muscle tenses the vocal cord, necessary for phonation of higher pitched sounds [25]. However, it has to be noted that not all patients are regular singers and the symptom is difficult to evaluate.

Conclusions

Swallowing and voice problems after anterior cervical spine surgery are significant problems in a proportion of patients even beyond 5 years after anterior cervical spine surgery. We feel that these should be discussed with patients offered anterior cervical discectomy and fusion as part of process of obtaining informed

consent. However it should also be noted that the majority of such symptomatic patients did not view that these persistent problems with voice and swallowing negated the positive effects of anterior cervical spine surgery. Future long-term prospective studies with more detailed otolaryngological evaluations may be required to further delineate the problems and their causes.

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