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Dysphagia Following Anterior Cervical Spine Surgery: Assessment Using an Abridged SWAL-QOL

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ABSTRACT

Background: Study design: Retrospective cohort study. Objective: To determine which components of the swallowing disorders quality of life (SWAL-QOL) survey are most relevant to assess dysphagia following anterior cervical spine surgery (ACSS). Summary of background data: The SWAL-QOL survey is an instrument that has been applied to patients undergoing ACSS procedures as a means of objectifying swallow function. However, the SWAL-QOL is lengthy, cumbersome, and primarily used for otolaryngological procedures.

Methods: Patients undergoing ACSS procedures were administered the SWAL-QOL prior to surgery and at 6- and 12-week postoperative visits. The preoperative and postoperative SWAL-QOL scores were compared using paired *t* tests. Questions with statistically and clinically significant postoperative changes were used to create an abridged survey.

Results: Fifty patients completed surveys at all 3 encounters and were included in the analysis. The total scaled score at 6 weeks was significantly lower than the preoperative score ($P = .003$) but returned to near baseline scores by 12 weeks ($P = .178$). Five sections had significantly lower scores at both postoperative visits compared to their respective preoperative values. Additionally, 13 individual questions had significantly lower scores at both postoperative visits, while 8 had significantly lower scores at only 1 of the postoperative visits. Of these 21 questions demonstrating statistical significance, 16 also demonstrated a clinically significant decrease (>5.0%) from preoperative scores. These 16 questions were included in the abridged survey developed for use in ACSS patients.

Conclusions: The results of this study suggest that several questions in the full SWAL-QOL questionnaire demonstrated minor or no changes at postoperative visits following ACSS. As a result, we propose a modified, 16-question SWAL-QOL survey including only questions that were both statistically and clinically significant. This truncated survey may be better suited for use in cervical spine patients.

Cervical Spine

Keywords: dysphagia, SWAL-QOL, swallowing, anterior cervical discectomy and fusion, anterior cervical spine surgery, ACDF

INTRODUCTION

Postoperative dysphagia is a frequent complication associated with anterior cervical spine surgery (ACSS), with reported rates up to 79%.[1–7] While a majority of cases resolve in the acute postoperative period, dysphagia occurring several years following surgery has been described.[7,8] As such, it is important for spine surgeons to be able to adequately and consistently assess patient swallowing function during the postoperative follow up. Development of a standardized instrument would allow spine surgeons and researchers alike to quantify dysphagia and assess the impact of interventions designed to reduce dysphagia.

Several questionnaires are available to evaluate dysphagia; however, many were not developed for use in the relatively healthy cervical spine surgery population. In their systematic review, Riley et al. assessed swallowing and dysphagia following ACSS and concluded that a better instrument was needed for this population.[1–7] In response, Skeppholm et al. created the Dysphagia Short Questionnaire (DSQ), a thoroughly validated survey designed in collaboration with otolaryngologists for use in ACSS patients.[1–7] However, it has not been widely accepted and, to the authors' knowledge, has not been cited in other studies. The most commonly used survey is the Bazaz Dysphagia Scale.[3,6,9,10] While it is short and easy to administer, it may be too simple of an assessment, making the differentiation of dysphagia severity difficult.[1,3] Additionally, the survey is collected over the phone, which may

introduce bias, and has never been formally validated. One validated tool is the M.D. Anderson Dysphagia Inventory (MDADI).[11] However, it is intended for patients with neurologic disease or oropharyngeal cancer, a population likely to experience more complex and severe dysphagia symptoms than those undergoing ACSS.

The SWAL-QOL survey is another validated instrument that has been used to assess dysphagia in ACSS patients.[12–15] However, it is relatively lengthy and cumbersome, consisting of 44 individual questions divided into 13 different sections. The developers of the SWAL-QOL reported a mean time to completion of 14 minutes, making it somewhat impractical for patients in the average clinical setting.[12] Additionally, a majority of ACSS patients experience less severe symptoms than what the SWAL-QOL survey is intended to assess, resulting in a clustering of high scores when used in this population. This ceiling effect suggests many questions may not be applicable to ACSS patients.

In this context, the purpose of this study is to determine which components of the SWAL-QOL are most relevant to assess dysphagia following ACSS. Using these identifiable questions, we sought to develop an abridged SWAL-QOL survey for use in patients undergoing ACSS.

METHODS AND MATERIALS

Patient Population

Following institutional review board approval (ORA: 14051301), a prospectively maintained surgical database of consecutive patients who underwent a primary, 1–3 level anterior discectomy and fusion (ACDF) was reviewed. Patients were invited to fill out an English version of the SWAL-QOL survey preoperatively and at each postoperative visit. Patients who underwent any previous cervical spine surgery and those who did not fill out surveys at all 3 time points (preoperative, 6-week, and 12-week follow-up visits) were excluded from the study.

Primary Analysis

The total number of points scored on each SWAL-QOL survey was calculated and divided by the total possible points to determine a scaled SWAL-QOL score (described as a percentage out of 100).[12] Similarly, individual section scaled scores were calculated by dividing the total number of points scored by the total number of points possible for each section. Average scaled preoperative scores for the test as a whole, as well as each section, were compared to both the 6- and 12-week postoperative visit scores. The percentage of patients who experienced a clinically significant change in dysphagia at each follow up, defined by a $>5.0\%$ decrease from preoperative score, was then determined. Lastly, each individual question was assessed for differences from the preoperative score at each postoperative visit.

Due to the ambiguity of the original SWAL-QOL survey, scoring of some sections was altered in order to designate a higher score as a better outcome and a lower score as a worse outcome. Each of the questions in sections 1 through 9 were scored as is written in the original survey, with 5 being the maximum possible points, and 1 designating a worse outcome. In order to agree with the remainder of the survey, the Section 10 scoring was reversed. Patients who answered "no" regarding feeding tube use received 2 points, while those who answered *yes* received 1 point. Sections 11 and 12 were written with answer choices A–E. An answer of "A" described a normal diet and an answer of "E" designated either tube feeding or no liquid by mouth. Answers of "A" received 5 points, while "B" received 4 points, "C" received 3 points, "D" received 2 points, and "E" received 1 point. Section 13 was scored as written, with 5 points defining "excellent" health, and 1 point defining "poor" health. As a result of these alterations, the SWAL-QOL was scored with a maximum of 237 points, indicating no swallowing difficulties or reduced quality of life.

Abridged Survey Development

A shortened SWAL-QOL survey for ACSS patients was developed using the questions that met all of the following criteria: (1) a statistically significant difference was demonstrated at either postoperative visit when compared to preoperative values, (2) a clinically significant difference, defined as at least a 5% decrease from preoperative values, was demonstrated at the postoperative visit, and (3) the question's primary focus was related to swallowing or its effects on mental health, and not general health or other physical symptoms (eg, fatigue, weakness, sleeping issues).

Post Hoc Analysis

Following the creation of the abridged survey, a comparison of total scaled scores was again

performed using only the questions in the new survey form. The method of analysis was the same as previously described. Additionally, 2 subscores were reported: a physical symptom score using only questions that are directly related to physical symptoms and a quality of life score using only questions that relate to mental or emotional health as a result of dysphagia. Lastly, the percentage of patients who experienced clinically significant dysphagia at each follow up, defined by a >5.0% change from preoperative score, was determined.

Statistical Analysis

Statistical analysis was performed using Stata/MP 13.1 for Mac (StataCorp LP, College Station, Texas). Baseline patient characteristics were reported using means and standard deviations for continuous variables and percentages for categorical variables. Pre- and postoperative SWAL-QOL scores were compared using paired *t* tests. A *P* value <0.05 was used to determine statistical significance, and all tests were 2 tailed. Cronbach's α was used to assess internal consistency of the abridged questionnaire at all 3 times points; α values of >.7 indicate adequate internal consistency.

RESULTS

Primary Analysis

A total of 78 patients underwent a primary ACDF and were invited to fill out the SWAL-QOL survey. Of the 78 eligible patients, 50 (64.1%) filled out surveys at all 3 time points and were included in the analysis. The overall completion rate for the surveys was 83.3%. The average patient age was 50.3 ± 8.7 years old, while a majority were male (60.0%) and underwent 1-level operations (62.0%). The average time required to fill out a SWAL-QOL survey was 9.37 ± 4.93 minutes. The remaining baseline patient characteristics are reported in Table 1.

Table 1. Baseline patient characteristics.

	ACDF (n = 50)
Age (mean ± SD, years)	50.3 ± 8.7
Sex (n)	
Female	40.0% (20)
Male	60.0% (30)
Ethnicity (n)	
Caucasian	78.0% (39)
African-American	10.0% (5)
Hispanic or Latino	8.0% (4)
Other	4.0% (2)
Insurance (n)	
Medicare	2.0% (1)
Workers' compensation	30.0% (15)
Commercial	68.0% (34)
Smoking status (n)	
Nonsmoker	92.0% (46)
Smoker	8.0% (4)
Body mass index (mean ± SD, kg/m^2)	29.1 ± 5.4
Comorbidity burden (CCI)	2.2 ± 1.7
Highest education level	
Some high school	2.0% (1)
High school	34.0% (17)
Some college	22.0% (11)
College	24.0% (12)
Postgraduate	18.0% (9)
Number of operative levels (n)	
1 level	62.0% (31)
2 levels	38.0% (19)
Operative level (n)	
C3-C4	8.0% (4)
C3-C5	2.0% (1)
C4-C5	8.0% (4)
C4-C6	8.0% (4)
C5-C6	16.0% (8)
C5-C7	28.0% (14)
C6-C7	30.0% (15)
Anterior plating (n)	
No	58.0% (29)
Yes	42.0% (21)

Abbreviations: ACDF, anterior discectomy and fusion; CCI, Charlston Comorbidity Index.

The average total scaled score at the 6-week postoperative visit was significantly lower than the preoperative score (91.2 ± 7.7 versus 87.6 ± 13.2; $P = .007$), but returned to near normal levels by the 12-week postoperative visit (91.2 ± 7.7 versus 89.5 ± 11.1; $P = .178$). Sections 5 (communication), 6 (swallowing fears), 7 (mental health), and 13 (overall health) were significantly lower at both postoperative visits when compared to preoperative values (Table 2). An additional 2 sections were significantly lower at the 6-week postoperative visit: Section 1 (swallowing burden) and Section 8 (social life). Additionally, 13 individual questions were significantly lower at both postoperative visits, while 8 were significantly lower at only 1 of the postoperative visits (Table 3). Of these 21 questions, 16 also demonstrated a clinically significant decrease (>5.0%) from preoperative scores. These 16 questions were included in the final form of the survey, the abridged SWAL-QOL for anterior cervical spine surgery (Appendix A). Cronbach's α values for the abridged survey were 0.912, 0.964, and 0.972 for preoperative, 6-week postoperative, and 12-week postoperative time points, respectively.

Post Hoc Analysis

The total scaled score at both 6- and 12-week postoperative visits were significantly lower than the

Table 2. Mean scaled swallowing scores by section number.[a]

	Preoperative (n = 50)	6 Weeks (n = 50)	*P* Value[b]	12 Weeks (n = 50)	*P* Value[b]
Total score (mean ± SD)	**91.2 ± 7.7**	**87.6 ± 13.2**	**.007**	89.5 ± 11.1	.178
Section 1	**96.0 ± 9.9**	**86.8 ± 20.3**	**<.001**	90.8 ± 17.6	.065
Section 2	95.3 ± 11.4	92.8 ± 14.1	.062	94.1 ± 10.1	.524
Section 3	91.3 ± 10.2	88.6 ± 14.3	.117	89.2 ± 13.7	.176
Section 4	94.2 ± 10.5	90.4 ± 17.7	.123	93.0 ± 16.2	.636
Section 5	**96.8 ± 9.8**	**93.0 ± 12.8**	**.045**	**92.8 ± 13.3**	**.022**
Section 6	**97.1 ± 6.3**	**92.3 ± 15.0**	**.008**	**91.0 ± 16.5**	**.007**
Section 7	**96.8 ± 8.7**	**90.4 ± 17.8**	**<.001**	**91.0 ± 16.6**	**.006**
Section 8	**96.7 ± 10.5**	**91.7 ± 17.6**	**.003**	93.2 ± 14.6	.065
Section 9	66.9 ± 22.3	66.6 ± 19.4	.916	69.4 ± 20.3	.443
Section 10	100.0 ± 0.0	100.0 ± 0.0	–	100.0 ± 0.0	–
Section 11	98.0 ± 7.3	96.8 ± 7.4	.322	98.0 ± 7.3	1.000
Section 12	97.6 ± 8.8	97.6 ± 10.4	1.000	98.0 ± 7.4	.569
Section 13	**68.8 ± 16.7**	**63.6 ± 18.8**	**.008**	**64.5 ± 22.8**	**.047**

[a]Boldface indicates statistical significance.
[b]*P* value calculated using paired *t* test.

preoperative score when using the abridged survey (preoperative: 95.0; 6-week: 87.9, $P < .001$; 12-week: 89.4, $P = .007$; Table 4). The physical symptom score was also significantly lower at both follow-up appointments (preoperative: 91.0; 6-week: 83.4, $P < .001$; 12-week: 86.4, $P = .017$). Similarly, the quality of life score was significantly lower at both postoperative visits (preoperative: 96.7; 6-week: 89.9, $P < .001$; 12-week: 90.8, $P = .007$). Using these results, it was determined that 40.0% of patients experienced clinically significant dysphagia (>5.0% decrease from preoperative score) at the 6-week postoperative visit, improving to 30.0% by 12 weeks postoperatively (Table 5).

DISCUSSION

Dysphagia is a common complication following ACSS. While several instruments are available for assessing dysphagia, none are particularly well designed for the ACSS population.[3,16] A standardized tool that allows quantifiable assessment of dysphagia is needed to allow evaluation of dysphagia rates between studies. Although validated, the SWAL-QOL is lengthy and cumbersome to complete, particularly for patients undergoing ACSS with relatively minor swallowing impairment. As such, the purpose of this paper was to develop a concise, yet clinically relevant survey for use in patients undergoing ACSS.

The results of this study suggest that the SWAL-QOL survey in its full form is not necessary to detect swallowing changes in the ACSS population. Several sections and individual questions demonstrated little to no change from preoperative to postoperative values, indicating the severity of dysphagia following ACSS is not as extreme as the dysphagia in the population for which the SWAL-QOL was originally developed. However, several questions did exhibit both statistically and clinically significant differences at the postoperative time points. Using only the questions that met these criteria, an abridged SWAL-QOL for ACSS was developed.

This abridged questionnaire contained 16 of the original 44 SWAL-QOL questions, a 63% reduction in total length. Although the reported time of completion for a standard SWAL-QOL survey was 14 minutes,[12] respondents from our study had an average completion time of 9.37 minutes, still a considerable time commitment. Using this time as a baseline, the abridged SWAL-QOL for ACSS is estimated to take approximately 3.4 minutes to complete. Additionally, the abridged survey can be broken into a physical symptom section, consisting of 5 questions, and a quality of life section, consisting of the remaining 11 questions. Thus, if a surgeon was interested in assessing only the physical or mental health symptoms of dysphagia and not its effect on both, this could be done using only 5 or 11 questions, taking an estimated 1.06 or 2.34 minutes to complete, respectively.

This abridged survey reported slightly higher rates of dysphagia at the 6-week postoperative visit and much higher rates at the 12-week postoperative visit when compared to the original SWAL-QOL survey. This indicates that the abridged version is more sensitive to detect symptoms of dysphagia in the ACSS population. Additionally, the standard deviation of scores was wider for the abridged survey, demonstrating a reduction in the ceiling

Table 3. Mean question scores.[a,b]

	Preoperative (n = 50)	6 Weeks (n = 50)	*P* Value[b]	12 Weeks (n = 50)	*P* Value[c]
Section 1: Swallowing—overall burden					
Question 1a[d]	**4.74 ± 0.66**	**4.22 ± 1.11**	**<.001[d]**	**4.48 ± 0.99**	**.129[d]**
Question 1b[d]	**4.86 ± 0.45**	**4.46 ± 0.97**	**.002[d]**	**4.60 ± 0.83**	**.041[d]**
Section 2: Swallowing—eating					
Question 2a	4.77 ± 0.71	4.75 ± 0.63	.785	4.73 ± 0.60	.688
Question 2b[d]	**4.64 ± 0.94**	**4.26 ± 1.29**	**.007[d]**	4.44 ± 1.07	.086
Question 2c	4.64 ± 0.94	4.68 ± 0.82	.735	4.70 ± 0.76	.700
Question 2d	4.66 ± 0.96	4.54 ± 1.03	.135	4.66 ± 0.89	1.000
Question 2e	4.88 ± 0.46	4.80 ± 0.71	.252	4.82 ± 0.48	.497
Section 3: Swallowing—symptom frequency					
Question 3a	4.12 ± 1.02	4.02 ± 0.94	.521	4.18 ± 0.98	.690
Question 3b[d]	**4.62 ± 0.64**	**4.32 ± 1.00**	**.018[d]**	4.36 ± 0.96	.052
Question 3c	4.64 ± 0.63	4.58 ± 0.86	.583	4.52 ± 0.86	.371
Question 3d	4.12 ± 1.14	4.18 ± 1.21	.762	4.24 ± 1.02	.436
Question 3e	4.54 ± 0.79	4.46 ± 0.95	.543	4.36 ± 1.01	.229
Question 3f	4.56 ± 0.86	4.70 ± 0.79	.109	4.62 ± 0.78	.497
Question 3g	4.82 ± 0.52	4.74 ± 0.66	.485	4.62 ± 0.88	.133
Question 3h	4.52 ± 1.03	4.46 ± 0.97	.690	4.40 ± 0.99	.382
Question 3i[d]	**4.08 ± 0.99**	**3.74 ± 1.10**	**.020[d]**	3.94 ± 1.24	.375
Question 3j[d]	**4.56 ± 0.79**	**3.98 ± 1.17**	**.001[d]**	4.28 ± 0.99	.056
Question 3k	**4.84 ± 0.42**	**4.62 ± 0.78**	**.033**	**4.64 ± 0.72**	**.032**
Question 3l	4.88 ± 0.44	4.86 ± 0.45	.743	4.78 ± 0.65	.200
Question 3m	4.96 ± 0.20	4.88 ± 0.44	.159	4.90 ± 0.36	.261
Question 3n	4.64 ± 0.78	4.50 ± 0.97	.341	4.60 ± 0.90	.710
Section 4: Swallowing—diet					
Question 4a	4.68 ± 0.71	4.48 ± 0.93	.192	4.66 ± 0.71	.894
Question 4b	4.74 ± 0.56	4.56 ± 0.88	.130	4.64 ± 0.83	.440
Section 5: Speaking—difficulty frequency					
Question 5a	4.82 ± 0.56	4.74 ± 0.60	.400	4.70 ± 0.65	.182
Question 5b[d]	**4.86 ± 0.45**	**4.56 ± 0.79**	**.008[d]**	**4.58 ± 0.76**	**.005[d]**
Section 6: Swallowing—concern frequency					
Question 6a[d]	**4.86 ± 0.40**	**4.58 ± 0.91**	**.011[d]**	**4.58 ± 0.88**	**.042[d]**
Question 6b	4.84 ± 0.47	4.70 ± 0.68	.164	4.62 ± 0.88	.101
Question 6c[d]	**4.90 ± 0.36**	**4.70 ± 0.76**	**.032**	**4.58 ± 0.88**	**.008[d]**
Question 6d[d]	**4.82 ± 0.56**	**4.48 ± 1.05**	**.018[d]**	**4.42 ± 1.07**	**.008[d]**
Section 7: Swallowing—emotion frequency					
Question 7a	**4.86 ± 0.53**	**4.68 ± 0.84**	**.028**	**4.66 ± 0.72**	**.031**
Question 7b[d]	**4.88 ± 0.44**	**4.52 ± 0.95**	**.001[d]**	**4.50 ± 0.93**	**.002[d]**
Question 7c[d]	**4.88 ± 0.44**	**4.54 ± 0.93**	**<.001[d]**	**4.56 ± 0.81**	**.002[d]**
Question 7d[d]	**4.76 ± 0.59**	**4.40 ± 1.03**	**.002[d]**	4.52 ± 0.95	.070
Question 7e[d]	**4.82 ± 0.52**	**4.46 ± 0.99**	**.004[d]**	**4.52 ± 0.89**	**.018[d]**
Section 8: Swallowing—social life					
Question 8a	**4.84 ± 0.55**	**4.64 ± 0.85**	**.006**	4.74 ± 0.63	.341
Question 8b	**4.84 ± 0.62**	**4.60 ± 0.83**	**.004**	4.72 ± 0.57	.159
Question 8c[d]	**4.84 ± 0.55**	**4.52 ± 0.95**	**.005[d]**	**4.58 ± 0.88**	**.022[d]**
Question 8d[d]	**4.84 ± 0.55**	**4.58 ± 0.95**	**.011[d]**	**4.60 ± 0.95**	**.051**
Question 8e	**4.82 ± 0.56**	**4.58 ± 0.95**	**.022**	4.66 ± 0.77	.146
Section 9: Other physical symptoms					
Question 9a	3.70 ± 1.18	3.50 ± 1.16	.285	3.86 ± 1.11	.420
Question 9b	3.42 ± 1.44	3.40 ± 1.20	.916	3.62 ± 1.24	.274
Question 9c	3.20 ± 1.26	3.14 ± 1.13	.760	3.20 ± 1.29	1.000
Question 9d	3.14 ± 1.31	3.26 ± 1.14	.485	3.22 ± 1.23	.699
Question 9e	3.26 ± 1.23	3.34 ± 1.12	.659	3.46 ± 1.18	.322

[a]Boldface indicates statistical significance.
[b]Not shown: Section 10: Feeding tube use; Section 11: Consistency of food; Section 12: Consistency of liquids; Section 13: Overall health.
[c]*P* value calculated using paired *t* test.
[d]Clinical significance determined by 5% decrease from preoperative value and included in final survey.

Table 4. Mean scaled swallowing scores for abridged survey.[a]

	Preoperative (n = 50)	6 Weeks (n = 50)	*P* Value[b]	12 Weeks (n = 50)	*P* Value[b]
Total score (mean ± SD)	**95.0 ± 8.0**	**87.9 ± 16.2**	**<.001**	**89.4 ± 16.0**	**.007**
Physical symptom score	**91.0 ± 9.4**	**83.4 ± 16.9**	**<.001**	**86.4 ± 16.7**	**.017**
Quality of life score	**96.7 ± 8.1**	**89.9 ± 16.9**	**<.001**	**90.8 ± 16.6**	**.007**

[a]Boldface indicates statistical significance.
[b]*P* value calculated using paired *t* test.

Table 5. Percent of patients experiencing clinically significant dysphagia.[a]

	6 wk (n = 50)	12 wk (n = 50)
Original SWAL-QOL total score	32.0% (16)	18.0% (9)
Abridged SWAL-QOL total score	40.0% (20)	30.0% (15)
Physical symptom score	40.0% (20)	34.0% (17)
Quality of life score	36.0% (18)	26.0% (13)

Abbreviation: SWAL-QOL, swallowing disorders quality of life.
[a]Clinically significant dysphagia was defined as a >5.0% decrease from preoperative score.

effect observed with the original survey in this patient population. As suggested by the high Cronbach's α values ($\alpha > 0.9$) for all time points, the abridged survey demonstrates strong internal consistency and reliability.

While the abridged SWAL-QOL has yet to be prospectively validated, several advantages exist over other surveys commonly used to assess dysphagia in the ACSS population. The Bazazz instrument has been considered to be too simplistic to detect meaningful discrepancies between patients. In comparison, the abridged SWAL-QOL assesses multiple possible symptoms and the effect on quality of life, allowing for a greater variation among those surveyed. The DSQ has never been formally validated, instead using an expert validation technique. This potentially makes it a less attractive option for implementation and may explain why it has not been adopted in other studies. In the development of the abridged SWAL-QOL, questions were taken from a familiar and previously validated questionnaire, reducing some of the uncertainty that can come with a new assessment tool. The only other validated dysphagia questionnaire is the MDADI; however, many of the questions in the MDADI survey are not applicable for patients undergoing ACSS. As such, creation of the abridged SWAL-QOL survey is a valuable step toward developing an efficient tool that may be used to predict dysphagia prognosis in ACSS patients.

This study is not without limitations. First, all patients underwent ACDF by a single surgeon at a single academic institution, limiting the generalizability of the results. Second, the number of patients who completed all 3 questionnaires is relatively small. Although this may limit the ability to detect differences in some aspects of dysphagia, by including only patients who completed all 3 surveys allows internal control and limits the effect of potential confounding variables. Third, as this was a retrospective analysis of the senior surgeon's standard practice, the first available follow-up data were 6 weeks after surgery. As such, no questionnaires were collected in the acute postoperative period, possibly underestimating the number of patients who experienced dysphagia. Although dysphagia may be most severe in the immediate postoperative period, prior studies have demonstrated that prevertebral swelling and symptoms of dysphagia peak approximately 2 weeks following surgery and often persist for several weeks.[14,17] Similarly, many patients do not follow up past 12 weeks, limiting the ability to assess dysphagia symptoms in the long term. Fourth, other potential risk factors for dysphagia following ACDF, such as alternative surgical techniques and choice of fusion materials, were not analyzed in this study. Although these surgical variables may result in variances in dysphagia rates, this population was treated by a single surgeon, allowing the abridged SWAL-QOL survey to be appropriately developed while limiting potential confounders for dysphagia. Lastly, due to the retrospective nature of this study, information on the prognosis of dysphagia could not be thoroughly analyzed. Thus, further prospective investigation with a larger sample size and earlier postoperative follow up is needed to establish the prognostic value of the questionnaire before general adoption by surgeons for ACSS patients.

CONCLUSIONS

This study develops an abridged instrument to assess dysphagia for use in ACSS patients. Using a commonly used and validated survey as its foundation, the abridged SWAL-QOL is a shorter and more effective method to quantify dysphagia in patients undergoing ACSS. Using this survey, up to 40% of patients experience some degree of dysphagia at 6 weeks following ACDF, improving to 30% at 12 weeks. This truncated survey may be better suited for use in cervical spine patients who typically present with less severe symptoms as compared to those with head and neck cancer, the population for which the SWAL-QOL was primarily designed. Future prospective studies validating its utility in this population are required.

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Appendix A. Abridged swallowing disorders quality of life (SWAL-QOL) for anterior cervical spine surgery (ACSS).

1. Below are some general statements that people with ***swallowing problems*** might mention. In the last month, **how true** have the following statements been for you?

	Very Much True	Quite a Bit True	Somewhat True	A Little True	Not at All True
(a) Dealing with my swallowing problem is very difficult.	1	2	3	4	5
(b) My swallowing problem is a major distraction in my life.	1	2	3	4	5

2. Below are aspects of day-to-day eating that people with ***swallowing problems*** sometimes talk about. In the last month, **how true** have the following statements been for you?

	Very Much True	Quite a Bit True	Somewhat True	A Little True	Not at All True
(a) It takes me longer to eat than other people.	1	2	3	4	5

3. Below are some physical problems that people with ***swallowing problems*** sometimes experience. In the last month, **how often** you have experienced each problem as a result of your swallowing problem?

	Almost Always	Often	Sometimes	Hardly Ever	Never
(a) Choking when you eat food	1	2	3	4	5
(b) Having to clear your throat	1	2	3	4	5
(c) Food sticking in your throat	1	2	3	4	5

4. In the last month, **how often** have the following statements about communication applied to you because of your ***swallowing problem***?

	All of the Time	Most of the Time	Some of the Time	A Little of the Time	None of the Time
(a) It has been difficult for me to speak clearly.	1	2	3	4	5

5. Below are some concerns that people with ***swallowing problems*** sometimes mention. In the last month, **how often** have you experienced each feeling?

	Almost Always	Often	Sometimes	Hardly Ever	Never
(a) I fear I may start choking when I eat food.	1	2	3	4	5
(b) I am afraid of choking when I drink liquids.	1	2	3	4	5
(c) I never know when I am going to choke.	1	2	3	4	5

6. In the last month, how often have the following statements **been true** for you because of your ***swallowing problem***?

	Always True	Often True	Sometimes True	Hardly Ever True	Never True
(a) Having to be so careful when I eat or drink annoys me.	1	2	3	4	5
(b) I have been discouraged by my swallowing problem.	1	2	3	4	5
(c) My swallowing problem frustrates me.	1	2	3	4	5
(d) I get impatient dealing with my swallowing problem.	1	2	3	4	5

7. Think about your social life in the last month. How strongly would you agree or disagree with the following statements?

	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
(a) My usual work or leisure activities have changed because of my swallowing problem.	1	2	3	4	5
(b) Social gatherings (like holidays or get-togethers) are not enjoyable because of my swallowing problem.	1	2	3	4	5

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