

# Dysphagia rates after minimally invasive tubular approach to the anterior cervical spine

## Tasas de disfagia posoperatoria en el abordaje tubular mínimamente invasivo de la columna cervical anterior

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### Abstract

**Introduction:** Cervical spine surgery (anterior cervical spine surgery [ACSS]) is a commonly indicated to provide neurological decompression, correct deformity, and preserve stability. Current series report good to excellent results, but a number of patients suffer from dysphagia with reported rates as high as 80%. **Materials and methods:** Retrospective cohort of patients undergoing ACSS (anterior cervical discectomy and fusion [ACDF]; and arthroplasty, total disc replacement [TDR]) from 2013 to 2017 by a single surgeon. We collected demographic data, surgical outcomes, clinical outcomes, and dysphagia incidence and magnitude (visual analog scale [VAS]), we analyzed results with SPSS 22. **Results:** A total of 81 patients operated from 2013 to 2018, ACDF was performed in 70, and TDR was performed in 11, mean surgical time was 156.8, mean neck pain and radicular pain VAS reduced significantly in both groups ( $p < 0.01$ ). Dysphagia was encountered in 18 ACDF patients, and one TDR patient. Overall dysphagia rate was 9.1% in day-1 post-operative, with mean 0.27 magnitude (standard deviation [SD] 0.4) in ACDF group and 0.18 (0.6 SD) in TDR group, 1-month follow-up dysphagia rate was 0%. **Conclusions:** Minimally invasive techniques may reduce post-operative dysphagia related to soft-tissue trauma, to 9% in day-1 post-operative (as compared to 39%), and to 0% (as compared to 8.5% reported worldwide) by 1-month follow-up.

**Key Words:** Anterior cervical. Tubular. Minimally invasive. Dysphagia. Spine surgery. Anterior cervical spine surgery.

### Resumen

**Antecedentes:** La cirugía cervical anterior (CCA) esta comúnmente indicada para proporcionar descompresión neurológica, corregir deformidades y preservar la estabilidad. Las series actuales reportan tasas de disfagia de hasta el 80%. **Método:** cohorte retrospectiva de pacientes sometidos a CCA (discectomía y fusión cervical anterior [DFCA], y artroplastia total de disco [ATD]) de 2013 a 2017. Se recopilaron datos demográficos, quirúrgicos, clínicos y de incidencia y magnitud de la disfagia (escala visual analógica [EVA]). Se analizaron los resultados con SPSS 22. **Resultados:** 81 pacientes operados de 2013 a 2018, ACDF en 70 y ATD en 11, tiempo quirúrgico promedio de 156.8 minutos. La puntuación en la EVA cervical y radicular

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Fecha de recepción: 23-04-2019

Fecha de aceptación: 27-08-2019

DOI: 10.24875/CIRU.19001257

Cir Cir. 2020;88(3):286-291

Contents available at PubMed

www.cirugiyacirujanos.com

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se redujo significativamente en ambos grupos ( $p < 0.01$ ). Hubo disfagia en 18 pacientes con DFCA y en uno con ATD. La tasa de disfagia fue del 9.1% en el primer día de posoperatorio, con EVA de 0.27 (desviación estándar [DE]: 0.4) en el grupo DFCA y de 0.18 (DE: 0.6) en el grupo ATD. La tasa de disfagia de seguimiento a 1 mes fue del 0%. **Conclusiones:** Las técnicas mínimamente invasivas reducen la disfagia posoperatoria en CCA al 9% en el primer día (en comparación con el 39%) y al 0% (en comparación con el 8.5% reportado mundialmente) al mes de seguimiento.

**Palabras Clave:** Cervical anterior. Tubular. Mínimamente invasiva. Disfagia. Cirugía de columna. Cirugía cervical anterior.

## Introduction

Anterior cervical spine surgery (ACSS) is a commonly indicated procedure to solve a variety of cervical spine pathologies (vertebral body fractures, tumors, and degenerative disk disease)<sup>1,2</sup>, at present, there exist a wide spectrum of surgical techniques able to be done through an anterior approach, whose main target is to provide neurological decompression of the neural axis, correct deformity, and preserve or attain mechanical stability<sup>3</sup>. Current series report good to excellent results on pain and neurological deficit improvement with high patient satisfaction scores<sup>4</sup> irrespective of the chosen surgical technique, never the less, early in the post-operative period, and even in the long-term follow-up, a number of patients suffer from dysphagia, because significant retraction may be exerted on the esophagus during the surgical procedure or related to adverse outcomes from surgery such as post-operative hematoma, recurrent laryngeal nerve palsy, esophageal injury, post-operative adhesions, and device migration<sup>1,3,5</sup>. Dysphagia, being a well-known complication of ACSS<sup>5,6</sup>, can interfere with daily and social life, affecting prognosis adversely because of dehydration, malnutrition, or ineffective protection of airway from aspiration, ultimately becoming a life-threatening condition in severe cases<sup>1,2,7</sup>.

Dysphagia is defined erratically as a subjective increase in the time or effort required to move food from mouth to the stomach or more practically as difficulty in swallowing solids and liquids, and as a matter of inconsistency in diagnostic criteria across the scientific literature, its ranges vary widely from 1% to 80%<sup>1,5,8</sup>. In prospective studies, rates of dysphagia 1-month post-operatively are reported to be as high as 50%, which might decrease progressively overtime to 10-12.5% at 1 year<sup>9-11</sup>. Risk factors to the development of dysphagia include female gender, age over 60 years, smoking, preexisting swallowing dysfunction, C4-C5 and C5-C6 involvement, and multilevel surgery<sup>9,12,13</sup>.

Most anterior cervical surgery trials are focused in outcomes related to fusion rates and pain relief as

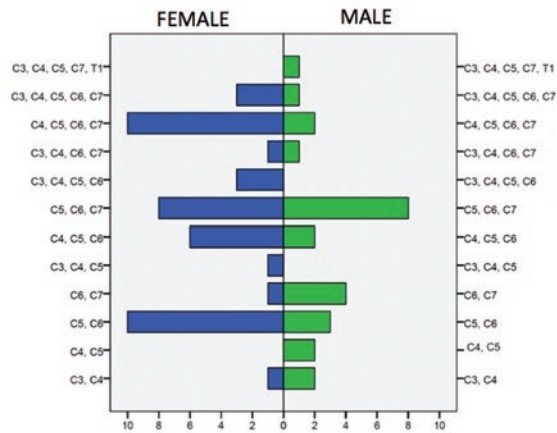
well as neurologic deficit recovery, but few researches have been undertaken to determine dysphagia rates consistently as well as in the measures to prevent its post-operative incidence<sup>9</sup>. There is some evidence about steroids use, graft type, low profile plates, and surgical approach regarding dysphagia rates with no guidelines established up to date<sup>3,8,14-20</sup>. In this paper, we sought to describe our experience with a minimally invasive tubular approach for the anterior cervical procedures such as anterior cervical discectomy and fusion (ACDF) and total disc replacement (TDR) (arthroplasty), with the aim to compare our rates of dysphagia with those of available literature.

## Materials and methods

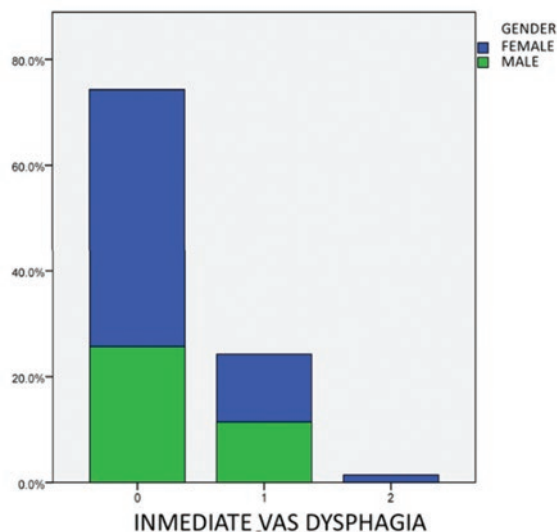
The present work represents a retrospective observational cohort study with historical cohort comparison. We review the clinical files of patients undertaking a minimally invasive tubular approach to the anterior cervical spine to perform an ACDF or arthroplasty from 2013 to 2017. We collected data from clinical files and divided them by type of surgery, we then review variables such as sex, age, body mass index (BMI), surgical procedure, surgical time, bleeding, number of operated levels, radicular and neck pain visual analog scale (VAS), dysphagia VAS at post-operative day 1, 1 month, and end of follow-up. We processed data with SSPS 22 software, performing demographic statistical analysis and comparing incidence rates of radicular and neck pain VAS, dysphagia VAS from pre-operative to 1<sup>st</sup>-day post-operative, 1 month, and end of follow-up. We then compared dysphagia rates for the type of surgical procedure.

## Results

We collected 81 patients operated by a minimally invasive approach from 2013 to 2017 by the senior author (JASS), 70 patients underwent surgery for



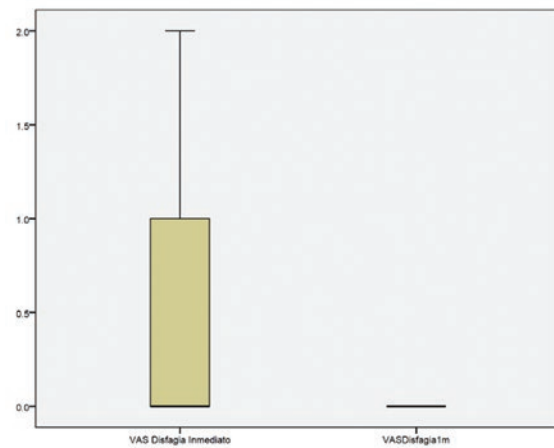
**Figure 1.** Patient distribution by operated levels and gender.



**Figure 2.** Immediate day 1 post-operative visual analog scale dysphagia distribution (0 means no dysphagia).

ACDF (44 females and 26 males) and 11 patients (8 females and three males) or arthroplasty.

Mean age in ACDF group was 52.5 years (11.9 standard deviation [SD]), mean BMI was 24.8 (3.7 SD), mean operated levels per patient were 2.01 (0.8 SD), mean surgical time was 156.8 min (SD 67.2), and mean surgical bleeding was 39.07 ml (SD 31.03). When analyzed by the number of levels, surgical time resulted to be 55.5 min (20.0 SD) per level, and bleeding was 23.23 ml per level (22.5 SD). Mean pre-operative radicular pain VAS was reported to be 6.77 (1.2 SD) as compared to 1.35 (1.1 SD) mean VAS at the end of follow-up ( $p < 0.01$ ). Mean pre-operative neck pain was reported to be 4.16 (2.7 SD) as compared to 0.67 (0.9 SD) mean VAS at the end



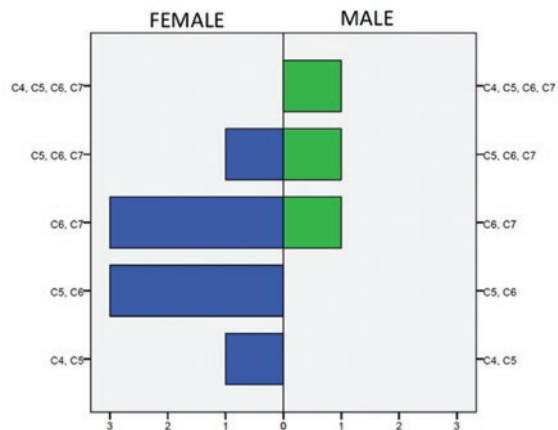
**Figure 3.** Significant changes ( $p < 0.01$ ) in mean dysphagia rates at day 1 post-operative and 1-month follow-up.

of follow-up ( $p < 0.01$ ). Mean post-operative VAS dysphagia on day 1 post-operative was 0.27 (0.4 SD) with a minimum of 0 and a maximum of 2, and no dysphagia was encountered at 1-month post-operative ( $p < 0.01$ ). The mean follow-up period was 32.7 months (13.0 SD) with a minimum of 9 months and a maximum of 60 months. Figure 1 shows patients distribution by operated level. Figure 2 demonstrates immediate day 1 post-operative VAS dysphagia distribution (0 means no dysphagia). Figure 3 shows significant changes ( $p < 0.01$ ) in mean dysphagia rates at day 1 post-operative and 1-month follow-up.

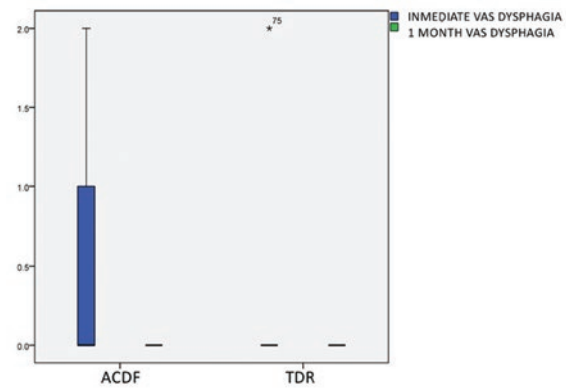
Mean age in arthroplasty group was 42.7 years (13.0 SD), mean BMI was 24.44 (3.0 SD), mean operated levels per patient were 1.36 (0.6 SD), mean surgical time was 125.45 min (SD 34.7), and mean surgical bleeding was 30.64 ml (SD 14.5). When analyzed by the number of levels, surgical time resulted to be 54.77 min per level (16.0 SD), and bleeding was 23.74 ml per level (9.2). Mean pre-operative radicular pain VAS was reported to be 7.0 (1.1 SD) as compared to 0.64 (0.8 SD) mean VAS at the end of follow-up ( $p < 0.01$ ). Mean pre-operative neck pain was reported to be 3.09 (2.5 SD) as compared to 0.64 (0.8 SD) mean VAS at the end of follow-up ( $p < 0.01$ ). Mean post-operative VAS dysphagia on day 1 post-operative was 0.18 (0.6 SD) with a minimum of 0 and a maximum of 2, and no dysphagia was encountered at 1-month post-operative with no statistically significant difference ( $p = 0.341$ ) due to the low sample size. The mean follow-up period was 26.7 months (6.7 SD) with a minimum of 18 months and a

**Table 1. Dysphagia rates reported in current literature as compared to the present series (Modified from Shriver 2017). FU = Follow-Up**

Author	Day-1 (95% CI)	End of FU Rates	FU Months
Soriano 2018	23.5 % (Mean) 9.1% (Arthroplasty) (Since 1-Month) 25.7% (ACDF)	0%	31.85
World Global Rate		8.5%	46.7
Graham 2014		8.1%	6
Burkus 2014		9.8%	84
Hou 2013		9.7%	22.5
Kepler 2012		39%	1.5
Coric 2011		6.1%	24
Cheng 2011		16.7%	36
McAfee 2010		8%	24
Anderson 2008		7.2%	24
Fernández-Fairen 2008		6.1%	24
Xie 2007		13.3%	24
Song 2006		2.6%	24
Bazaz 2002		20.2%	6
Bruneau 2001		1.9%	24.6
Bolesta 200		6.7%	42

**Figure 4. Distribution by operated levels and gender.**

maximum of 36 months. Figure 4 shows patients distribution by operated levels. Figure 5 demonstrates comparative day-1 post-operative and 1-month VAS dysphagia distribution between ACDF and arthroplasty. Table 1 shows dysphagia rates reported in current literature as compared to the present series (Modified from Shriver).

**Figure 5. Comparative day-1 post-operative and 1-month visual analog scale dysphagia distribution between anterior cervical discectomy and fusion and total disc replacement.**

## Discussion

Current research on dysphagia after ACSS has focused on surgical approach (ACDF vs. TDR, vs. anterior cervical corpectomy and fusion vs. ZERO-P)<sup>21-26</sup>, steroid use (intraoperative vs. post-operative, local or systemic)<sup>27</sup>, and graft implications (bone morphogenetic proteins two use vs. autografts vs. allograft)<sup>18,28</sup>, as well as overall incidence<sup>28</sup>, but few researches have been taken over the impact of minimally invasive approaches to reduce incidence rates.

Minimally invasive approaches have the common aim of avoiding biomechanical complications and are associated with decreased pain and morbidity in the early post-operative period, as well as with faster recovery rates accounting for the increasing number of safe outpatient-procedures being performed nowadays even in the cervical spine<sup>29,30</sup>. The present study was conceived based on the concept that minimally invasive approaches reduce soft-tissue trauma<sup>31</sup>, and so for reduce post-operative complications, such as dysphagia, a well-known complication related to soft-tissue edema (among other causes) after an ACSS<sup>6</sup>. Theoretically, a lesser rate of dysphagia in the early post-operative period would provide a proof of concept that minimally invasive tubular approaches, in fact, reduce soft-tissue trauma and their related complications. Worldwide rates of dysphagia are reported to be around 8.5 (5.7-11.3%, 95% confidence interval) as reported by Shriver et al. in their meta-analysis of 14 papers evaluating post-operative dysphagia after ACDF<sup>28</sup>, among them, the greatest rate of dysphagia (39%) was reported by Kepler on a cohort study with



mean follow-up of 1.5 months<sup>1</sup>, becoming also the paper with the shortest follow-up, which translates in a high dysphagia rate in the early post-operative period, providing evidence of the important role of soft-tissue trauma in the genesis of dysphagia, a fact that can help understand why steroids have proved effective in reducing early post-operative dysphagia<sup>32-34</sup> driven by their known anti-inflammatory effects. Conversely, our present series results report a 9% rate of dysphagia by 1-month follow-up, presenting a 9% dysphagia rate in day-1 post-operative that fully recovered by the end of follow-up.

## Conclusions

Based on this result, we can assume that minimally invasive techniques may provide an effective and safer surgical approach to the anterior cervical spine to reduce post-operative dysphagia related to soft-tissue trauma, as stated by the present series results effectively reducing early post-operative dysphagia to 9% in day-1 post-operative (as compared to 39%) and to 0% (as compared to 8.5% reported worldwide, 46.7 months mean follow-up) by 1-month follow-up. Further research with a level 1 evidence randomized clinical trial may help underscore the importance of adopting minimally invasive techniques in the armamentarium of spine surgeons to achieve better results in the anterior cervical spine, a surgical procedure that is well known by their excellent results, that can further been improved by reducing soft-tissue trauma-related complications that have potentially life-threatening outcomes such as dysphagia, and by the same time increasing patient satisfaction by a faster recovery rate and reducing hospital stay.

## Acknowledgment

The authors would like to thank our families and friends for their time given and their support over all these years.

## Conflicts of interest

The present article is a systematic review and so for an ethical approval was not required.

## Funding

The present work had no other funding than the authors own.

## Ethical disclosures

**Protection of human and animal subjects.** The authors declare that no experiments were performed on humans or animals for this study.

**Confidentiality of data.** The authors declare that they have followed the protocols of their work center on the publication of patient data.

**Right to privacy and informed consent.** The authors declare that no patient data appear in this article.

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