Effect of cervical brace on postoperative axial symptoms in patients with Anterior Cervical Discectomy and Fusion

Qunfei Yu
Zhejiang University School of Medicine
Ying Ren (ry0900@zju.edu.cn)
Zhejiang University School of Medicine
Zhan Wang
Orthopedics Research Institute of Zhejiang University
Guoping Xu
Zhejiang University School of Medicine
Yaojing Ma
Orthopedics Research Institute of Zhejiang University
Hua Zhang
Orthopedics Research Institute of Zhejiang University

Research Article

Keywords: brace, axial symptoms, anterior cervical discectomy and fusion (ACDF)

Posted Date: July 21st, 2022

DOI: https://doi.org/10.21203/rs.3.rs-1866383/v1

Abstract

Objective This study was intended to investigate the effect of cervical brace on postoperative axial symptoms in patients with single-segment anterior cervical discectomy and fusion (ACDF).

Methods Retrospective analysis of patients who underwent anterior cervical single-segment ACDF from May 2020 to August 2021 was performed. Patients were divided into the cervical brace group (Group 1) and the non-cervical brace group (Group 2) according to whether to wear cervical brace in postoperative patients. The incidence of axial symptoms ,cervical mobility and postoperative quality of life were compared between the two groups.

Results A total of 121 patients, 62 in the Group 1 and 59 in the Group 2. The general data of age, gender, BMI, smoking status, disease duration has no statistically differences. The incidence of axial symptoms at 1 month after surgery in the Group 2 was significantly lower. The cervical mobility in the Group 2 at 1 month after surgery were significantly higher.

Conclusion The absence of brace after surgery in patients with single-segment ACDF can reduce the incidence of early postoperative axial symptoms, improve their quality of life, and facilitate the recovery of postoperative cervical mobility.

Introduction

Axial symptom (AS) is a symptom of soreness, pain and stiffness in the cervical collar medially or paraspinally on both sides[1]. AS is generally more common after posterior cervical surgery, in which the paraspinal muscles are separated from the vertebral plates bilaterally and the surrounding ligaments are severed. These operations weaken the posterior paraspinal muscle power source, caused irreversible muscle atrophy and cervical-spinal sagittal imbalance, and then resulted in the development of axial symptoms. Studies have shown that the incidence of axial symptoms after posterior cervical single-opening spinal canal enlargement and plasty can reach 47.5%-81%[2–3].

Anterior Cervical Discectomy and Fusion (ACDF) is the most common surgical procedure for the treatment of cervical spondylosis. Although the anterior cervical surgery can be performed by separating the tissue gaps to reach the operative area directly, with less trauma to muscles and soft tissues and less bleeding, the incidence of postoperative axial symptoms is not uncommon. Studies have shown that the incidence of axial symptoms after ACDF is as high as 38.8% [4–5], which seriously affects the effective recovery of patients after surgery.

Patients are usually required to wear a neck brace immediately after surgery to limit excessive neck movement, and the general fixation time is 1 month. In clinical practice, it is found that patients can develop neck stiffness and even ulcers and pressure sores in severe cases due to prolonged wearing of neck brace. Several studies have shown that patients without brace after single-segment anterior cervical surgery does not affect patients' postoperative vertebral fusion and cervical dysfunction index [6–8]. Thus, patients

without brace after surgery may be safe and reliable. However, the effect of patients with axial symptoms after anterior cervical surgery without a brace on is still unclear.

Our hospital conducted an evidence-based project in 2020 on the need for cervical braces in patients after single-segment cervical spine surgery. After incorporating some guidelines and opinions from orthopedic spine specialists, patients do not need to wear a brace after single-segment ACDF in January 2021 in order to promote a rapid and quality recovery.

This study reviewed the data from May 2020 to August 2021 based on electronic medical records. The aim of the study is to investigate the effect of not wearing a brace after single-segment ACDF on postoperative axial symptoms and cervical mobility.We hope to provide a basis for the postoperative clinical management of such patients.

Materials And Methods

Study design

We retrospectively analyzed patients with ACDF from May 2020 to August 2021. Patients were divided into cervical brace group (Group 1) from May to December 2020 and non-cervical brace group (Group 2)

from January to August 2021 according to whether a cervical brace was used or not after surgery. Both groups of patients had uniform preparation such as preoperative examinations, preoperative education, and postoperative functional exercise instruction, and the same postoperative care program was implemented, including: postoperative vital sign monitoring, care of tubes (wound drainage tubes, catheters), dietary management, wound care, instruction on axial turning and early functional exercise, observation and prevention of complications, etc. Patients in the Group 1 were instructed to wear the brace correctly when they got out of bed for the first time. Key points to note for patients in Group 1 include that the neck brace should not be worn too tightly or too loosely to prevent pressure sores and should be worn ≥ 8 hours each day until 1 month after discharge. In the Group 2, patients do not need to wear a brace. Both groups needed the assistance of a nurse to guide them when they got out of bed for the first time after surgery to prevent the occurrence of postural hypotension or falls.

Patients

In this study, patients who underwent single-segment ACDF for the first time from May 2020 to August 2021 were selected for the study. Inclusion criteria: (1) Stable medical condition, meeting the diagnostic criteria of cervical spondylosis in the Expert Consensus on Surgical Treatment and Perioperative Management of Cervical Spondylosis (2018)[9]. and patients who underwent cervical surgery for the first time. Exclusion criteria: (1) combined with infection, inflammation or other serious systemic diseases. (2) those who were lost during follow-up or had incomplete information.

Outcomes

Axial symptoms,Range of motion and The quality of life were observed and recorded in both groups. Axial symptoms included stiffness and pain in the neck and shoulder, limited neck movement, and pain ranging

from behind the ear and under the occiput to the back of the shoulder and scapular region. They were classified into four levels: good, mild, severe, and serious [10]. Good level is defined as a patient with no stiffness or pain in the neck or shoulders. Mild level is defined as a patient who experiences neck or shoulder discomfort after minor exertion or a cold and recovers quickly, not interfering with the patient's daily activities, and little restriction of neck movement. Severe level is defined as a patient with frequent pain, daily activities are interfered with, physical therapy or pain medication is required to relieve pain. Serious level is defined as a patient with frequent pain symptoms that significantly interfere with daily activities, frequent need for pain medication to relieve symptoms. We defined good and mild levels as having no axial symptoms and severe or serious levels with symptoms lasting one month or more as having axial symptoms. Data is obtained by reviewing the patient's follow-up records.

Range of motion (ROM) of cervical spine was measured by measuring the angle a1 at the posterior border of the C2 and C7 vertebrae in hyperflexion and the angle a2 in hyperextension on a lateral radiograph. a1 was negative if the cervical spine was anteriorly convex in hyperflexion and a2 was negative if the cervical spine was deformed and retroflexed in hyperextension. ROM = a1 + a2[11]. We measured and recorded the patient's cervical mobility preoperatively, and at 1 and 3 months of discharge, through the patient's cervical hyperextension hyperflexion slices at each follow-up visit.The quality of life was measured by the SF-36 (quality of life assessment scale) scores,The SF-36 scale includes 8 dimensions, with a total of 36 items. The higher the score, the better the quality of life of the patient. high, Cronbach's alpha coefficient > 0.7 [12] .

General information such as age, gender, body mass index (BMI), duration of disease, smoking, and chronic comorbidities of the patients were recorded.

Statistical analysis

SPSS 26.0 statistical software was used to analyze the data. The measurement data were expressed as mean ± standard deviation, and the t test was used to compare the means between groups. The χ^2 test was used to compare the rates between groups for counting data. The test level $\alpha = 0.05$, and $P < 0.05$ was considered statistically significant difference.

Results

A total of 132 patients were included, 66 in the Group 1 and 66 in the Group 2.11 patients were excluded (4 patients in the Group 1 and 7 patients in the Group 2 lost to follow-up or with incomplete information). Eventually, a total of 121 patients, 62 in the Group 1 and 59 in the Group 2. The general data of age, gender, BMI, smoking status, disease duration, and chronic disease comorbidities such as hypertension and diabetes were compared, and the differences were not statistically significant, as shown in Table 1.The incidence of axial symptoms in the brace group was significantly higher than that in Group 2 at 1 month and 3 months after surgery. The incidence of axial symptoms in both groups gradually decreased over time. There was no significant difference in the cervical spine mobility and quality of life evaluation scores between the two groups before surgery, and the differences were statistically significant at 1 month and after operation, and gradually increase over time as shown in Table 2.The cervical mobility between the two groups were not statistically significant before surgery. But at 1 month after surgery, the cervical mobility and SF-36 scores in

Group 2 were significantly higher. The cervical mobility of both groups gradually improved with time (Table 2).

Table 1
Comparison of general information between the two groups of patients

Group	N	Gender		BMI (x ± s)	Age (years,x ± s)	Smoking status		High blood pressure		Diabetes		Duration of disease (years,`x ± s)
		Male	Female			Yes	No	Yes	No	Yes	No	
Group 1	62	38	24	25.87 ± 3.36	62.93 ± 8.01	15	47	18	44	9	53	3.72 ± 1.96
Group 2	59	37	22	25.60 ± 2.85	61.02 ± 7.38	18	41	15	44	12	47	4.01 ± 2.06
χ^2 /t-value		0.03		0.62	0.59	0.61		0.12		0.71		0.14
P-value		0.87		0.53	0.55	0.43		0.65		0.39		2.70

Table 2
Comparison of axial symptoms and cervical mobility between two groups of patients

Projects	Time	Group 1 (62 cases)	Group 2 (59 cases)	χ2 /t-value	P-value
Axial symptoms	1 month after surgery	27 (43.54%)	15 (25.42%)	4.38	< 0.05
	3 months after surgery	14 (22.58%)	8 (13.55%)	1.65	0.19
Cervical Mobility	Pre-operative	45.69°±2.89°	45.63°±2.35°	0.13	0.89
	1 month after surgery	33.09°±2.04°	38.52°±1.80°	12.92	< 0.00
	3 months after surgery	42.41°±2.40°	42.45°±1.66°	0.10	0.92
SF-36 scores	Pre-operative	63.40 ± 4.81	62.43 ± 5.85	0.89	0.37
	1 month after surgery	91.22 ± 3.97	97.31 ± 2.88	9.62	< 0.00
	3 months after surgery	111.18 ± 3.64	114.67 ± 2.55	0.92	0.36

Discussion

The symptoms of axial symptoms after cervical spine surgery include soreness, swelling, weakness, pain, stiffness and limitation of movement in the neck and back of the shoulder, etc. When the pain and limitation of movement continue to worsen, the quality of life of patients after surgery is seriously reduced [13]. Our study showed that not wearing a neck brace reduces the incidence of axial symptoms in the early

postoperative period after anterior cervical spine surgery. But there is no significant difference in incidence of axial symptoms at 3 months. Maybe the restriction of neck movement is lifted after 1 month and stiffness and limitation of movement are better than before. Due to the degeneration and instability of the patient's operated segment and adjacent segments, the normal physiological curvature of the cervical spine is reduced, resulting in cervical kyphosis. Soft tissues such as neck muscles and ligaments as well as the deep joint capsule are subject to stress changes under tension in a strained state. If a patient wears a brace for a long time after ACDF surgery, it restricts the active movement of his neck and leads to atrophy and stiffness of the posterior cervical muscle groups, which in turn produces axial symptoms or aggravates them [14]. One study has shown that axial symptoms after cervical fusion can be prevented or reduced by early postoperative static neck exercises, which increase neck mobility and promote the recovery of self-care ability [15]. Therefore, for patients after single-segment ACDF, the incidence of axial symptoms can be reduced by not wearing a cervical brace and by performing early functional neck exercises while ensuring safety.

Cervical spine mobility can effectively evaluate the postoperative quality of life and cervical spine motor function in patients with cervical spine diseases [16]. Our results showed that there was no significant difference in the cervical spine mobility between the two groups before surgery. The cervical spine mobility of the two groups gradually increased with time after surgery, but it was still lower than before. Patients in the no brace group had higher cervical mobility than those in the brace group at 1 and 3 months postoperatively, and the difference in mobility at 1 month postoperatively was statistically significant. Due to the removal of the diseased disc, implantation of the fusion device and placement of the plate anteriorly during ACDF, the cervical mobility of the fused segment was directly lost. Moreover, the cervical brace was fixed for 1 month after surgery in the brace group, which restricted the movement of the neck and caused stiffness of the neck muscles, thus affecting the recovery of cervical mobility. Another study reported that wearing a brace for a long time after surgery significantly reduced the motion of the cervical C3-6 vertebrae, resulting in a decrease in overall cervical mobility and an increase in compensatory motion of the cervical 2/3 and cervical 6/7 segments. Finally, the patient developed axial symptoms [17]. Therefore, for patients after single-segment ACDF, it is recommended to not wear a brace, which not only facilitates the recovery of cervical mobility, but also reduces the occurrence of axial symptoms.

In the beginning, postoperative cervical spine patients often needed a cervical brace to limit excessive movement of the cervical spine, increase the stability and promote the fusion of the cervical spine vertebrae. With the development of internal fixation techniques and materials, titanium plates are routinely fixed anteriorly to the vertebral body in ACDF surgery. Internal fixation with titanium plates can prevent displacement and subsidence of the intervertebral fusion, maintain segmental stability and interbody height, promote implant fusion, and reduce the dependence on external fixation[18]. Additionally, cervical braces may cause discomfort and related complications such as dysphagia, and muscle atrophy, and even lead to changes in gait, affecting the quality of life and safety of patients [19]. Therefore, patients after single-segment ACDF can be recommended to improve their postoperative quality of life by not wearing a brace.

There are some limitations in the study. The follow-up time of this study was only 3 months, the sample size was small and the surgical modality was limited to ACDF. Multicenter, anterior cervical multi-surgical

modalities with longer follow-up time in randomized controlled clinical trials should be conducted in the future.

Conclusion

Although the anterior cervical approach is less traumatic than the posterior cervical approach, the incidence of axial symptoms should not be underestimated. This study showed that the absence of a postoperative brace could not only reduce the incidence of axial symptoms but also facilitate the recovery of cervical mobility.

Declarations

Ethics declarations

Ethics approval

This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the Ethics Committee of The Second Affiliated Hospital Zhejiang University School of Medicine (Ethical approval No. 2022-0431).

Consent to participate

Informed consent was obtained from all individual participants included in the study.

Consent for publication

Not applicable.

Contributions

Qunfei Yu: Study design, manuscript writing, statistical analysis, results, interpretation.

Ying Ren: Study conceptualization, data collection, data analysis, manuscript, writing, results interpretation.

Zhan Wang: Results interpretation, manuscript review.

Guoping Xu: Data collection, manuscript review, results interpretation.

Yaojing Ma: Results interpretation, manuscript review.

Hua Zhang:Data collection, manuscript review, results interpretation.

Funding

This work was supported by the China Postdoctoral Science Foundation (2021M692792), National Natural Science Foundation of China (82103499), Zhejiang Provincial Natural Science Foundation (LQ22H160040), and Medical Science and Technology Project of Zhejiang Province 2022KY171 .

Competing interests

The authors declare no competing interests.

Availability of data and materials

The date that support the findings of this study are available from the corresponding author under reasonable request.

References

1. Zhang, X., Gao, Y., Gao, K., Yu, Z., Lv, D., Ma, H., & Zhai, G. (2020). Factors associated with postoperative axial symptom after expansive open-door laminoplasty: retrospective study using multivariable analysis. European Spine Journal, 29(11), 2838-2844.
2. Wang, L. F., Dong, Z., Miao, D. C., Shen, Y., & Wang, F. (2019). Risk factor analysis of axial symptoms after single-segment anterior cervical discectomy and fusion: a retrospective study of 113 patients. Journal of International Medical Research, 47(12), 6100-6108.
3. Fujiwara, H., Oda, T., Makino, T., Moriguchi, Y., Yonenobu, K., & Kaito, T. (2018). Impact of cervical sagittal alignment on axial neck pain and health-related quality of life after cervical laminoplasty in patients with cervical spondylotic myelopathy or ossification of the posterior longitudinal ligament. Clinical spine surgery, 31(4), E245-E251.
4. Wang, M., Luo, X. J., Deng, Q. X., Li, J. H., & Wang, N. (2016). Prevalence of axial symptoms after posterior cervical decompression: a meta-analysis. European Spine Journal, 25(7), 2302-2310.
5. Zhang, Y., Liu, H., Yang, H., & Pi, B. (2019). Relationship between sagittal balance and axial symptoms in patients with cervical spondylotic myelopathy treated with anterior cervical discectomy and fusion. Journal of Investigative Surgery.
6. Overley, S. C., Merrill, R. K., Baird, E. O., Meaike, J. J., Cho, S. K., Hecht, A. C., & Qureshi, S. A. (2018). Is cervical bracing necessary after one-and two-level instrumented anterior cervical discectomy and fusion? A prospective randomized study. Global Spine Journal, 8(1), 40-46.
7. Scerrati, A., Visani, J., Norri, N., Cavallo, M., Giganti, M., & De Bonis, P. (2019). Effect of external cervical orthoses on clinical and radiological outcome of patients undergoing anterior cervical discectomy and fusion. Acta Neurochirurgica, 161(10), 2195-2200.
8. Scerrati, A., Visani, J., Norri, N., Cavallo, M., Giganti, M., & De Bonis, P. (2019). Effect of external cervical orthoses on clinical and radiological outcome of patients undergoing anterior cervical discectomy and fusion. Acta Neurochirurgica, 161(10), 2195-2200.
9. Fehlings, M. G., Smith, J. S., Kopjar, B., Arnold, P. M., Yoon, S. T., Vaccaro, A. R., ... & Shaffrey, C. I. (2012). Perioperative and delayed complications associated with the surgical treatment of cervical spondylotic myelopathy based on 302 patients from the AOSpine North America Cervical Spondylotic Myelopathy Study: Presented at the 2011 Spine Section Meeting. Journal of Neurosurgery: Spine, 16(5), 425-432.
10. Hosono, N., Sakaura, H., Mukai, Y., Fujii, R., & Yoshikawa, H. (2006). C3-6 laminoplasty takes over C3-7 laminoplasty with significantly lower incidence of axial neck pain. European Spine Journal, 15(9), 1375-

1379.

11. Korovessis, P., Mpountogianni, E., Syrimpeis, V., Andriopoulou, M., & Korovesis, A. (2021). Quality of Life in Adult Patients Receiving Cervical Fusion for Fresh Subaxial Cervical Injury: The Role of Associated Spinal Cord Injury. BioMed Research International, 2021.
12. McHorney, C. A. (1996). Measuring and monitoring general health status in elderly persons: practical and methodological issues in using the SF-36 Health Survey. The Gerontologist, 36(5), 571-583.
13. Xia, C., Shi, F., Chen, C., Lv, J., & Chen, Q. (2022). Clinical Efficacy and Safety of Anterior Cervical Decompression versus Segmental Fusion and Posterior Expansive Canal Plasty in the Treatment of Multilevel Cervical Spondylotic Myelopathy. Journal of Healthcare Engineering, 2022.
14. Kadam, A., Millhouse, P. W., Kepler, C. K., Radcliff, K. E., Fehlings, M. G., Janssen, M. E., ... & Vaccaro, A. R. (2016). Bone substitutes and expanders in spine surgery: a review of their fusion efficacies. International Journal of Spine Surgery, 10.
15. Wang, X. J., Huang, K. K., He, J. B., Wu, T. K., Rong, X., & Liu, H. (2022). Fatty infiltration in cervical extensor muscle: is there a relationship with cervical sagittal alignment after anterior cervical discectomy and fusion?. BMC Musculoskeletal Disorders, 23(1), 1-9.
16. Feng, M., Liang, L., Sun, W., Liu, G. W., Yin, X., Han, T., ... & Zhu, L. (2019). Measurements of cervical range of motion using an optical motion capture system: Repeatability and validity. Experimental and therapeutic medicine, 18(6), 4193-4202.
17. Wang, M., Luo, X. J., Deng, Q. X., Li, J. H., & Wang, N. (2016). Prevalence of axial symptoms after posterior cervical decompression: a meta-analysis. European Spine Journal, 25(7), 2302-2310.
18. Hah, R. J., Alluri, R., & Anderson, P. A. (2020). Biomechanical analysis of an anterior cervical discectomy and fusion pseudarthrosis model revised with machined interfacet allograft spacers. Global Spine Journal, 10(8), 973-981.
19. Russell, D. M., Kelleran, K. J., & Morrison, S. (2016). Bracing the trunk and neck in young adults leads to a more aged-like gait. Gait & posture, 49, 388-393.