

Indwelling Drains Are Not Necessary for Patients Undergoing One-level Anterior Cervical Fixation Surgery

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Background: Anterior cervical discectomy and fusion (ACDF) has become a common procedure for cervical spine surgeries, since it is safe and effective in most patients. However, some patients develop life-threatening problems such as respiratory obstruction arising from rare postoperative hematoma and edema, although intraoperative bleeding caused by the connective tissue splitting procedure or bleeding caused by postoperative insertion of a suction tube has rarely been reported. Investigation of the requirement for indwelling drains in patients who undergo cervical spine surgery is necessary because of the pain, anxiety, and discomfort caused despite the use of high-quality materials.

Methods: Enrolled in the study were 43 patients who underwent one-level anterior cervical fixation surgery, including 23 (randomly selected) who received an indwelling drain (group A, mean age: 57.78±14.46 years, range: 39–82 years, male/female: 13/10), and 20 who received no indwelling drain (group B, mean age: 57.00±13.99 years, range: 29–81 years, male/female: 12/8). Intraoperative bleeding amounts, lateral views of plain cervical spine radiographs, prevertebral space (PVS) changes on plain radiographs and computed tomography (CT) images, wound inspections, and pain assessments on the Numeric Rating Scale (NRS) were compared between groups. In addition, a history of risk factors for bleeding, such as hypertension, diabetes, and cerebrovascular diseases which require antiplatelet therapy, was determined. Hepatic failure was observed in none of the patients.

Results: Postoperative CT images obtained the day following surgery showed no densities indicating the presence of postoperative hematoma in any of the 43 patients. The maximum amount of intraoperative bleeding was 10 mL, with no significant difference between groups. No patients reported an obvious pain level on NRS, but the pain was significantly milder in group B (A: 1.326±0.911, B: 0.555±0.556, $p=0.0037$). The postoperative PVS increment on plain radiographs was comparable between groups (A: 1.778±0.992, B: 1.730±0.966, $p=0.8728$).

Discussion: Given the negligible intraoperative and postoperative bleeding observed in both groups, and the lack of difference in PVS increments between the groups, our results suggested that indwelling drains are not required for patients undergoing typical anterior cervical fixation surgery. However, it is important to take care of major vessels such as the superior and inferior thyroid arteries and the external jugular vein as well as the prevertebral venous plexus during surgery.

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Key words: anterior cervical discectomy and fusion, hematoma, prevertebral space

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Introduction

Anterior cervical discectomy and fusion (ACDF) is one of the approaches to the anterior cervical region, an area considered to have the most complicated anatomy, and it is a widely accepted surgical procedure that is safe and effective in most patients and has a favorable postoperative course. However, it is frequently associated with surgical complications¹⁻⁶, and in recent years, there have been a number of reports of serious and sometimes fatal complications, such as airway compression caused by postoperative hematomas developing in the anterior cervical region⁷⁻¹⁰.

An indwelling wound drain is used to facilitate the drainage of postoperative bleeding, which is common during wound closure after surgical procedures. To date, we have followed the practice of drain insertion in the anterior aspect of the vertebral body in more than 500 cases of cervical anterior fixation surgery; however, drain discharge has been minimal with no incidence of intraoperative bleeding or postoperative hematoma formation.

An indwelling drain is associated with pain in the area of insertion, and its withdrawal and cutting result in anxiety and negatively affect the bed-rest period of the patient. In addition, a hematoma can develop because of bleeding during drain removal, which is not limited to ACDF, and, in some rare instances, the patient may develop infection.

The region with the highest risk of hematoma formation following ACDF is the entry pathway on the medial side of the carotid arteriovenous system and the anterior aspect of the vertebral body. This is commonly observed on plain cervical spine radiographs and computed tomography (CT) images. Changes in soft tissues containing a hematoma are easily and commonly differentiated from those in the prevertebral space (PVS), particularly on the lateral view of a plain cervical spine radiograph.

To date, no study has addressed the necessity of an indwelling drain in patients who undergo anterior cervical fixation surgery. In this study, we conducted daily postoperative examinations to assess the changes in the PVS on plain cervical spine radiographs and CT images in patients who underwent ACDF and received an indwelling drain.

Materials and Methods

In total, 43 patients who underwent anterior cervical fixation surgery for one-level degenerative cervical spondylosis in our hospital from June 2011 to June 2014 were enrolled. The patients were randomly assigned to two

groups: group A included 23 patients who received indwelling drains in the anterior aspect of the vertebral body and group B included 20 patients who did not. It was explained to all patients that the placement of an indwelling wound drain was to facilitate the drainage of postoperative bleeding, but this explanation was not supported by any scientific evidence of risk prevention. We had never considered the necessity of an indwelling drain in our past cases of ACDF because of negligible intra- and postoperative bleeding. The mean age of patients in groups A and B was 57.78 ± 14.46 (range: 39–82) and 57.00 ± 13.99 (range: 29–81, $p=0.89$) years, respectively, with 13 men and 10 women in group A, and 12 men and 8 women in group B ($p=0.75$). Factors related to bleeding complications included hypertension (A/B: 12/10, $p=0.87$), diabetes mellitus (A/B: 3/2, $p=0.62$), and antiplatelet therapy (A/B: 7/5, $p=0.79$). Thus, patient characteristics differed significantly between the groups. Antiplatelet therapy was discontinued according to the 2009 stroke guidelines because of known perioperative effects (Table 1).

Surgical Procedures

In principle, a right-sided approach was used in all patients. Following placement of a transverse 5-cm incision along the skin wrinkles visualized under a microscope, delamination was performed between the dermal layers containing the adipose tissue and platysma. Following transverse incision placement in the platysma, an access was created through the sternocleidomastoid and thyrohyoid muscle sheaths. The thyrohyoid and sternothyroid muscles were sequentially separated, followed by opening of the space between the carotid sheath, thyroid, and esophageal fascia starting from the avascular area of the connective tissue in order to reach the anterior aspect of the vertebral body. During this procedure, microveins less than 1 mm in diameter were coagulated and cut. However, the procedure involved sharp dissection, and there was negligible bleeding. Although coagulation and cutting of the superior and inferior thyroid arteries were not necessary in most patients, we peeled off 10 mm or more when performed this was and used a hemoclip, followed by a cut after sufficient coagulation. A retractor was used for left and right separation, and the Takayasu anterior cervical retractor (Mizuho Medical Co., Ltd., Tokyo, Japan), which can place a blade on the longus colli muscle, was used. This retractor appropriately adjusts the incision tension and is useful for preventing pressure complications. Although bleeding occurs from the vertebral body bone and venous plexus during all procedures

Table 1 Background characteristics of the 43 patients who underwent anterior cervical discectomy and fusion (ACDF)

	Group A (N=23)	Group B (N=20)	p-value
age (mean±SD)	57.8±14.5 (39–82)	57.0±14.0 (29–81)	0.89
Male	13	10	0.75
Lesion site			
C45	5	3	
C56	12	12	
C67	6	5	0.22
Past history			
HT	12	10	0.87
DM	3	2	0.62
AP	7	5	0.79

Group A: with indwelling drain

Group B: with no indwelling drain

HT: hypertension, DM: diabetes, AP: on anti-platelet therapy for cerebral infarction or heart disease

from typical intervertebral disc removal to osteophyte and hernia removal using a high-speed drill, hemostasis can be easily achieved with bone wax and surgical sealant. The M-cage SR (AMTEC Co., Ltd., Osaka, Japan) was mainly used for fixation (Fig. 1).

The Following Protocol Was Observed.

1. The presence or absence of bleeding in the surgical wound area was observed on cervical CT scans obtained the day following surgery (in particular, the anterior aspect of the vertebral body, the area around the carotid arteriovenous system, the area around the thyroid gland, and the muscular and subcutaneous layers were evaluated).

2. The amount of intraoperative bleeding was analyzed.

3. Wound area assessment was performed the day following surgery (inspection and palpation for the presence [+] or absence [-] of a swelling). Pain in the wound area was evaluated using the Numeric Rating Scale (NRS)¹⁹.

4. The PVS at the equivalent surgical intervertebral disc level was measured on the lateral view of cervical spine plain radiographs before and the day following surgery. The values obtained were corrected against the ratio^{11,12} (Fig. 2).

Statistical Analysis

When significant differences were observed between the groups on Bartlett's test, the Mann-Whitney U-test with nonparametric comparisons was conducted. In the absence of significant differences, Student's t-test was used. Differences in gender, lesion site, and history between groups were assessed using Pearson's chi-square

test of proportions. Statistical significance was set at $p < 0.05$. All statistical analyses were performed using Stat-View version J-5.0 (SAS Institute Inc., Cary, NC, USA) on a Windows 7 computer.

Results

Cervical CT scans obtained the day following surgery did not reveal any densities that would indicate bleeding in the anterior aspect of the vertebral body, around the carotid arteriovenous system, around the thyroid gland, or in the muscular and subcutaneous layers in any of the 43 patients. Furthermore, the amount of intraoperative bleeding was negligible and consequently could not be measured in any of the patients.

Nineteen patients in group A and 18 patients in group B exhibited no postoperative swelling, while 4 and 2 patients, respectively, did; there was no significant difference between the groups ($p=0.48$). The mean NRS score for pain was 1.326 ± 0.991 (range, 0–3) in group A and 0.555 ± 0.556 (range, 0–2) in group B, indicating significantly milder pain in group B ($p=0.0037$, Table 2). Interviews for pain assessment were conducted prior to drain removal in group A. Because there was no difference in the wound condition between the groups, the cause of pain and discomfort was most likely to have been the indwelling drain.

PVS increments observed on a lateral view of cervical spine plain radiographs in groups A and B, respectively, after surgery were as follows: minimum: 0.1 mm/0.2 mm, maximum: 3.4 mm/3.5 mm, mean: 1.778 ± 0.992 mm/ 1.730 ± 0.966 mm. There was no significant difference between the groups ($p=0.8728$, Table 2).

Table 2 Results of wound pain assessments and analysis of the prevertebral space (PVS) after ACDF
Wound pain was evaluated using the Numeric Rating Scale (NRS)¹⁹

	Group A (N=23)	Group B (N=20)	p-value
wound			
swelling (+/-)	4/19	2/18	0.48
pain (NRS)	1.33±0.99	0.56±0.56	0.004
PVS increment (mm)	1.79±0.99	1.73±0.97	0.87

Discussion

ACDF is one of the most commonly performed spinal procedures and has a satisfactory outcome in most patients. However, occasional complications are a problem and, in rare circumstances, fatal. One of the most serious adverse events associated with anterior cervical spine surgery is wound hematomas that result in airway compromise. The reported incidence of this postoperative complication has varied from 0.2% to 1.9%¹³.

Fountas et al.⁵ reported that postoperative hematoma occurred in 5.6% patients who underwent ACDF, 2.4% of whom required reoperation. However, Aono et al.¹⁴ reported an incidence of 0.21%. In addition, case reports of life-threatening circumstances and critical patients who required tracheotomy and reoperation have also been published in recent years^{7,9,10}.

Hematoma formation following anterior cervical spine surgery may be the result of inadequate arterial or venous bleeding control during surgery and have been reported to be caused by superior thyroid artery dissection⁷.

No reports or analyses have examined the necessity of indwelling drains in patients who undergo spinal surgery. Basques et al.¹⁵ measured the amount of drainage, which was rare. In addition, to date, only a few reports have mentioned the drainage status, even in case reports of postoperative hematomas. Furthermore, one report documented the absence of drainage⁷. Barring the delayed onset of a postoperative cervical hematoma, there have been many reported cases of hematoma development within 6 h after surgery. Affected patients required treatment, including a quick diagnosis and reoperation, but the amount of drainage was not necessarily included as a reference. In addition, when bleeding from the superior thyroid artery was excluded, the point of bleeding during the time of reoperation has been unclear in many cases. Early diagnoses and judgment of treatment from clinical signs such as neck swelling and progressive respiratory disturbance have become important, as pro-

posed in the guidelines by Palumbo et al.¹³.

Development of titanium cages has resulted in the adoption of the transvertebral approach for keyhole surgery on the cervical body and the use of autogenous bone grafts without iliac bone collection, introduced with the Williams-Isu method of anterior fixation surgery, both of which allow patients to enjoy a comparatively free bed rest from an early postoperative period. An indwelling drain is often one of the factors causing patient distress¹⁶⁻¹⁸. Because of the 5-cm skin incision and the fact that anterior fixation surgery mostly does not injure or cut the vascular system, there is almost no postoperative wound pain, but the discomfort and pain caused by drain fixation have resulted in anxiety in many patients.

In addition, traction of the midline structures on the side contralateral to the entry side is inevitable in anterior cervical fixation surgery, suggesting procedural complications. Indwelling drains can indicate persistent postoperative bleeding by confirming changes in the amount of drainage immediately after surgery. However, they do not contribute to complications other than bleeding, such as laryngeal edema due to circulatory disturbance and neurological disorders such as dysphagia and hoarseness.

Furthermore, indwelling drains significantly prevent infection caused by postoperative bleeding and the accumulation of transudate in the wound, but the possibility of infection caused by the drain cannot be ruled out. In addition, many surgeons have encountered hematoma formation caused by bleeding following drain removal.

This study analyzed the necessity of indwelling drain placement in patients who undergo anterior cervical fixation surgery by evaluating the following events: intraoperative bleeding, quantifiable postoperative bleeding in the drainage bag, and reliable findings of hematoma on CT scans obtained the day following surgery.

With regard to one- or two-level anterior cervical fixation surgeries, including patients with lesions at C34, 45, 56, and 67, drain placement can be avoided if the following criteria are fulfilled.

1. The operator has adequate experience with the ante-

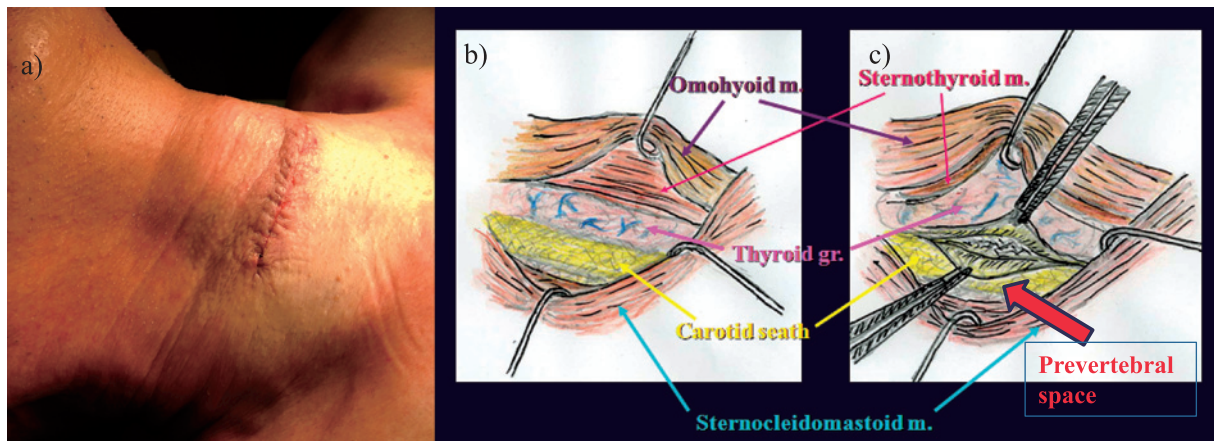


Fig. 1 Skin incision and approach toward the vertebral body in anterior cervical discectomy and fusion (ACDF).
 a) Skin incision for ACDF after surgery without an indwelling drain (40–50 mm, right side of the neck).
 b) Superficial view: The most important step is hooking of the omohyoid and sternothyroid muscles.
 c) Deep view: After sharp dissection of the connecting tissue, the prevertebral space is accessed through the avascular area, with traction of the thyroid gland, trachea, and esophagus to the contralateral side.

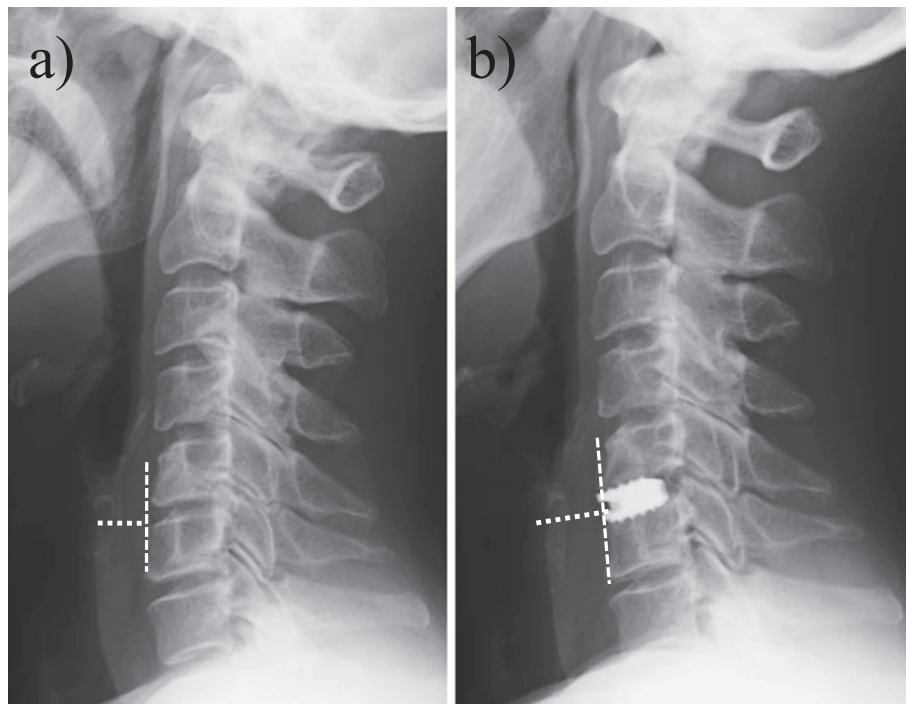


Fig. 2 Measurement of the prevertebral space (PVS).
 Lateral view of plain cervical spine radiographs.
 The distance from the anterior aspect of the vertebral body to the posterior aspect of the trachea is measured at the fusion level.
 a) Preoperative
 b) Postoperative

rior incision procedure.

2. The amount of intraoperative bleeding is negligible (<10 cc).

3. Ligation and cutting of the relatively large veins that are directly connected to the superior and inferior thyroid arteries and external jugular vein should be precise.

4. There should be no bleeding or a negligible amount of bleeding from the venous plexus in the PVS.

5. An extensive corpectomy is not performed.

The following points should also be noted with regard to wound closure.

1. Bone wax is used to fill even the finely removed

parts of the bone, such as the vertebral body bone, including osteophytes.

2. Sufficient coagulation and lavage are required if there is bleeding from the peripheral venous plexus.

3. Hemostasis is confirmed when coagulation and cutting of the vessels is performed.

4. The contralaterally pulled midline structures are returned to their positions and hemostasis is confirmed by the Valsalva maneuver. An indwelling drain is considered unnecessary if there is negligible intraoperative and postoperative bleeding.

However, patients in need of relatively rare anterior procedures that require multilevel corpectomies for the upper cervical spine and those with ossification of the posterior longitudinal ligament, tumors, or vascular disorders were not included in this study. Therefore, the necessity of indwelling drains should be considered on a case-by-case basis.

In conclusion, the results of our study indicated that indwelling drains are not necessary in patients who undergo one-level anterior cervical fixation surgery, and that observation of the PVS on simple cervical spine radiographs is the simplest and most useful method to determine any complications. Physicians should be aware of hematoma formation, which is the most problematic and critical complication of ACDF.

Conflict of Interest: The authors declare no conflict of interest.

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