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Our surgical results with anterior cervical corpectomy and iliac graft fusion

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Abstract
Aim: Our aim in this study is to show that an autologous graft taken for fusion after cervical corpectomy is an extremely reliable, inexpensive, and physiological method for creating a fusion.
Material and Methods: Thirty patients who were operated on in our clinic between 2015 and 2019 were evaluated retrospectively.
Results: In our study, 13 of 30 patients were male and 17 were female. The mean age was 54.8 years. A one-level corpectomy was performed in 23 patients and a two-level corpectomy in seven patients. An iliac graft was placed in the distance, and a plate was placed on one lower and one upper level of the corpectomy vertebrae. Thirty patients who underwent iliac grafts were followed for 2 years. Dysphagia developed in three patients, wound infection developed in three patients, and subcutaneous hematoma developed in two patients. The mean preop lordosis angle of the patients was 9.5, and the mean in the 2nd postoperative year was 14. The preoperative JOA score of the patients was 9, and in the 2nd postoperative year, it was 13.9. Preoperative visual analogue scale (VAS) of the patients was 5.9, in the 2nd postoperative year, it was 1.6.
Discussion: An autologous graft is physiological and inexpensive, and infection, foreign body reaction, and poor fusion are less common. When fusion does not occur, catastrophic complications such as stenosis or injuries to the esophagus, trachea, or great vessels may occur. An autogenous graft is the gold standard for fusion.

Keywords
Cervical Vertebrae, Neck Pain, Lordosis

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Introduction

The posterior longitudinal ligament starts at the 1st cervical spine and extends to the sacrum, and functions to resist excessive flexion of the spine. Ossification occurs by the replacement of fibroblast tissue in the ligament with ectopic new bone over time [1].

Patients should be evaluated with magnetic resonance imaging (MRI) and computerized tomography (CT) preoperatively. As the ossified tissue begins to thicken, it creates a space-occupying lesion narrowing the spinal canal causing neurological findings. Following anterior corpectomy in these patients, the ossified connective tissue should be freed and removed with the help of a drill or Kerison, without damaging the underlying dura. Care should be taken as there are strong adhesions between the ossified ligament and the dura mater. After adequate decompression, arthrodesis is performed using autologous bone grafts or cages [2].

After the anterior corpectomy is performed, the cervical spine should be reconstructed to ensure long-term stabilization. Autograft and allograft are used as the fusion material. Fibula and iliac crest are used as autografts, and cages are used as allografts. Pseudoarthrosis is an important cause of complications. Pseudoarthrosis can result in mobilization of the graft and complications such as injuries to the esophagus, trachea, or great vessels, and spinal cord stenosis may develop. Infections are another important complication seen after cervical corpectomy [3, 4].

Material and Methods

Between 2015 and 2019, patients presented to us with symptoms such as pain in the suboccipital and neck regions, neck and arm pain, thenar or hypothenar atrophy, spastic paresis in the lower extremities, and ataxia. Posterior longitudinal ligament ossification was visualized on MRI and CT examinations. Thirty patients who underwent anterior corpectomy and fusion with iliac graft were included in the study. The patients were mobile 6 hours postoperatively and were discharged after an average of 1 week. The patients used a Philadelphia-type cervical collar for approximately 2 months. Postoperative imaging was performed on the 1st day, and at 3 and 24 months to check the status of the fusion.

Demographic characteristics of the patients such as age, gender, level of operation and complications were evaluated. The patients' lordosis angle, VAS and JOA scores preoperative, postoperative 3rd month and postoperative 2nd year results were compared.

Statistical analysis

Descriptive statistics were used to describe continuous variables (mean, standard deviation, minimum, median, maximum). Frequency and percentage values were calculated for the descriptive statistics of categorical variables.

A comparison of more than two continuous variables that were dependent and not normally distributed was made with the Friedman test. Post-hoc evaluation of the parameters found to be significant was done with the Wilcoxon Signed Rank Test with a Bonferroni correction.

A comparison of more than two continuous variables with a dependent and normal distribution was made with the Repeated Measures ANOVA test.

A comparison of independent and non-normally distributed continuous variables was made with the Mann-Whitney u test. Statistical significance was determined as 0.05. Analyses were performed using MedCalc Statistical Software version 12.7.7 (MedCalc Software bvba, Ostend, Belgium; http://www.medcalc.org; 2013).

Ethical approval

Ethics Committee approval for the study was obtained.

Results

The mean age of the patients was 58.4 years. Thirteen (43.3%) patients were male and 17 (56.7%) were female. A single-level corpectomy was performed in 23 (76.7%) patients, and a two-level corpectomy was performed in 7 (23.3%) patients. A subcutaneous hematoma was seen in two patients, superficial wound infection in three patients, and transient dysphagia in three patients. CSF fistulas or deep infections did not develop in any patient.

The mean lordosis angle of preoperative patients was 9.5 + 4.7. The 3rd month postoperative average value was 13.6 + 4.6 and the 2nd year postoperative average value was 14 + 4.2. The change in the lordosis angle from preoperatively to the 2nd postoperative year showed a statistically significant change. While the change from preoperative to the 3rd postoperative month was statistically significant, the change from the 3rd postoperative month to 2 years postoperatively was not statistically significant. The difference in the lordosis angle between the sexes was not statistically significant. The change in the lordosis angle between corpectomy levels was also not statistically significant (Table 1).

The mean preoperative JOA score of the patients was 9 + 1,8. The JOA score in the 3rd postoperative month was12.6 + 1.7, while in the 2nd postoperative year it was 13.9 + 1.8.

The changes in the JOA scores from the preoperative period to

Table 1. Examination of changes in the lordosis angle over time

	Preop Lordosis Angle	Postop 3rd month Lordosis Angle	Postop 2nd year Lordosis Angle	p
Mean+SD	9,5+4,7	13,6+4,6	14,0+4,2	<0,001*
Med(min-max)	9,5(1-19)	14,5(5-22)	15(7-22)	

* Repeated Measurements ANOVA

Table 2. Examination of JOA's change over time

	Preop JOA	Postop 3rd month JOA	Postop 2nd year JOA	p
Mean+SD	9,0+1,8	12,6+1,7	13,9+1,8	<0,001*
Med(min-max)	8,5(6-13)	12,5(10-16)	14(10-17)	

*Friedman test

Post Hoc Comparisons	
	P (Bonferroni corrected)
Preop-Postop 3rd month	<0,001
Preop-Postop 2nd year	<0,001
Postop. 3rd month- postop 3rd year	0,004

Table 3. Examination of VAS change over time

	VAS Preop	VAS 3rd month	VAS 2nd year	p
Mean+SD	5,9+1,7	2,9+1,3	1.6+1,0	<0,001*
Med (min-max)	6(3-9)	3(1-6)	1(1-5)	
*Friedman test				
Post Hoc Comparisons				
			P (Bonferroni corrected)	
Preop-Postop 3rd month			<0,001	
Preop-Postop 2nd year			<0,001	
Postop. 3rd month- postop 3rd year			0,002	

3 months postoperatively, from the preoperative period to 2 years postoperatively, and from 3 months postoperatively to 2 years postoperatively were statistically significant. The change in the JOA score from 3 months to 2 years postoperatively was not statistically significant. The change in the JOA score between genders was not statistically significant. The change in the JOA score between corpectomy levels was not statistically significant (Table 2).

The mean preoperative VAS was 5.9 + 1.7. In the third month postoperatively, VAS was 2.9 + 1,3, while in the 2nd postoperative year, VAS was 1.6 + 1. The changes in the VAS scores from the preoperative period to the 3rd month postoperatively, from preoperative period to the 2nd postoperative year, and from the 3rd month postoperatively to the 2nd year postoperatively were all statistically significant. The change in the VAS between genders was not statistically significant. The change in the VAS between corpectomy levels was not statistically significant (Table 3).

The change of lordosis angle shows a statistically significant change from the preoperative period to postoperative 2nd year. This change shows statistically significant difference from the preoperative period to postop 3rd month, from the preoperative period to postoperative 3rd year. From postop 3rd month to postop 2nd year changes were not statically sigificant (Bonferroni corrected p values <0.001 for 3 comparisons).

Statistically significant change in JOA scores between the preoperative period and the postoperative 2nd year.

This change shows statistically significant difference betweenpreoperative and postopoperative 3rd month, between preoperative to postoperative 3rd year, and between postopoperative 3rd month to postopoperative 2nd year.

Statistically significant change in VAS scores between the preoperative period and postoperative 2nd year.

This change shows statistically significant difference between preoperative to postoperative 3rd month, between preoperative to postoperative 3rd year and between postoperative 3rd month to postoperative 2nd year.

Discussion

OPPL can cause severe stenosis in the cervical spinal canal. Patients initially begin with complaints such as mild neck pain and numbness in the hands, and then begin to experience serious symptoms that affect daily life. In advanced disease, clumsiness in the hands, a spastic gait, weakness in the arms and legs, and urinary and fecal incontinence may be seen. While symptomatic treatment is sufficient in mild cases and cases without severe canal stenosis, surgical treatment should be performed in advanced cases. There are still debates on the surgical treatment of cervical pathologies caused by ossification posterior longitudinal ligament (OPLL). Corpectomy and ossified ligament excision can be performed through an anterior approach, or laminectomy/laminoplasty can be performed through a posterior approach. Anterior approach is preferable to posterior approach. Excision of the ossified ligament in the anterior approach provides better decompression than in the posterior approach. Increased kyphosis with a posterior approach is another of its disadvantages. However, in severe stenosis, the risk of neural tissue damage with the anterior approach is higher than with the posterior approach. Another disadvantage of the posterior approach is the long-term pain caused by dissection of the neck muscles and the risk of C5 development due to traction. The anterior approach is generally preferred in cases where there is local or segmental-type OPLL that extends for less than three vertebrae, the spinal canal is not congenitally narrow, and the lesion is below C2 but above T1 [2, 5-7].

After corpectomy and excision of the ligament with an anterior approach, fusion provides stabilization. Autologous bone grafts and allograft cages are used for fusion. Iliac crest graft and fibular graft are the gold standards for autologous graft fusion [8]. Production of protein and other growth factors in the autologous bone graft is induced by osteoprogenitor cells, increasing osteogenesis and increasing bone conduction, supporting a high rate of fusion [9, 10]. In our study, we saw fusion in every patient. Complications due to the autologous graft donor site can cause serious problems. These include infection, pain in the donor area, fracture, pseudoarthrosis, graft dislocation, graft fracture, and deformity [3]. In a study by Nassr et al., the incidence of graft complications reached 50%, but Hoffman et al. stated that these high complication rates were exaggerated and the study was influenced by industry [11, 12]. We did not see any serious complications related to the graft in our study. Allograft cages have been used to avoid autologous donor site complications. Poly-ether-ether-ketone cages and more commonly titanium mesh cages have been used, while more recently, nano-hydroxyapatite/polyamide cages have also been used. Cages does not have as high a fusion rate for an autograft [3]. Another disadvantage of cages is the high cost compared to autografts. Another disadvantage is causing metallic artifacts on CT and MRI. This causes difficulties in evaluating the patient in the postoperative period. Cages also have the disadvantage of causing resorption in the adjacent bone [13].

The most important disadvantage of using a cage is subsidence. While it does not cause any significant clinical findings with collapse up to 1 mm, it can cause serious narrowing of the spine and nerve root damage with collapses of 3 mm, and a second surgery is required. A long-term study conducted by Chen et al. found that 79% of the patients had a collapse of 1 mm and 19% had a collapse of more than 3 mm [9]. In another study, Fengbin et al. observed an average of 2.5 mm collapse in patients with

classical cages. There was no neurological loss in any of their patients and they did not need reoperation, but they described severe neck pain in the patients [9, 14].

In our study, we operated on 30 patients with posterior longitudinal ligament ossification. We used autogenous grafts as the fusion material. We followed the patients for 2 years after the procedure. We observed fusion in all of the patients. We did not see any complications at the graft site in any of our patients. We observed that our patients' preoperative JOA scale and postoperative 2nd year JOA scale were approximately 5 points better. The study of 178 cases by Ying et al. obtained similar results [15]. The preoperative VAS scale of our patients decreased by approximately 5 points in the 2nd year postoperatively, and we saw a significant reduction in pain in our patients. We observed that similar results were obtained in the study by Zhang et al.[4]. A study by Anduriz et al. showed a strong and significant relationship between increased kyphosis and chronic neck pain. In our study, with a significant decrease in the VAS score and an increase in the angle of lordosis, we obtained results similar to their study [1]. In addition, although we did not see a statistically significant difference between lordosis angle, JOA, and VAS scales between corpectomy levels and number in our study, we found that as the number of corpectomies increased, the JOA score and lordosis angle increased less and the VAS scale decreased less. Transient dysphagia developed in 3 of our patients, superficial skin infection in 3, and subcutaneous hematoma in two patients. We did not see any CSF fistula or deep infection or complications at the graft site in any of the patients.

Conclusion

In conclusion, posterior longitudinal ligament ossification can cause many different symptoms and can cause severe paresis even after simple traumas. While corpectomy with a fusion can be performed with the anterior approach, a laminectomy can also be performed with a posterior approach. However, the anterior approach achieves better clinical results in terms of decompression, since there is an opportunity to directly intervene in the compression with the anterior approach. Another important point is the choice of fusion material that will be placed after the corpectomy. Autogenous and allografts are used for fusion material. An autogenous graft is the gold standard for fusion, it is inexpensive, it does not cause artifacts on MRI and CT, and autogenous graft does not cause bone resorption and collapse like an allograft. We believe that the use of cages should be considered beforehand in patients who have undergone corpectomy.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

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Conflict of interest

None of the authors received any type of financial support that could be considered potential conflict of interest regarding the manuscript or its submission.

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