How to Cite:

Ellabbad, M. A., Aboelkher, M. M., Rewehy, A. I., Albialy, M., & Elmaghraby, M. (2022). Vertebral body reconstruction by titanium mesh or PEEK after anterior cervical vertebroplasty, applications and difficulties. *International Journal of Health Sciences*, 6(S4), 2525–2535. https://doi.org/10.53730/ijhs.v6nS4.7635

Vertebral body reconstruction by titanium mesh or PEEK after anterior cervical vertebroplasty, applications and difficulties

Mohamed Ahmed Ellabbad, M. D.

Neurosurgery Department Faculty of Medicine Al-Azhar University Egypt E-mail: mellabbad@hotmail.com

Mostafa Mahmoud Aboelkher, M. D.

Neurosurgery Department Faculty of Medicine Al-Azhar University Egypt E-mail: mostafaaboelkhir81@gmail.com

Ahmed Ibrahim Rewehy, M. D.

Neurosurgery Department Faculty of Medicine Al-Azhar University Egypt Email: <u>dr.rewehy@gmail.com</u>

Mohammad Albialy, M. D.

Neurosurgery Department Faculty of Medicine Al-Azhar University Egypt Email: mohammadelbialy@gmail.com

Mostafa Elmaghraby, M. D.

Neurosurgery Department Faculty of Medicine Al-Azhar University Egypt *Corresponding author email: mostafa.elmaghraby@azhar.edu.eg

> **Abstract**---Cervical vertebroplasty is a successful operation for decompression of the spinal cord and optimum restoration of cervical lordosis in individuals with severe canal stenosis. In this research, we demonstrate our method of reconstruction and replacement to the cervical vertebral body disorders with an expandable titanium cage or polyetheretherketone (PEEK). Neurologic status, morbidity, and mortality were evaluated before and after the surgery. We conducted a single-center, prospective study for all patients with cervical vertebral body lesions, who underwent single-stage vertebrectomy with an expandable titanium cage alone or PEEK with plate and screws reconstruction of the vertebral body. The study period between January 2014 and June 2020 in Al- Azhar university hospitals. The study included 25 patients who underwent single-stage, anteriorapproach surgery. We used an expandable titanium mesh cage in five of them, and the other 20 were reconstructed using PEEK, plate, and

Manuscript submitted: 27 March 2022, Manuscript revised: 18 April 2022, Accepted for publication: 9 May 2022

International Journal of Health Sciences ISSN 2550-6978 E-ISSN 2550-696X © 2022.

screws. All patients had neurological symptoms before surgery, including brachialgia, motor deficit, or sphincter problems. The mean follow-up was 45.7 months (1-65 months). Neurological improvement was recorded in 20 patients at the last follow-up time, and five patients were not improved. Also, one case had a CSF leak complicated with meningitis and finally died. Our findings indicate that an anterior approach in treating cervical spinal body lesions would be optimal in spinal cord decompression and enhancing clinical outcome and the easier implanted artificial body was the Pyrafix (PEEK) compared to an expandable titanium cage.

Keywords---PEEK, cervical compression, mesh, titanium.

Introduction

Spinal vertebral body disorders (tumors, fractures, and infection) have become widespread spine lesions and are more common nowadays.¹. Treatment of these patients requires a unique approach that is multidisciplinary and comprehensive. Surgical stabilization is needed for patients with intolerable pain, neurological deficits, and spinal instability.². Specific surgical methods are required to improve tumor removal, spinal stability, and morbidity in tumor excision and fracture decompression of the spinal cord. ^{3,4}

Materials and Methods

This present research is a single-center analysis of 25 cases with cervical vertebral body pathology patients. Surgery was done between January 2014 and June 2020 via the anterior approach. All operations were performed in our neurosurgery department Al-Azhar University, Cairo, Egypt. Patients seeking spinal cord decompression for acute neurological dysfunction and histologic evaluations of single localized spine body lesions were offered vertebrectomy with partial excision of the vertebral body utilizing anterior instrumentation. We analyzed patient status using neurological evaluation pre-operative and postoperative. Patient data included was personal data, age, corpectomy levels, fixation levels, pre-operative and post-operative angles, operative duration, blood loss, length of hospital stay following surgery, complications, reconstruction instrument, and data on follow-up. We used computed tomography (CT) and magnetic resonance imaging (MRI) preoperatively and CT postoperatively for all patients. (figure 1, 2, 3) The integration of grafts into both vertebral endplates and trabecular bone formations was evaluated using multiplanar CT scan reconstructions. All of the patients were clinically evaluated three and six months following surgery.

Surgical procedure Position

The patients were placed supine with a small pillow between the shoulders to elevate them and obtain the cervical extension. The endotracheal tube was placed by fibro-optic on the left side of the mouth, and the head was turned to the left.

Marking

The angle of mandible, midline, and anterior border of sternomastoid were marked.

Incision

The incision is made longitudinally parallel to the anterior border of the sternomastoid midway between the midline and anterior border of the sternomastoid extended from one inch below the angle of the mandible to two inches above the clavicle.

Dissection

The muscle is separated by blunt dissection, the carotid sheath was identified, retracted laterally, and thyroid cartilage was identified and retracted medially; then, we opened the prevertebral fascia after opening the investing layer of fascia.

Leveling

Leveling was done by C arm X-ray lateral view and a spinal needle gauge 18 kinked at the tip to be inserted in the disc space to have the leveling on.

Drilling: We drilled the fractured bodies, removed the tumor, and distracted the above and below vertebral bodies with Caspar's instrument. En bloc vertebrectomies were performed by dividing the body from below and releasing the discs above and below. Also, we removed the middle 3/5 of the transverse length of the affected cervical body. During the drilling, irrigation with normal saline was done to avoid the thermal effect of drilling on the dura, spinal cord, and adjacent tissues. A C-arm was used to control screw trajectories during surgery and install PEEK or expandable titanium cage following filling with autologous bone graft powder generated during drilling. Bipolar coagulation of segmental arteries, bone wax, and gel foam were used to produce hemostasis. Post-operative treatment included deep venous thrombosis prevention and early mobilization with physiotherapy. Further radiation or chemotherapy treatments were administered after histologic evaluation of tumor instances. After the procedure, a one-month hard neck collar was also worn.

Results

This study was conducted on (25) patients between (25y-70y) with single or multiple variable levels of cervical spinal diseases at Al-Azhar University hospitals in 6 years from January 2014 until June 2020. The patients were 17 males,8 females and their ages ranged from 31 to 70 years with a mean of (54 ± 15) . All patients underwent serial clinical evaluations at pre-operative and early postoperative periods. Table (1). In our series, the commonest presentation was sensory brachialgia in 20 cases (80 %), motor weakness in 17 cases (68 %), sphincteric affection in 15 cases (60%), neck pain in 11 cases (44 %), and neck deformity only in 4 cases (16 %) (Table2). Tables (3, 4, and 5) show clinical, radiological outcomes, and death rates. Regarding pain in both upper limbs and

2528

brachialgia, it improved in 22 patients (91.7%), motor and sphincter affection improved by the same percent in 20 patients (83.3%). However, the complication rate was recorded as follows infection 2 cases (8.4%), instrument migration in 2 cases (8.4%), CSF leak in 2 cases (8.4%), cord injury was only in 1 case (4.2%). Finally, the mortality rate was (4,2%) (Table3).

Discussion

In this prospective case study, we applied an autograft bone fusion technique during anterior cervical corpectomy (ACC) for cervical lesions producing myelopathy. We analyzed the outcomes according to the neurological outcome, radiological outcome, and complications to determine the success of our anterior approach and autograft technique. ACC operations were performed in our study for 25 cervical cases with myelopathy caused by multi-segmented cervical lesions. Five of our patients, their middle 3/5 of the vertebral body, were reconstructed using an expendable titanium mesh cage, variable in diameter and length, filled with the extracted healthy cortical bone fragments from the targeted vertebral body then implanted. The other 20 patients were reconstructed using Polyetheretherketone (PEEK) filled with the same material, and the securing plate and five screws were put on top. A median 3/5 cervical body corpectomy was performed in all cases to decompress the cervical canal and spinal nerve roots.

The expandable titanium mesh cage "EgyFix co." was installed after the ACC in 5 cases with sever difficulty in expanding it as its instrument is rotating above the cord from RT to LT position in small space rather thanbeing twisting easier movement. In the rest 20 patients, an anterior cervical plate was implanted with screws in the level above, below, and the PEEK cage below in the center to establish primary cervical spinal column stability. Age, sex, pre-and postoperative myelopathy, the number of decompressed levels, radiological findings, and complications were all taken into account. In 91% of cases, symptomatic improvement of neurological impairments was obtained in our study, but it was 80% of the patients in the oxford article published in 2003 for 27 cases were operated using a similar technique .⁵. The complication rate recorded in our study was (8.4%), as 2 cases developed an infection, and one of them died from hydrocephalus. Instrument migration occurred in one patient who underwent extensive corpectomy with the odontoid of C2 without posterior fixation. (0.04)but no infection occurred in the mentioned article.⁵. In the Oxford trial, no patient's myelopathic symptoms worsened, while one patient acquired severe myelopathy and severe paraparesis G1/5 (0.04) in ours.⁵

After 6-months, radiological follow-up studies revealed the beginning of bone fusion in all of the patients in our research. Also, regarding the usage of both the expandable titanium mesh and the PEEK, there was slight migration in the lateral view in the X-ray cervical spine in one of the 5 cases that we used in the titanium mesh. In comparison, it occurred only in one case from 20 cases in the PEEK cases. Another study comparing titanium mesh with PEEK in anterior cervical corpectomy and reconstruction found that the PEEK group had a greater fusion rate (100 % vs. 86.5 %, P=0.0335). The PEEK group had an 80% success rate in terms of clinical outcomes, while the titanium group only had a 75% success rate (P=0.6642). 6

Conclusion

The results of this study demonstrate that anterior cervical corpectomy is the approach of choice and easy. Also, the best artificial body implanted was the Pyrafix (PEEK) and its plate for easy application, and it's securing built-in plate and screws. On the contrary, we met difficulties in applying both: expandable Pyramish, because it was difficult in the opening, and plain titanium pyramish, because it lacks a built-in opening for a screw from the middle of the plate to it. After transplantation, autograft bone material obtained during the ACC was well integrated into the cage and adjacent vertebral bodies. As a result, issues related to extracting autograft material from other donor locations, such as the iliac crest, might be avoided. Early post-operative and mid-term follow-up phases indicated no evidence of morphological or functional impairment of the operated cervical segments when this autograft technique was performed in conjunction with cervical instrumentation. Finally, a prospective multicenter controlled research with large sample size is required to confirm our findings.

Acknowledgment

Al-Azhar University fully funded this research.

References

- 1. Gokaslan ZL. Spine surgery for cancer. Curr Opin Oncol. 1996;8(3):178-181. doi:10.1097/00001622-199605000-00002
- 2. Shen FH, Marks I, Shaffrey C, Ouellet J, Arlet V. The use of an expandable cage for corpectomy reconstruction of vertebral body tumors through a posterior extracavitary approach: a multicenter consecutive case series of prospectively followed patients. Spine J. 2008;8(2):329-339. doi:10.1016/j.spinee.2007.05.002
- 3. Bilsky MH, Boland P, Lis E, Raizer JJ, Healey JH. Single-stage posterolateral transpedicle approach for spondylectomy, epidural decompression, and circumferential fusion of spinal metastases. Spine (Phila Pa 1976). 2000;25(17):2240-2250. doi:10.1097/00007632-200009010-00016
- 4. Fourney DR, Abi-Said D, Rhines LD, et al. Simultaneous anterior-posterior approach to the thoracic and lumbar spine for the radical resection of tumors followed by reconstruction and stabilization. J Neurosurg. 2001;94(2 SUPPL.):232-244. doi:10.3171/spi.2001.94.2.0232
- Rieger A, Holz C, Marx T, et al. Vertebral autograft used as bone transplant for anterior cervical corpectomy: Technical note. Neurosurgery. 2003;52(2):449-454. doi:10.1227/01.NEU.0000043815.31251.5B
- Chi-Chien Niu , et al. Outcomes of interbody fusion cages used in 1 and 2levels anterior cervical discectomy and fusion: titanium cages versus polyetheretherketone (PEEK) cages J Spinal Disord Tech. 2010 Jul;23(5):310-6.

		Table 1	l		
Sex and age	distribution	among	cervical	corpectomy	group

Total Number of Cases		No.=25			
Sorr	Females	8 (29.2%)			
Sex	Males	17 (70.8%)			
4.50	Mean±SD	54.00	± 15.30		
Age	Range	31	- 70		

This table is showing the cases underwent for anterior cervical corpectomy with the percentage of males to females 17 males, 8 females and also the age of them ranging from 31 to 70 years with the mean 54 ± 15

	No.	%	
Sensory brachialgia	20	80%	
Motor weakness	17	68%	
Sphincteric affection	15	60%	
Neck pain	11	44%	
Neck deformity	4	16%	

Table 2 Clinical presentation

Table (2) shows clinical presentation of patients and the percentage of each presentation in our patients

Table 3 Showing the clinical and radiological outcome for patients

Occurrence		No.	%
Pain Improvement	No	3	8.4%
	Yes	22	91.6%

2	8.4%
23	91.6%
5	16.7%
20	83.3%
5 20	16.7% 83.3%

Motor	No	5	16.7%
improvement	Yes	20	83.3%
Sphincter	No Yes	5 20	16.7% 83.3%
improvement			
Deformity	No	5	16.7%
improvement	Yes	20	83.3%
mprovement	No	23	91.6%
CSF leak	Vez	0	0 40/
Occurrence	ies	2	0.470
Cord injury	No	24	95.8%
Occurrence	Yes	1	4.2%
Hemorrhage	No	23	91.6%
Occurrence	Yes	2	8.4%
Infection	No	23	91.6%
Occurrence	Yes	2	8.4%
Instrument	No	23	91.6%
Migration Occurrence	Yes	2	8.4%
	Alive	25	95.8%
Outcome	Died	1	4.2%

No

Yes

Sensory improvement

Table 4 Showing the death rate after our procedure

Alive	Died	Chi-square test	D
No.=24	No.=1	X^2/t^*	r- value

Sor	Females	7 (23.8%)	1 (4.2%)	0.224	0 107
SEX	Males	18(76.2%)		2.004	0.127
	Mean±SD	56.80 ± 15.64	47.00 ± 16.97		
Age	Range	31–70	35–59	0.736*	0.495

*: Independent t-test

P-value > 0.05: non-significant P-value < 0.05: significant P-value < 0.01: highly significant from the above table and chart as regard P-value there is insignificant relation between age and sex with the cervical procedures as regard death rate.

		Alive		Died			
		No.=2	24	No.=1		X ²	P-value
Pain Improvement	No	2	9.5%	0	0.0		
r ann improvement	Yes	19	90.5%	3	% 100 .0%	0.312	0.577
Sensory	No	2	9.5%	0	0.0		
improvement	Yes	19	90.5%	3	% 100 .0%	0.312	0.577
Motor improvement	No	3	14.3%	1	33.3		
motor improvement	Yes	18	85.7%	2	% 66.7 %	0.686	0.408
Sphincter improvement	No	3	14.3%	1	33.3 %	0.686	0.408
	Yes	18	85.7%	2	66.7 %		
Deformity improvement	No Yes	3 18	14.3% 85.7%	1 2	33.3 % 66.7	0.686	0.408
CSF leak Occurrence	No	20	95.2%	2	<u>%</u> 66.7	2.805	0.094

Table 5 Clinical outcome and complications

2532

25	3	3

	Yes	1	4.8%	1	% 33.3 %		
Cord injury Occurrence	No Yes	20 1	95.2% 4.8%	3 0	100 .0% 0.0 %	0.149	0.699
Hemorrhage Occurrence	No Yes	19 2	90.5% 9.5%	3 0	100 .0% 0.0 %	0.312	0.577
Infection Occurrence	No Yes	20 1	95.2% 4.8%	2	66.7 % 33.3 %	2.805	0.094
Instrument Migration Occurrence	No Yes	20 1	95.2% 4.8%	2	66.7 % 33.3	2.805	0.094

From the above table and chart as regard P-value there is insignificant relation between complication and cause of death except for the CSF leak in one patient caused infection then hydrocephalus and death.



Fig 1. C5 compression fracture Bab-Alsheareya university hospital



Fig 2. Pyrafix preparation and filling with autologous Bab-Alsheareya university hospital



Fig 3. Post-operative C5 corpectomy Bab-Alsheareya university hospital



Fig 4. Post-operative C6 Corpectomy with PEEK insertion Elhussein university hospital



Fig 5. Post-operative MRI showing C6 corpectomy Elhussein university hospital