Eastern Green Neurosurgery Original Article

egneuro,06(01): 3-9, 2026

Anterior Cervical Microdiscectomy and Fusion: A Single Center Study with Management and Outcomes

Daniel Encarnacion Santos[1], Murat Pachev[2], Eugeny Shestov[2,] Ismail Bozkurt[3], Jorge Jimenez-Alvarez[4], Jose de la Fuente-Hernandez[4], Gennady Chmutin[4], Egor Chmutin[4], Bipin Chaurasia[5], Kivanc Yangi[6]

[1]Department of Neurosurgery of People of Friendship University, Moscow, Russia.
[2]Department of Neurosurgery, City Clinical Hospital №68 Gbuz Gkb Im. V.P. Demikhova
[3]Department of Neurosurgery, Medical Park Ankara Hospital, Ankara, Turkey
Department of Neurosurgery, School of Medicine, Yuksek Ihtisas University
[4]Department of Neurosurgery of People of Friendship University, Moscow, Russia.
[5]Department of Neurosurgery, Neurosurgery Clinic, Birgunj, Nepal
[6]Department of Neurosurgery, Prof. Dr. Cemil Tascioglu City Hospital, Istanbul, Turkey

Correspondence:

Daniel Encarnacion-Santos
Mikluho Maklaya 6
Department of Neurosurgery
117198. Moscow, Russia
Email: Danielencarnacion2280@gmail.com
Phone: +79253847196
ORCID ID: 0000-0001-6484-6775

Abstract

Background: Cervical spondylosis surgery can be performed through two primary approaches: anterior and posterior. The initial anterior approaches were reported by Robinson and Smith in the mid-1930s, followed by Cloward (1958). The aim, based on the placement of the cage within the intervertebral space and the stabilization offered by the plate, was assessed to determine its impact on enhancing postoperative cervical spine dynamics. **Materials and Methods:** A retrospective cohort study was undertaken on 21 patients (9 male and 11 female) in the age range of 28 to 66 years old to explore variations in postoperative outcomes among patients who underwent anterior cervical microdiscectomy and fusion with a cage. The research was done between January 2023 and November 2024. **Results:** We performed a retrospective observational analysis of N=20 patients who matched our inclusion criteria, and we included 9 men and 11 females, aged between 28 and 66 years, with N=7 patients with left radiculopathy for (35%) and N=10 patients with right radiculopathy for (50%). while N=3 patients exhibited symptoms of radiculopathy or numbness. (15%).**Conclusion:** In our study, the position of the cage in the intervertebral space and the fixation supplied by the plate were analyzed to assess their impact on improving the dynamics of the postoperative cervical spine. The postoperative outcomes include reduction of the C6 vertebral dislocation and anterior cervical fusion at C6-C7 utilizing the IRENE cage.

Key Words: ACDF, cervical Stenosis, Cage, Microdicectomy and outcomes

Introduction

Cervical fusion surgery is categorized into two primary approaches: anterior and posterior. Robinson and Smith initially delineated anterior techniques in the mid-1930s, subsequently revised by Cloward in 1958. Cloward came up with the anterior cervical discectomy with

fusion (ACDF), which makes it easier to remove compressive spondylotic spurs and intervertebral disc fragments right away. In 1976, Hakuba devised the transuncodiscal technique, integrating anterior and lateral access to cervical discs. In this method, the uncovertebral joint is cut open, the disc is removed, and the ipsilateral posterior osteophytes and contralateral uncinate process are cut out.[1-3] In 1989, Snyder and Bernhardt introduced a fractional decompression approach aimed at the anterior cervical region for the treatment of cervical radiculopathy. [4]

ACDF has evolved into a prevalent treatment utilizing intervertebral cages for the management of cervical disc herniations. Artificial cages containing grafts are frequently utilized, guaranteeing less morbidity and satisfactory fusion rates. Additionally, anterior plates can be employed to minimize cage subsidence and to improve fusion by compressing the interbody space. [5]

This study is to assess the efficacy of managing cervical pathologies or spinal injuries in the cervical region that result in cervical stenosis. The placement of the cage within the intervertebral space and the stabilization offered by the plate were assessed to determine their impact on enhancing postoperative cervical spine dynamics.

Materials and Methods

A retrospective cohort study was undertaken on 21 patients (9 male and 11 female) in the age range of 28 to 66 years old to explore variations in postoperative outcomes among patients who underwent anterior cervical microdiscectomy and fusion with a cage. The cage's position in the intervertebral space and the fixation supplied by the plate were analyzed to determine their impact on enhancing postoperative cervical spine dynamics. The study adheres to the ethical principles specified in the Declaration of Helsinki for Good Clinical Practice, ensuring informed consent was acquired from all participants. The research was done between January 2023 and November 2024 at Moscow City Clinical Hospital №68, Demikhova V.P., Moscow, under Ref. number 1857, dated 02.07.1992, No. 2300-1 (as revised on 06.11.2021).

Results

We performed a retrospective observational analysis of N=20 patients who matched our inclusion criteria, and we included 9 men and 11 females, aged between 28 and 66 years, with N=7 patients with left radiculopathy for (35%) and N=10 patients with right radiculopathy for (50%). while N=3 patients exhibited symptoms of radiculopathy or numbness. (15%). We also found 5 patients with herniated discs with damage and stenosis. (HDLS) related to other pathologies and traumas, with (25%). (Herniation of disc with damage and stenosis): (HDLS); N=15 patients with (75%). At the level of the cervical vertebrae C7, N=1 patient for (5%). C6, N=1 patient also with (5%). N=3 patients at C5 level, for (15%); N=4 patients at C3, for (20%). N=2 patients at the C4 level, for (10%), and patients with complications of postoperative dysphagia, for (35%).

Postoperative imaging assessments were undertaken using axial CT slices with reconstruction, complemented by MRI-CT, even though MRI is not typical for ACDF, to investigate the cervical spine (C3-C7-T1). The imaging demonstrated straightening of the physiological lordosis of the spine. The distance between the lateral masses of the atlas and the dens of C2 was symmetrical, while the distance between the dens of C2 and the posterior border of the anterior arch of the atlas measured <2 mm. The vertebral bodies revealed typical arrangements with a triangular shape and thicker cortical plates. Marginal osteophytes were detected throughout the anterior and posterolateral sides of the vertebral bodies,

projecting into the intervertebral foramina and creating unequal narrowing, particularly in the C3-C5 segments.

The height of the intervertebral discs was irregularly lowered, with the discs extending 3-4 mm beyond the vertebral body surfaces at C3-C4, C4-C5, and C5-C6. The spinal canal was not appreciably constricted at the levels tested. However, degenerative lesions such as spondylosis and spondyloarthrosis were identified, combined with a herniated disc at C5-C6, which resulted in compressive ischemic radiculopathy of the right C6 nerve root.

Variables	No.	%
Male	9	45
Female	11	55
Radiculopathy on the left	7	35
Radiculopathy on the right	10	50
Radiculopathy	3	15
HDLS with another pathology	5	25
HDLS alone	15	75
C7	1	5
C6	1	5
C5	3	15
C3	4	20
C4	2	10
Dysphagia	7	35

Table 2. Patients with cervical herniation stenosis and associated diseases receiving ACDF surgery

Patients	Gender	Age	Diagnose	Symptomatology	Techniques	Length of the fusion	Complication	Management	Outcomes
1	Male	35	Herniated disc lesion stenosis	Radiculopathy C6 on the left	ACDF	Single level	Dysphagia	Conservative and consultation	GOOD
2	Female	63	DLCS/ HDLS	Radiculopathy C4 on the left	ACDF	Two levels	Soft tissue swelling and pain	Conservative and pill killer	Improve condition
3	Female	48	HDLS	Radiculopathy C5 on the right	ACDF	Single level	Soft tissue swelling	Conservative	Improve condition
4	Female	55	HDLS	Radiculopathy C5	ACDF	Single level	Dysphagia	Conservative and consultation	GOOD
5	Male	54	Cervicalgia Degenerative-dystrophic/HDLS	Radiculopathy C3	ACDF	Two levels	Pain and welling	Conservative and pill killer	Improve condition
6	Female	63	HDLS	Radiculopathy C4 on the right	ACDF	Two levels	Soft tissue swelling	Conservative	Improve condition
7	Male	46	HDLS	Radiculopathy C5-on the right	ACDF	Single level	Soft swelling and redness	Conservative and antibiotics	Improve condition
8	Female	38	Cervical intervertebral disc herniation/HDLS	Radiculopathy C3 on the left	ACDF	Two level	Dysphagia	Conservative and consultation	GOOD
9	Male	28	HDLS	Radiculopathy C5 on the left	ACDF	Single level	Swelling tissue	conservative	Improve condition
10	Female	37	HDLS	Radiculopathy C5 on the right	ACDF	Two level	Dysphagia	Conservative and consultation	Improve condition
11	Female	35	DLCS/HDLS	Radiculopathy C3, (RP).	ACDF	Two levels	Swelling tissue and pain	Conservative and pain killer	Improve condition
12	Male	34	HDLS	Radiculopathy C4 on the right	ACDF	Single level	Pain	Pain killer	GOOD
13	Female	45	Cervical intervertebral disc/ HDLS	Radiculopathy C3 on the right	ACDF	Two level	Swelling tissue and pain	Conservative and pain killer	Improve condition
14	Male	34	DLCS/HDLS	Radiculopathy C5 on the left	ACDF	Single level	Swelling tissue/ low pain	Conservative	Improve condition
15	Female	66	HDLS	Radiculopathy C4 on the left	ACDF	Two level	Dysphagia	Conservative and consultation	GOOD
16	Male	57	HDLS	Radiculopathy C3 On the right	ACDF	Two level	Dysphagia and pain	Conservative and consultation	GOOD
17	Male	62	HDLS	Radiculopathy C7 On the right	ACDF	Single level	Swelling tissue	conservative	Improve condition
18	Female	68	HDLS	Radiculopathy C5 On the right	ACDF	Single level	Swelling and pain	Conservative and pain killer	Improve condition
19	Male	42	HDLS	Radiculopathy C6 On the left	ACDF	Single level	Swelling tissue	Conservative	Improve condition
20	Female	63	HDLS	Radiculopathy C3 On the right	ACDF	Two levels	Dysphagia and pain	Conservative and consultation	GOOD

Table 1. Patients with cervical spine stenosis, including diagnosis, therapy, and surgical intervention by ACDF technique and cage installation for enhanced stabilization. Herniated disc lesion stenosis (HDLS).

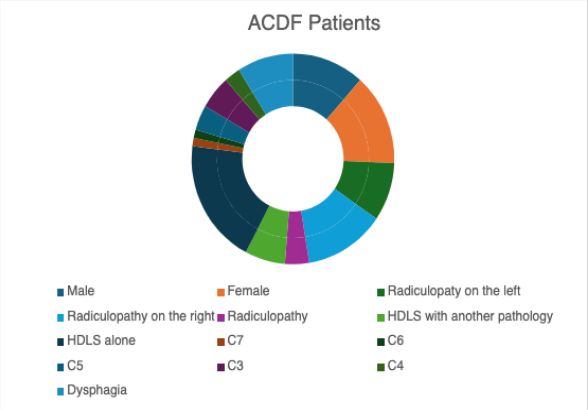

Figure. 1. Patients with cervical disc herniation, with right and left radiculopathy, by location, undergoing ACDF surgery and with postoperative dysphagia

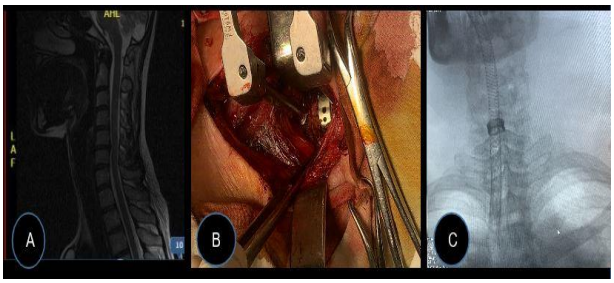

Figure 2. a) A 46-year-old female exhibits an MRI of the cervical spine revealing osteochondrosis and spondyloarthrosis. Median herniation b) C5-C6, resulting in compression of the C5 nerve root. Correction and cage implantation Microdiscectomy c) C5-C6, accompanied by anterior cervical fusion utilizing a C5-C6 cage.

Condition following the reduction of C6 vertebra dislocation and anterior cervical fusion: 2 patients at C6-C7 utilizing the IRENE cage and the C6-C7-Th1 plate with the IRENE plate. The fracture of the right transverse process of the C7 vertebra stays stable and without displacement. At the level of C6-C7, on the right posterior part of the spinal canal within the epidural space, a tiny fragment measuring 3x1 mm is found, producing significant compression of the dural sac.

Postoperative imaging from 4 patients after C5-C6 microdiscectomy and anterior cervical fusion at C5-C6 with a cage showed the cage's shadow positioned within the C5-C6 intervertebral space. A sequence of axial CT scans, followed by reconstruction, revealed a picture of the cervical spine (C1-T3), indicating straightening of the physiological lordosis. The axis of the spine is intact. The vertebral bodies reveal a typical arrangement with a triangular structure, and the integrity of the vertebrae remains undisturbed.

While stiffness artifacts are found within the C5-C6 interbody space, attributable to its normal postoperative placement, the height of the other intervertebral gaps is preserved. The patient is now getting conservative treatment.

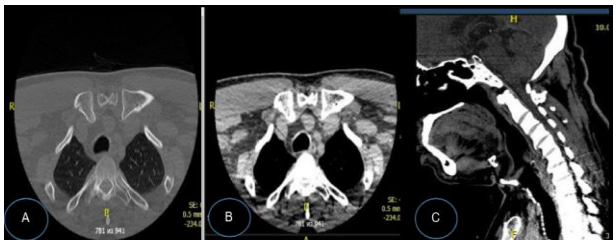

Figure 3. a) A 49-year-old male, CT imaging indicates extensive degenerative-dystrophic changes in the cervical spine b) (osteochondrosis, spondylosis, spondyloarthrosis). c) Dystrophic changes protruding from the C4-C5, C5-C6, and C6-C7 disc levels.

The bone structure and position of the atlanto-occipital and atlanto-dentate joints are intact. 2 patients' Cervical lordosis C4 is straightened, accompanied by the establishment of pathological kyphosis. The vertical alignment of the spine indicates a variation of 5 degrees to the right. At the levels of C4-C5, C5-C6, and C6-C7, a reduction in disc height is noticed, accompanied by compensatory alterations in the adjacent vertebrae, including subchondral sclerosis and thickening of the endplates. Pronounced marginal osteophytes are evident along the anterior and posterolateral surfaces of the vertebral bodies, with the most severe alterations visible at C4-C5, C5-C6, and C6-C7.

Hypertrophy of the posterior longitudinal ligament and central disc bulging in 4 patients at the C4 level. While C4-C5, C5-C6, and C6-C7, extending into the spinal canal by 3 mm, are noticed. At other levels, there is no evidence of disc height reduction or bulging. Calcification of the anterior longitudinal ligament is found at the C5-C6 level. Additionally, areas of cystic

rearrangement are observed in the vertebral bodies of C4, C5, C6, and C7.

Discussion

After using the imaging using T1- and T2-weighted MRI in sagittal and axial planes, an increase in thoracic kyphosis was demonstrated. A C-shaped displacement of the spinal axis to the right was seen in the supine posture. Degenerative-dystrophic alterations in intervertebral discs were detected, characterized by mild and unequal reductions in disc height and hydrophilicity of the nucleus pulposus.

The deformational alterations were observed in the vertebral bodies of C3-C4, C5-C6, and C6-C7, with spinal stenosis being remarkable at Th5-Th7 due to impressions on the upper endplates, with reductions in vertebral body height by 1/4 to 1/3, without notable increases in their sagittal dimensions. The bone marrow structure showed no evidence of edema. Less pronounced deformational changes were found in the vertebral bodies of Th8-Th12 due to erosive abnormalities, with height reductions of 10-15%. At Th2/3, a dorsal median disc herniation measuring 3 mm was identified, squeezing the anterior contour of the dural sac. Similarly, a dorsal left paramedian herniation of the Th8/9 disc measuring 3.5 mm was detected, squeezing both the anterior dural sac and the left lateral recess. Smaller dorsal median and paramedian protrusions were observed at Th7/8, Th9/10, and Th10/11, measuring 1.5-2 mm, causing minor distortion of the anterior dural sac. Uneven thickening of the longitudinal and posterior yellow ligaments was seen across the studied regions, associated with marginal osteophytes, particularly along the anterior and lateral surfaces of the vertebral bodies.

Despite the degenerative alterations, the bone marrow structure of the vertebral bodies remained diverse, with no indications of fatty degeneration, edema, or pathological infiltrates. Moderate degenerative-dystrophic alterations were detected in the facet joints of Th7-Th12, characterized by abnormalities and hypertrophy of the articular facets.

Anterior Cervical Discectomy and Fusion (ACDF)

ACDF is a widely used treatment to decompress cervical nerves and the spinal cord. The discectomy component involves the removal of the intervertebral disc to address herniation and decompress the damaged nerve tissue. The fusion treatment stabilizes surrounding vertebrae, which are commonly affected during decompression. To do this, a cage device with a bone graft, or a cage paired with body support, is inserted to replace the disc tissue while maintaining foraminal height. An anterior plate is often placed to improve spinal stability and enhance fusion dynamics. Posterior fusion of neighboring vertebrae via the intervertebral disc can also result in solid arthrodesis with minimal risk.[6-12]

According to many writers, anterior cervical discectomy is regarded as safe and successful. In several outpatient investigations, anterior cervical plates were not used; however, positive outcomes were attained with fewer problems. Another study analyzed patients within the first 23 hours postoperatively and, when compared to histology findings, showed no differences in complication rates.[7] Microsurgical discectomy without fusion has been associated with considerable recovery of cervical spine dynamics and functional stability. [8-13]

Electromyography (EMG) and transcranial evoked potentials are widely performed during anterior cervical microdiscectomy with fusion for cervical disc herniation, which are often accompanied by radiculopathy. These approaches are excellent for monitoring spinal cord function after surgery and have an essential predictive role.[9] Psychological factors, particularly depression, can influence outcomes in patients with degenerative cervical or lumbar spine illnesses. Thus, assessing and addressing psychological aspects can considerably improve rehabilitation and recovery processes.[10-14]

Our findings on cage implants, such as polyether-ether-ketone, titanium, and polymers reinforced with carbide fibers, as well as polymethyl methacrylate, revealed their efficiency according to the literature at the moment of fusion between the two. While the stability after the implant and the prosthesis had an enormous postoperative advantage, which indicated a better bone growth with an efficient arthrodesis. Everything will be related to the adequate placement of the implant for a better cervical dynamic.[11-15] Regarding the surgical method, it was satisfactory, more anterior. Another surgical alternative among the same is the posterior cervical foraminotomy, which exhibits safety and efficacy as our study, although there were difficulties after the anterior approach with the fusion.[16-19]

Conclusion

In our study, the position of the cage in the intervertebral space and the fixation supplied by the plate were analyzed to assess their impact on improving the dynamics of the postoperative cervical spine. The results were optimal in the cage position, with only two patients requiring cervical prosthesis. While the most frequent consequence was reported in 7 patients with postoperative dysphagia. When we identified cervical stenosis at the C5-C6 vertebrae, there was a minor displacement creating herniation, so we continued to its reduction and decompression, and we noted the fracture of the right transverse process of the C7 vertebra. The postoperative outcomes include reduction of the C6 vertebral dislocation, anterior cervical fusion at C6-C7 utilizing the IRENE cage, and stability with the IRENE plate in 2 patients at the C6-C7-Th1 level. The results of microdiscectomy in patients having ACDF showed that there was a small fragment at the C3-C7 levels on the right, which caused mild compression of the dural sac. In addition, dorsal herniation of the intervertebral discs was seen at both the cervical C3-C4 and C5-C6 levels. All patients received ACDF along with microdiscectomy. The use of cervical collars, a six-month follow-up period, rehabilitation therapy, and conservative treatment was strongly suggested to guarantee optimal recovery.

Declarations:

Author Contributions

Conceptualization, S.A. BC. M.P., D.R.C., E.S., D.E.S.; methodology, D.E.S., G.S.; software, D.E.S., and G.C.; validation, JJA. JFH. I.B., G.S. and B.C; formal analysis, G.S., and G.F.; investigation, D.E.S. resources, M.B. and E.S. Data curation, G.S.; writing—original draft preparation, D.E.S., writing—review and editing, G.S., D.E.S., visualization, AR, N.B., supervision, K.A.V., G.C., EC, I.B., G.S.

Data Availability: All Data can be requested from the corresponding author

Informed consent: was obtained from all patients

Conflicts of Interest: There is no conflict of interest

Ethical Approval:

The study adhered to the ethical guidelines outlined in the Declaration of Helsinki for Good Clinical Practice, ensuring informed consent was obtained from all participants. The research was conducted between January 2019 and November 2024 at Moscow City Clinical Hospital №68, Demikhova V.P., Moscow, under Ref. number 1857, dated 02.07.1992, No. 2300-1 (as amended on 06.11.2021).

Funding: No

Acknowledgments:

Department of Neurosurgery City Clinical Hospital No. 68 Gbuz Gkb Im. V.P. Demikhova. in Moscow, Russia.

References

1. Mixter WJ, Barr JS: Rupture of the intervertebral disc with involvement of the spinal canal. N Engl J Med 211: 210–215, 1934
2. Cloward RB: The anterior approach for removal of ruptured cervical disks. J Neurosurg 15: 602–617, 1958
3. Hakuba A: Trans-unco-discal approach. A combined anterior and lateral approach to cervical discs. J Neurosurg 45: 284–291, 1976
4. Lee JY, Löhr M, Impekoven P, et al.: Small keyhole transuncal foraminotomy for unilateral cervical radiculopathy. Acta Neurochir (Wien) 148: 951–958, 2006
5. Dağlı M, Er U, Simşek S, Bavbek M. Late results of anterior cervical discectomy and fusion with interbody cages. Asian Spine J. 2013 Mar;7-1-34-8
6. Noordhoek, I., Koning, M.T. & Vleggeert-Lankamp, C.L.A. Evaluation of bony fusion after anterior cervical discectomy: a systematic literature review. Eur Spine J 28, 386–399-2019
7. Liu JT, Briner RP, Friedman JA. Comparison of inpatient vs. outpatient anterior cervical discectomy and fusion: a retrospective case series. BMC Surg. 2009 Mar 5; 9:3
8. Selladurai BM. Cervical myelopathy due to nuclear herniations in young adults: clinical and radiological profile, results of microdiscectomy without interbody fusion. J Neurol Neurosurg Psychiatry. 1992 Jul;55-7-604-8
9. Fotakopoulos G, Alexiou GA, Pachatouridis D, Karagiorgiadis D, Konitsiotis S, Kyritsis AP, Voulgaris S. The value of transcranial motor-evoked potentials and free-running electromyography in surgery for cervical disc herniation. J Clin Neurosci. 2013 Feb;20-2-263-6.
10. Jabłońska R, Ślusarz R, Królikowska A, Haor B, Antczak A, Szewczyk M. Depression, social factors, and pain

perception before and after surgery for lumbar and cervical degenerative vertebral disc disease. J Pain Res. 2017 Jan 4; 10:89-99
11. Kang C, Jang S, Jung H. Cervical Radiculopathy: Focus on Factors for Better Surgical Outcomes and Operative Techniques. Asian Spine J. 2022 Dec;16(6):995-1012
12. Epstein E. A Review of Complication Rates for Anterior Cervical Diskectomy and Fusion (ACDF). Surg Neurol Int. 2019 Jun 7; 10:100
13. Iyer S, Kim J. Cervical radiculopathy. Curr Rev Musculoskelet Med. 2016 Sep;9(3):272-80
14. Chen M, Yang J, Wu C. Cervical Disc Arthroplasty (CDA) versus Anterior Cervical Discectomy and Fusion (ACDF) for Two-Level Cervical Disc Degenerative Disease: An Updated Systematic Review and Meta-Analysis. J Clin Med. 2024 May 29;13(11):3203
15. Safdar A, Headley B, Rommelman M, Haseeb A, Motiei-Langroudi R. The Effect of Interbody Cage Parameters on the Rate of Subsidence in Single-Level Anterior Cervical Discectomy and Fusion (ACDF): A Retrospective Analysis of 98 Patients. Cureus. 2023 Dec 12;15(12): e50386.
16. Daniel ES, Pachey M, Chmutin G,Chmutin E, Chaurasia B. CerevicalSpinal Epiduritis, Pertaining toDiagnosis, Treatment, and Outcome:on Severe Spinal Cord. A CaseReport and A Literature Review.Asian Australasian Neuro and HealthScience Journal. 2025 Dec07(03):92-99
17. Santos DE, Bozkurt I, Pachev M, Chmutin G, Shestov E, Rubenoviich-Chicara D, et al. Degenerative Cervical Spondylolisthesis: A Comprehensive Systematic Review in Diagnosis, Management, and Outcomes. Oman Med J [Internet]. 2025 [cited 2026 Jan 21]; Available from: https://omjournal.org/articleDetails.aspx?coType=2&aId=3916
18. Encarnación-Santos D, Valerievich KA, Scalia G, Shestov E, Pachev M, Wellington J, et al. Spondylodiscitis: Understanding pathophysiology, surgical strategies, and postoperative management – A single-center study. Journal of Craniovertebral Junction and Spine. 2024 Apr;15(2):185–9.
19. Encarnación Santos, D., Scalia, G., Bozkurt, I., Volovish, A., Tapia Sierra, A., Wellington, J., & Chaurasia, B. (2024). Current insights and surgical interventions in craniovertebral junction instability: A systematic review and meta-analysis. *Romanian Neurosurgery*, *38*(2), 180–188.