International Journal of Multidisciplinary Research and Publications
ISSN (Online): 2581-6187

A Comparative Review of Conservative and Operative Management on Cervical Hernia Nucleus Pulposus

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Abstract*—Cervical disc herniation is characterized by displacement of disc material that compresses nerve root or cord, producing radiculopathy or myelopathy. Degenerative biology, occupational biomechanics, trauma and comorbid conditions interact to shape individual risks. Clinical expression ranges from asymptomatic imaging findings to sharp radicular pain, dematomal sensory loss, motor deficits and myelopathic long tract signs. Provocative tests such as Spurling and Shoulder Abduction Relief testing and focused neurologic examination aid localisation seen through imaging. Conservative management centers on activity modification, NSAIDs, paracetamol, adjunctive neuropathic agents, structured physical therapy, and interventional options achieves meaningful relief in most patients. Minimally invasive percutaneous techniques such as nucleoplasty and discectomy offer an intermediate option for contained soft herniations after failed conservative care, demonstrating low complication rates and favorable short to medium term outcomes. To improve patient selection and timing across conservative, percutaneous, and open surgical routes, high-quality, adequately powered randomized trials with standardized inclusion criteria and protracted follow-up are necessary.*

***Keywords*—** *Cervical, Hernia Nucleus Pulposus, Conservative, Operative.*

I. Introduction

Cervical disc herniation is defined by displacement of disc material beyond the normal boundary of the intervertebral disc. Morphologically, herniation are classified as protrusions, typically contained by the annulus fibrosus, as extrusions, that may be contained or uncontained, and as a sequestration when the fragment become completely detached. These structural abnormalities arise within the cervical segments composed of seven vertebrae (C1-C7) and six intervertebral disc, which normally provide cushioning, load sharing and motion. Herniated cervical discs compress or irritate the exiting nerve root or dorsal root ganglion, producing cervical radiculopathy, or narrow the spinal canal and compress the spinal cord, causing cervical myelopathy. Epidemiological understanding is constrained by a lack of recent large-scale population-based studies, and methodological variability in diagnostic criteria, sampling strategies and clinical settings [1]. Risk factor research supports a multifactorial etiology for cervical disc herniation with categories such as: degenerative biology, behavioral factors and lifestyle, occupational biomechanics, trauma and comorbid medical conditions. More recently, emerging evidence links prolonged sedentary behavior and forward head posture during computer or digital device use to cervical spine pathology, although this association requires further investigation [1]. Overall, shifts in technology utilisation and physical activity patterns are likely influencing current disease patterns, highlighting the need for updated epidemiologic studies to define the modern burden of cervical disc herniation and associated radiculopathy.

II. Conservative Management Strategies

Conservative strategies are often positioned as first line, especially when neurological deficits are absent and symptoms remain tolerable. In patients with herniated nucleus pulposus, conservative therapy is achieved through pharmacological therapy that may include NSAIDs, paracetamol, tramadol, antidepressants or anticonvulsants, combined with physical therapy to target pain control, functional capacity and a higher quality of life. Activity advice emphasizes avoidance of high impact loading, heavy lifting, and sustained non neutral cervical postures that aggravate symptoms. Especially in older individuals, pharmacologic treatment is customized to the comorbidities and severity of symptoms [9]. Metamizole offers short term analgesia with mostly mild side effects but lacks trials specifically in elderly herniated nucleus pulposus cohorts. Opioids, including tramadol, are reserved for individuals who cannot tolerate NSAIDs or have persistent severe pain, tramadol can reduce visual analogue scale (VAS) scores by about 4.5 points with a relatively milder adverse event profile [5]. When radicular symptoms are prominent, neuropathic pain-targeting drugs are incorporated. Tricyclic antidepressants and anticonvulsants such as gabapentin and pregabalin have been associated with meaningful reductions in visual analogue scale (VAS) scores in elderly patients with neuropathic pain due to herniated nucleus pulposus, although dizziness, drowsiness, and balance disturbances are frequent. These data support their use as adjuncts, with careful surveillance for tolerability issues [5]. With combined, personalised therapy, many patients improve without surgery with no hospitalisation or shorter healthcare utilisation. Conservative therapy also avoids operative risks such as anesthesia-related complications, which makes it especially advantageous for elderly patients or those with significant comorbidities. Despite these benefits, prolonged reliance on conservative treatment in patients who fail to improve or instead develop progressive neurological

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deficits may lead to suboptimal long-term outcomes, highlighting the need fortimely surgical evaluation and individualized, patient-centered decision-making in older adults [5].

III. Operative Management Strategies

Operative approaches for disc herniation is reserved for individuals who fail to obtain meaningful symptom relief or present with higher risk profiles that justify the added risk of operative approach. They are to be used after conservative pharmacological and non pharmacological modalities are used as a first line therapy. Clinical decision making must account for comorbidities and age related susceptibility, since long term NSAID and opioid use can be complicated by gastrointestinal, cardiovascular, and renal events, which may shift the risk benefit balance toward earlier surgery in selected cases [5]. Percutaneous cervical nucleoplasty, percutaneous cervical discectomy, and percutaneous cervical annuloplasty target contained or slightly extruded soft disc herniations, discogenic neck pain, or cervical radicular pain in patients who have failed at least 6 weeks of non operative management and prefer or require less invasive options. Indication frameworks emphasize MRI confirmed soft herniated nucleus pulposus with concordant clinical findings, absence of severe myelopathy, sequestration, or segmental instability, and adequate general condition for intervention. Available studies report low complication rates and suggest that these procedures are generally safe and effective in appropriately selected patients, with comparative studies indicating that percutaneous cervical nucleoplasty may provide greater pain relief, functional improvement and faster return to daily life than continued conservative care. However, heterogeneity in patient selection, procedural techniques and study design limits definitive conclusions regarding their comparative effectiveness [6]. Open surgical decompression, typically via anterior cervical discectomy, is commonly offered when disabling radicular symptoms persist or when more severe neurological compromise is present. In cervical radicular syndrome due to herniated disc, success rates for anterior discectomy of approximately 80 to 95% have been reported when outcomes are defined by pain and functional measures.. Comparative work reports advantages of arthroplasty in terms of reduced reoperation at the index level, lower incidence of adjacent segment syndrome, and preservation of cervical range of motion, albeit with heterotopic ossification in approximately 23% of cases that does not negate favorable clinical and functional outcomes relative to anterior cervical arthrodesis. Other randomized trials, however, have found similar functional results between arthroplasty and anterior cervical discectomy with or without interbody fusion, without clear superiority of one technique. These inconsistencies highlight that final operative selection must consider radiologic discopathy, presence of myelopathy, cervical alignment, and segmental stability, as well as institutional resources and surgeon experience [7].

IV. Comparative Effectiveness

Comparisons between nonoperative care and surgery for disc herniation increasingly stress that pharmacologic and rehabilitative strategies constitute first line treatment in older patients without major neurological impairment, reserving surgery for those who do not respond adequately or who face unacceptable drug related risks. Conservative approaches based on NSAIDs, metamizole, tramadol, antidepressants, anticonvulsants and physical therapy, which are reported to provide substantial symptom relief and functional gains while avoiding perioperative hazards. At the same time, prolonged reliance on medications that offer mainly transient analgesia without correcting mechanical compression may allow persistent disability, and delayed surgery after extended symptom duration has been associated with lowered long-term outcomes. These observations support a treatment pathway in which conservative management is initiated broadly but is coupled with close monitoring, individualized adjustment, and timely escalation when clinical indications emerge. Physical and other non pharmacologic interventions form a second pillar of conservative care. Structured strengthening programs in elderly herniated nucleus pulposus populations improve daily activities in approximately three quarters of patients and lower visual analogue scale pain by roughly 3 points, particularly when combined with NSAIDs, which offers a nonoperative route to pain relief and functional recovery that can, in selected cases, obviate or defer open surgery [5]. Minimally invasive percutaneous cervical techniques provide an intermediate option between extended conservative care and open discectomy. Systematic review data characterize percutaneous cervical nucleoplasty and percutaneous cervical discectomy as safe and effective for appropriately selected patients with contained or slightly extruded soft cervical herniations and persistent symptoms despite at least 6 weeks of nonoperative treatment. Comparative analyses show that percutaneous cervical nucleoplasty yields superior pain relief, better functional outcomes, and faster return to daily activities than continued conservative care, and long term follow up reports high patient satisfaction and durable symptom control. These findings position percutaneous techniques as viable alternatives to anterior cervical discectomy and as potential bridges that can delay or avoid open anterior cervical discectomy and fusion in some patients, although substantial heterogeneity, small samples, and variable inclusion criteria limit firm conclusions about their superiority or durability relative to traditional surgery [6].

V. Future Directions

Comparative data on cervical disc herniation management in elderly patients highlight the need to balance symptom relief, treatment efficacy, and procedure-related risks when selecting between conservative and operative management. When conservative management is selected, treatment should be individualized and time-limited, with structured reassessment to identify patients who may benefit from earlier escalation to invasive decompression [5]. Comparative studies of conservative versus operative treatment for cervical herniated nucleus pulposus have consistently demonstrated that surgery provides more rapid symptom relief, whereas conservative management often achieves comparable long-

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term functional outcomes in appropriately selected patients. However, the heterogeneity of study populations—including differences in symptom severity, neurological status, age, and comorbidity burden—limits direct comparison between treatment strategies. Future studies should also incorporate occupational outcomes, such as return-to-work time, productivity, and economic burden, to better assess the real-world impact of treatment. Although current guidelines provide broad indications for surgical intervention, they lack validated predictive models capable of estimating an individual patient's likelihood of success with conservative versus operative management. Developing such models would facilitate more personalized, evidence-based treatment selection.

VI. Conclusion

Cervical herniated nucleus pulposus requires a patient-centered management strategy that balances symptom severity, neurological status, age, comorbidities, and treatment related risks. Conservative therapy remains the first line approach for appropriately selected patients and provides meaningful relief while avoiding operative complications, whereas surgical intervention offers faster recovery and is essential for those with progressive neurological deficits or failure of non operative treatment. Emerging minimally invasive techniques bridge the gap between prolonged conservative care and open surgery, although further high-quality comparative studies are needed to define their long-term effectiveness and optimise individualised treatment pathways.

Acknowledgment

The authors would like to express their sincere gratitude to Universitas Airlangga for providing the academic environment and resources that supported the completion of this literature review, and to all individuals who contributed, directly or indirectly, to the successful completion of this work.

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