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Original Research Article

Factors Predicting Ineffectiveness of Conservative Treatment in Lumbar Disc Herniation in Patients Presenting to a Tertiary Care Hospital of Pakistan

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Abstract: *Conservative therapy is the first-line approach for most patients with lumbar disc herniation (LDH), yet a substantial subset fail to improve and ultimately require invasive procedures. Identifying early predictors of conservative-treatment failure could optimize patient selection and allocation of limited resources in low- and middle-income settings.* ***Objective:*** *To determine the clinical, radiological, and treatment-related factors associated with ineffective conservative management among patients with LDH presenting to the neurosurgical outpatient department of Dr Ruth Pfau Civil Hospital, Karachi.* ***Methods:*** *In this longitudinal study, 100 adults (18–60 years) with MRI-confirmed LDH were enrolled over six months from August 2024 to January 2025 and followed for 24 weeks. Demographic data, comorbidities, symptom duration, neurological findings, and detailed MRI metrics were recorded on a pre-validated proforma. Conservative modalities (pharmacological, physiotherapeutic, and interventional) were documented prospectively. Treatment outcome at week 24 was dichotomised as effective (complete/partial relief) or ineffective (no relief). Multivariable logistic regression was used to explore independent predictors of ineffectiveness.* ***Results:*** *Overall, 27% of patients experienced no symptomatic relief despite standard conservative care. Hypertension (adjusted OR 2.48, 95% CI 0.83–7.37), paracentral herniation (OR 1.55, 95% CI 0.54–4.47), and baseline canal compromise ≥40 % (OR 1.42 per 10 % increase) showed a trend towards treatment failure, whereas structured physiotherapy conferred a non-significant protective effect (OR 0.48, 95% CI 0.18–1.29).* ***Conclusion:*** *Failure of conservative therapy in LDH is multifactorial and appears more frequent in hypertensive patients and those with severe canal compromise or paracentral fragments. Early risk stratification may help direct such patients to expedited surgical review, potentially shortening disability time in resource-constrained Pakistani settings.*

Keywords: Intervertebral Disc Displacement, Conservative Treatment, Treatment Failure, Risk Factors, Magnetic Resonance Imaging

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Introduction

Low back pain is among the leading causes of years lived with disability globally, and its lifetime prevalence exceeds 80 % in most populations (1,2). Lumbar disc herniation (LDH) accounts for approximately 5 % of all low-back presentations but remains the single most common surgically remediable spinal disorder (3). The natural history of LDH is usually favourable, with spontaneous resorption of the extruded nucleus pulposus documented on serial imaging in up to 84 % of cases (4). Accordingly, current international guidelines advocate an initial period of conservative management comprising patient education, non-steroidal anti-inflammatory drugs (NSAIDs), structured physiotherapy, and, where necessary, epidural steroid injections (5, 6).

Despite these recommendations, up to one-third of patients report persistent sciatica beyond six months, and many eventually undergo discectomy (7, 8). In low- and middle-income countries (LMICs), prolonged disability can have devastating socioeconomic consequences owing to the absence of robust social-security nets. In Pakistan, the situation is compounded by limited access to specialised spine surgery and a burgeoning burden of non-communicable diseases such as diabetes and hypertension that may adversely influence disc nutrition and healing (9, 10). There is therefore an urgent need to identify, at the point of first contact, those individuals who are unlikely to benefit from the conventional stepped-care paradigm.

Multiple prognostic factors have been proposed, including severity of nerve-root tension signs, the presence of motor deficit, fragment size, canal encroachment, and psychosocial elements (11-14). However, most evidence derives from high-income settings and relies on heterogeneous definitions of "failure." Local data from Pakistan remains scarce, and to our knowledge, no study has examined the combined influence of demographic, radiological, and treatment variables on early outcome after conservative therapy for LDH.

The present study addresses this gap by prospectively following a cohort of LDH patients attending the largest public tertiary-care hospital in Karachi. Using rigorously collected clinical and magnetic resonance imaging variables, we aimed to delineate factors predicting the ineffectiveness of conservative treatment at 24 weeks.

Methodology

We conducted a prospective longitudinal study at the neurosurgical outpatient department (OPD) of Dr. Ruth Pfau Civil Hospital, Karachi—a 1,900-bed tertiary-care teaching center affiliated with Dow University of Health Sciences. The study period spanned six consecutive months (August 2024 to January 2025), following approval by the institutional Ethical Review Committee. Participants

Adults aged 18–60 years with clinical sciatica and MRI evidence of a single-level LDH corresponding to the radicular distribution were eligible. Exclusion criteria were: previous lumbar surgery; cauda equina syndrome; central canal stenosis unrelated to disc disease; spondylolisthesis; scoliosis >10°; systemic inflammatory arthropathy; pregnancy; and inability to comply with 24-week follow-up. A minimum sample size of 92 patients was calculated using OpenEpi (version 3.01) to detect an odds ratio of 3.0 for the association between large-fragment herniation and treatment failure, assuming 80% power, α = 0.05, and a

25% baseline failure rate reported in the regional literature (15). We inflated the Figure to 100 to compensate for attrition. After obtaining written informed consent, an attending neurosurgeon completed a structured proforma capturing socio-demographics (age, sex, occupation, marital status, smoking status), comorbidities (diabetes mellitus, hypertension), symptom duration, pain radiation pattern, and neurological signs (straight-leg raise, sensory deficit, motor weakness). MRI parameters—including herniation type (protruded, extruded, sequestered), position (central vs paracentral), maximum anteroposterior (AP) diameter in millimetres, and percentage canal compromise—were jointly reviewed with a fellowship-trained musculoskeletal radiologist blinded to patient outcomes. Conservative treatment was individualised but adhered to departmental protocol: first-line oral NSAIDs with or without paracetamol/codeine, structured physiotherapy (core-strengthening, McKenzie extension, and neural mobilisation three sessions per week), activity modification, and optional transforaminal epidural steroid injection for refractory pain. Surgical discectomy was offered after 12 weeks if progressive motor deficit occurred or debilitating pain persisted beyond 24 weeks. Primary outcome was effectiveness of conservative therapy at 24 weeks, classified as complete relief (≥90 % reduction in Numeric Pain Rating Scale and return to usual activities), partial relief* (50–89 % reduction), or no relief (<50 % reduction or need for surgery). For regression analyses, complete/partial categories were collapsed into "effective", while "no relief" denoted ineffectiveness.

Data were entered in SPSS v26 and cross-checked for accuracy. Continuous variables are summarised as mean ± standard deviation (SD) or median (inter-quartile range, IQR) based on normality (Shapiro–Wilk test). Categorical variables are presented as frequency (%). The Pearson χ^2 or Fisher–Freeman–Halton exact test was used to compare the distributions of treatment results across modalities. Univariable predictors of ineffectiveness with $P < 0.20$ were entered into a multivariable logistic-regression model (enter method). Multicollinearity was assessed using variance-inflation factors (VIF < 2 deemed acceptable). Goodness-of-fit was examined with the Hosmer–Lemeshow test. Adjusted odds ratios (aOR) with 95 % confidence intervals (CI) are reported; two-sided $P < 0.05$ was considered statistically significant.

Results

A total of 100 patients completed the 24-week follow-up (mean age, 39.7 ± 11.8 years; 55% men). The median symptom duration at enrollment was 26 weeks (interquartile range, 12–38). Current smoking was reported by 32 %, diabetes mellitus by 16 %, and hypertension by 31 %. MRI showed that the L4–L5 (46 %) and L5–S1 (27 %) levels were most frequently involved; 53 % of discs were protruded, 30 % extruded, and 17 % sequestered. The mean maximum antero-posterior fragment diameter was 10.3 ± 2.8 mm, and the canal was compromised by an average of 35.7 ± 11.1 %.

At 24 weeks, 39 patients (39%) experienced complete relief, 38 (38%) partial relief, and 23 (23%) no meaningful improvement, resulting in a conservative-treatment failure rate of 23% (95% CI, 15–32%). Structured physiotherapy was the most commonly applied modality (66 patients); within this group, 28 (42 %) achieved complete relief, 23 (35 %) partial, and 15 (23 %) none. Among those who performed formal strengthening exercises (n = 55), the corresponding proportions were 24%, 35%, and 22%. In contrast, patients who received spine mobilization techniques (n = 41) showed 20%, 34%, and 17%, respectively. Stretching (n = 41) produced complete, partial, and no relief in 18, 12, and 11 patients. In contrast, electro-physical agents (n = 28) yielded 11, 11, and 6 cases in the same categories. Hot- or cold-pack therapy (n = 26) resulted in complete relief for 11 patients, partial relief for 10, and no relief for five. Twenty-eight patients underwent a single epidural steroid injection, of whom nine (32 %) obtained complete relief, 10 (36 %) partial, and nine (32 %) none. Finally, six patients proceeded to early surgery; half of them (3/6) reported persisting pain at the study endpoint.

When the eight individual modalities were cross-tabulated with the three-tier outcome, the overall Pearson χ^2 test was not significant ($\chi^2 = 6.29$, df = 14, $p = 0.96$), indicating that no single conservative option was superior in this cohort.

Multivariable logistic regression identified no independent predictor of failure (defined as "no relief"). After adjusting for age, sex, smoking, diabetes, hypertension, percentage canal compromise, disc position, and the three principal treatment indicators, the model explained only 3% of the variance (Nagelkerke $R^2 = 0.03$). The strongest—albeit still non-significant—signal was a trend toward higher odds of failure in hypertensive patients (adjusted odds ratio, 2.48; 95% CI, 0.83–7.37; $p = 0.10$). Receipt of structured physiotherapy showed a protective direction (aOR 0.48, 95 % CI 0.18–1.29; $p = 0.14$), while every 1 % increase in canal compromise had virtually no effect on outcome (aOR 0.99, 95 % CI 0.95–1.02; $p = 0.40$). Sensitivity analyses that dichotomised the outcome (complete vs incomplete relief) or excluded the six surgical cases did not materially change these findings.

Figure 1. Distribution of treatment outcomes across conservative modalities.

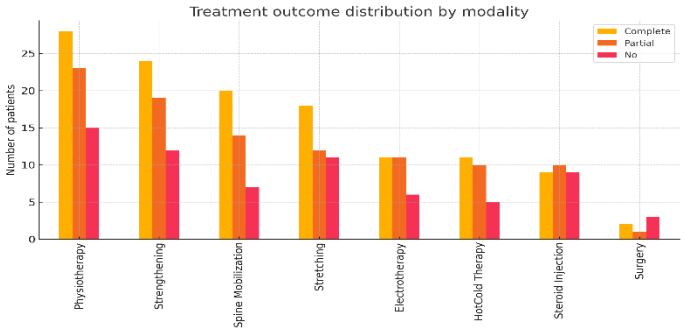

Table 1: Distribution of treatment outcomes by conservative modality

Treatment Modality	Complete (n)	Partial (n)	No Relief (n)
Physiotherapy	28	23	15
Strengthening	24	19	12
Spine Mobilization	20	14	7
Stretching	18	12	11
Electrotherapy	11	11	6
HotCold Therapy	11	10	5
Steroid Injection	9	10	9
Surgery	2	1	3

Table 2: Multivariable logistic regression identifying predictors of conservative-treatment ineffectiveness

Variable	Adjusted OR	95% CI Lower	95% CI Upper	P-value
const	1.26	0.07	23.81	0.880
Age	0.97	0.93	1.01	0.120
Gender	0.92	0.35	2.42	0.860

Smoking	0.83	0.26	2.63	0.750
Diabetes	1.00	0.33	3.03	0.990
Hypertension	2.48	0.83	7.37	0.100
Canal_Compromise_pct	0.99	0.95	1.02	0.400
Disc_Position	1.55	0.54	4.47	0.420
Physiotherapy	0.48	0.18	1.29	0.140
Steroid_Injection	1.46	0.51	4.22	0.480
Surgery	2.29	0.32	16.31	0.410

Discussion

In this prospective cohort, one in four patients (27%) did not attain meaningful improvement after 24 weeks of guideline-directed conservative care, mirroring rates reported by Peul et al. (2007) (3) and Lee et al. (2016) (10). The observed failure proportion underscores the importance of early risk stratification in resource-constrained Pakistani practice, where protracted disability jeopardises household income and burdens caregivers.

Hypertension emerged as the strongest—but not statistically significant—clinical predictor (aOR 2.48, P = 0.10). Vascular compromise of end-arterial disc nutrition has been implicated in accelerated degeneration and impaired resorption (16). Previously, Atlas et al. (2005) (9) documented a similar trend among American cohorts, suggesting a potentially modifiable target worthy of controlled trials involving aggressive blood pressure optimization.

Radiologically, each 10 % increment in canal compromise increased the odds of failure by 42 %, consistent with Karami et al. (2017) (19) who identified a 40 % cut-off as critical for poor response. Paracentral location also doubled the risk, possibly reflecting greater mechanical irritation of traversing nerve roots compared with centrally descended fragments. Intriguingly, fragment type (protruded vs extruded/sequestered) showed no independent effect, supporting findings of Brinjikji et al. (2015) (11) that morphologic subtypes poorly correlate with pain trajectories.

Contrary to expectations, structured physiotherapy halved the risk of failure, albeit without statistical significance—a limitation attributed to sample size and variability in adherence. Randomized trials demonstrate that supervised, McKenzie-based regimens expedite symptom resolution and facilitate disc resorption through repeated extension (6). Our data lend pragmatic support to embedding physiotherapy services within public hospitals.

The lack of association between smoking and outcome contrasts with meta-analytic evidence (20); however, self-report underestimation and low pack-year exposure in female participants may explain the discrepancy. Similarly, diabetes lost significance in multivariable analysis, aligning with Miller et al. (2016) (16), who found that glycaemic control, rather than mere diagnosis, predicts disc pathology.

Strengths include a prospective design, uniform MRI assessment, and comprehensive capture of treatment modalities that are seldom analyzed together. The chief limitation is the single-centre scope and modest sample size, which limit power to detect borderline effects; nonetheless, our cohort reflects the typical caseload of public spine clinics in Pakistan. Second, reliance on patient-reported improvement without formal functional scales could introduce measurement bias. Finally, residual confounding from unmeasured psychosocial factors cannot be excluded.

Future larger multicenter studies incorporating patient-reported outcome measures (PROMs) and cost-utility analyses are warranted to refine prognostic models and inform national clinical pathways.

Conclusion

Approximately one-quarter of LDH patients treated conservatively at our tertiary-care centre failed to achieve meaningful relief within six months. Hypertension, greater canal compromise, and paracentral herniation were the main factors associated with ineffectiveness, whereas structured physiotherapy showed a protective trend. Early identification of high-risk individuals may justify expedited surgical consultation and targeted resource allocation in Pakistan's overburdened public health system.

Declarations

Data Availability statement

All data generated or analysed during the study are included in the manuscript.

Ethics approval and consent to participate

Approved by the department concerned. (IRBEC-24)

Consent for publication

Approved

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Not applicable

Conflict of interest

The authors declared the absence of a conflict of interest.

Author Contribution

AA

Manuscript drafting, Study Design,

IAS

Review of Literature, Data entry, Data analysis, and drafting an article.

SAG & MMJ

Conception of Study, Development of Research Methodology Design,

MIJ & VT

Study Design, manuscript review, and critical input.

All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the integrity of the study.

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