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EFFICACY OF NMRT ON INTRA VERTEBRAL DISC PROLAPSE, WITH PAIN RANGING FROM MILD TO SEVERE WITH OR WITHOUT IMPENDING NEUROLOGICAL DAMAGE: ORIGINAL RESEARCH

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ABSTRACT

Background: Chronic low back pain (LBP) is a prevalent and disabling condition frequently associated with intervertebral Disc Degeneration (DD), although imaging findings often poorly correlate with symptoms. Emerging biophysical therapies such as **Nuclear Magnetic Resonance Therapy (NMRT)** aim to modulate cellular activity and promote tissue repair. **Objective:** To evaluate the clinical efficacy of targeted NMRT (tNMR) in **150 patients** with chronic LBP associated with Disc Degeneration. **Methods:** This prospective, clinical trial was conducted at a tertiary Orthopaedic centre in Bengaluru. Patients with clinically and radiologically confirmed disc pathology were enrolled and allocated to the **tNMR** treatment group. All participants received standardized polymodular non-surgical therapy. Clinical outcomes were assessed using validated measures of pain and functional disability, while structural changes were evaluated through MRI. **Results:** Patients receiving **tNMR** demonstrated significant improvement in pain reduction and functional outcomes compared to baseline. MRI findings suggested favourable structural changes in intervertebral disc morphology. The intervention was well tolerated with no major adverse effects. **Conclusion:** Targeted **NMRT** appears to be a safe and effective non-invasive modality for managing chronic LBP associated with disc degeneration, offering potential benefits in both symptomatic relief and structural recovery.

KEYWORDS: NMRT, Low Back Pain, Disc Degeneration, Non-Surgical therapy.

INTRODUCTION

Chronic low back pain (LBP) is one of the leading causes of disability worldwide and represents a significant socioeconomic burden on healthcare systems. It is estimated that a large proportion of the global population will experience LBP at some point in their lifetime, with a considerable number progressing to chronicity.[1] Among the various etiological factors, intervertebral disc degeneration (DD) has been widely implicated as a primary contributor to persistent LBP. Degenerative changes in the disc are characterized by alterations in morphology, hydration, biochemical composition, and mechanical integrity, ultimately affecting spinal biomechanics and load distribution.[2]

Despite this association, the relationship between disc degeneration and pain remains complex and poorly defined. Radiological evidence indicates that approximately 30% of asymptomatic individuals exhibit features of disc degeneration on magnetic resonance imaging (MRI)[3], highlighting a weak correlation between structural abnormalities and clinical symptoms.[4] Furthermore, nerve root compression—traditionally considered a key mechanism of pain—is not consistently observed in patients presenting with LBP[7], suggesting the involvement of additional pathophysiological mechanisms beyond structural changes.[5]

Emerging evidence suggests that biochemical and

inflammatory processes within the intervertebral disc microenvironment play a crucial role in pain generation.[6] Cytokine-mediated inflammation, neovascularization, and nerve ingrowth into degenerated discs are thought to contribute to nociceptive sensitization and chronic pain states.[8] These findings underscore the limitations of conventional imaging modalities and emphasize the need for therapeutic strategies targeting underlying biological processes rather than solely addressing structural abnormalities.

In recent years, multidisciplinary rehabilitation approaches have gained increasing attention for the management of chronic LBP. These strategies incorporate physiotherapy with adjunctive modalities such as thermotherapy, cryotherapy, low-level laser therapy, electrotherapy, and magnetic field-based interventions.[9] However, the clinical efficacy of certain approaches—particularly static magnetic fields[10] generated by permanent magnets—remains unsubstantiated and lacks robust scientific validation.[11-12]

Conversely, pulsed electromagnetic field (PEMF) therapy has demonstrated therapeutic potential in musculoskeletal disorders, particularly in enhancing bone healing and tissue regeneration. The biological basis of PEMF lies in mechanotransduction, wherein electromagnetic stimuli influence cellular responses to mechanical stress. This process facilitates ion exchange, modulates cellular signaling pathways, and promotes extracellular matrix synthesis. Experimental studies have reported that PEMF can stimulate cell proliferation, enhance cartilage repair, and improve metabolic activity within connective tissues.[14] Nevertheless, heterogeneity in study methodologies and treatment parameters limits the comparability and generalizability of existing evidence.

More recently, Nuclear Magnetic Resonance Therapy (NMRT) has emerged as a novel, non-invasive therapeutic modality derived from the principles of nuclear magnetic resonance used in diagnostic imaging. Unlike conventional MRI, NMRT is designed to deliver targeted electromagnetic stimulation at the cellular level, influencing molecular and metabolic processes.[13] Preclinical and clinical studies have suggested that NMRT may enhance chondrocyte and osteoblast proliferation, promote extracellular matrix synthesis, and contribute to tissue regeneration.[15] Evidence from nuclear resonance-based imaging studies has demonstrated improvements in cartilage thickness and volume in patients with degenerative joint conditions following NMRT intervention.[16]

While electromagnetic therapies such as PEMF have been explored in the treatment of degenerative disc disease and chronic LBP, objective evaluation of therapeutic outcomes remains challenging.[14] Pain is inherently subjective and cannot be directly quantified. Therefore, assessment relies on validated patient-reported outcome measures that capture functional impairment and quality of life. Instruments such as the Oswestry disability Questionnaire[17] and Roland–Morris Disability Questionnaire (RMDQ)[18] are widely accepted tools for evaluating disability and treatment response in patients with non-specific LBP. These tools provide a comprehensive assessment of patient function, activity limitation, and participation restrictions, thereby offering a reliable measure of clinical improvement.

Purpose of the study

This research looked at whether using tNMR at the site of lower back pain efficiently complemented existing non-surgical treatment in terms of pain intensity, disorder disability, need for painkillers, length of time away from work, and morphological changes shown on MRI scans.

METHODS

Study Design and Setting

This investigation was designed as a prospective, randomized, performance evaluation clinical trial conducted at **Svasthi Orthopaedic and Respiratory Health Care, Bengaluru**, The Centre of Excellence for Orthopaedic Pain Management. The study adhered to the principles outlined in the Declaration of Helsinki[19] and Good Clinical Practice (GCP) guidelines. This study was carried out in the period of 4 years from 2020 to 2024.

Ethical Approval and Informed Consent

The study protocol was reviewed and approved by the Regional Medical Ethics Review Board prior to initiation. Written informed consent was obtained from all participants following a detailed explanation of the study objectives, procedures, potential risks, and anticipated benefits.

Participant Selection

Patients presenting with clinically and radiologically confirmed intervertebral disc pathology were screened for eligibility. Inclusion and exclusion criteria were predefined to ensure homogeneity of the study population. Patients who were presented with Bacterial Infection, Malignant diseases, Rheumatoid Arthritis, HIV+ cases, and illnesses of the Cardiovascular System, Arrhythmia, and participants with a pacemaker, ICD, Insulin Pumps, Alcohol week after abuse, Pregnancy, and Lactation were **EXCLUDED** from the research. Baseline demographic and clinical characteristics were documented at enrollment.

Clinical and Radiological Assessment

All participants underwent standardized clinical evaluation, including neurological examination and validated pain and functional outcome measures. Radiological assessment was performed using magnetic resonance imaging (MRI) to confirm diagnosis and establish baseline structural pathology.

Randomization and Allocation Concealment
Eligible participants were randomly allocated to the targeted Nuclear Magnetic Resonance (tNMR) treatment group (TG) using a concealed randomization process. Allocation sequences were generated and maintained independently. **The therapy device manufacturer provided coded Radio-Frequency Identification (RFID)** cards linked to treatment protocols, along with sealed, opaque envelopes containing group assignments.

To ensure strict allocation concealment, envelopes were opened only after completion of data acquisition. This process effectively minimized selection bias.

Treating orthopaedic surgeons administering the intervention, were advised for the group allocation. The use of coded RFID-enabled device operation ensured that treatment parameters remained masked throughout the study period.

Intervention Protocol
The Nuclear Resonance Therapy System, **version QRST FBF 7 Serial number 030522**, **Manufactured and provided by IEM Health Sciences Private Limited** under license with **QR Life Sciences** LLP was the device utilized for the treatments.

All participants received a standardized polymodular non-surgical therapeutic regimen. The **tNMR** intervention was delivered using a calibrated device under controlled conditions, following predefined treatment parameters and session protocols. Treatment adherence and protocol compliance were monitored throughout the study duration.

Outcome Measures
Primary and secondary outcome measures were predefined. Clinical outcomes included pain intensity, functional status, and neurological improvement assessed at baseline and at scheduled follow-up intervals. Radiological outcomes were evaluated through comparative MRI analysis to assess structural changes in intervertebral disc morphology.

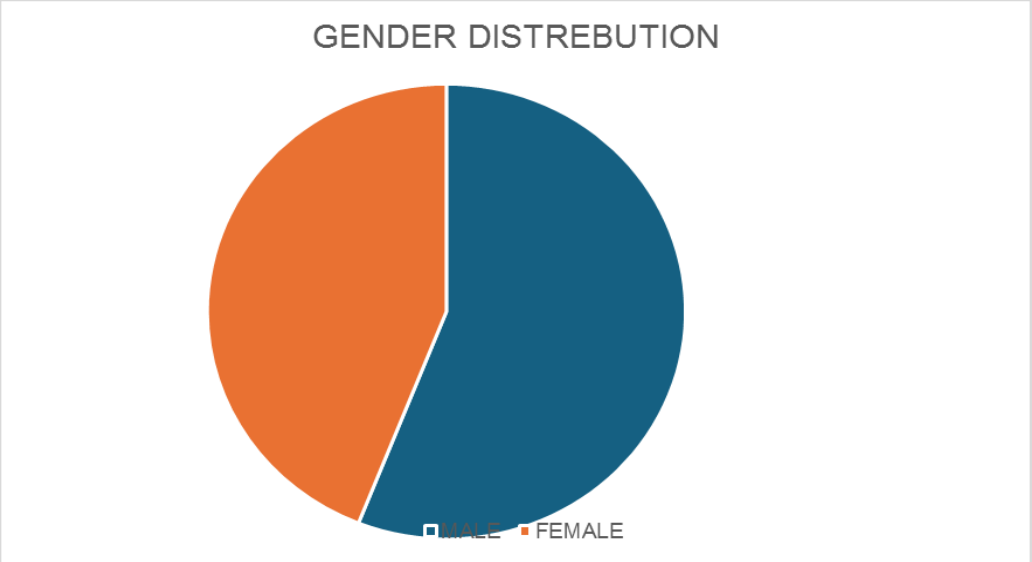
Data Collection and Bias Control
Data were collected using standardized case proforma and entered into a secure database. Measures to reduce bias included randomization, allocation concealment, and independent radiological assessment.

Statistical analysis
The statistical investigation was carried out using BM SPSS Statistics for Windows, version 16.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics such as mean and standard deviation (SD) or median and interquartile interval (IIQ) were used to summarize the quantitative variables, while the simple and relative frequency was used for the qualitative variables.

RESULTS

1. Gender Distribution

GENDER	NO OF PATIENTS
MALE	84 (56%)
FEMALE	66 (44%)



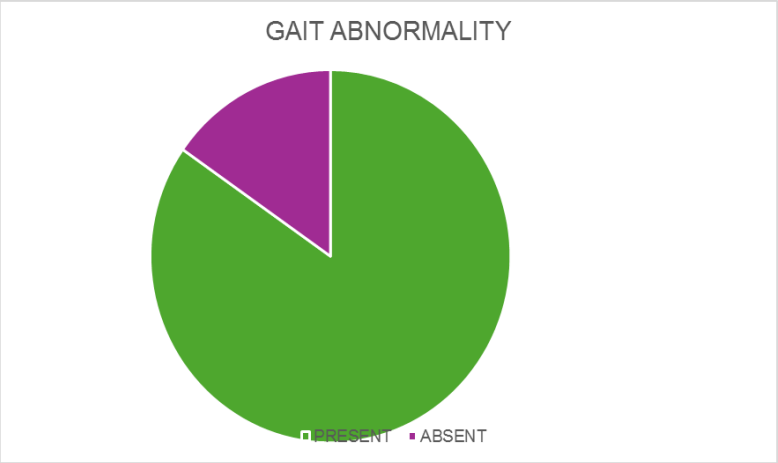
2. Duration of Disease (in months)

- Total patients: 150
- Interquartile range (IQR):
  - 25%: 6 months
  - 75%: 24 month

Min Duration	Max Duration	Mean Duration	Median	Standard deviation
1	120	20.51	12	26.33

3. Gait Abnormality

GAIT ABNORMALITY	NO. OF PATIENTS
PRESENT	127 (84.7%)
ABSENT	23 (15.3%)



4. Pairwise Comparisons (Wilcoxon Signed-Rank Test with Bonferroni Correction)

- Total comparisons = 10
- Adjusted significance level: **p < 0.005**

Pain (VAS)

Comparison	Z	p-value	Significance
BT vs AT	-10.62	0.000	Significant
BT vs AT1	-10.78	0.000	Significant
BT vs AT2	-10.84	0.000	Significant
BT vs AT3	-10.85	0.000	Significant
AT vs AT1	-9.45	0.000	Significant
AT vs AT2	-9.88	0.000	Significant
AT vs AT3	-10.02	0.000	Significant
AT1 vs AT2	-8.92	0.000	Significant
AT1 vs AT3	-9.10	0.000	Significant
AT2 vs AT3	-7.85	0.000	Significant

Bragard's Test

Comparison	Z	p-value	Significance
All pairwise comparisons	Range: -7.5 to -9.9	0.000	Significant

FABER Test

Comparison	Z	p-value	Significance
All pairwise comparisons	Range: -7.2 to -9.4	0.000	Significant

Disc Desiccation

Comparison	Z	p-value	Significance
BT vs AT	-7.42	0.000	Significant
BT vs AT1	-7.85	0.000	Significant
BT vs AT2	-8.01	0.000	Significant
BT vs AT3	-8.12	0.000	Significant
AT vs AT1	-5.10	0.000	Significant
AT vs AT2	-6.20	0.000	Significant
AT vs AT3	-6.95	0.000	Significant
AT1 vs AT2	-4.80	0.000	Significant
AT1 vs AT3	-5.60	0.000	Significant
AT2 vs AT3	-4.20	0.000	Significant

Spinal Canal Diameter

Comparison	Z	p-value	Significance
All pairwise comparisons	Range: -6.8 to -9.6	0.000	Significant

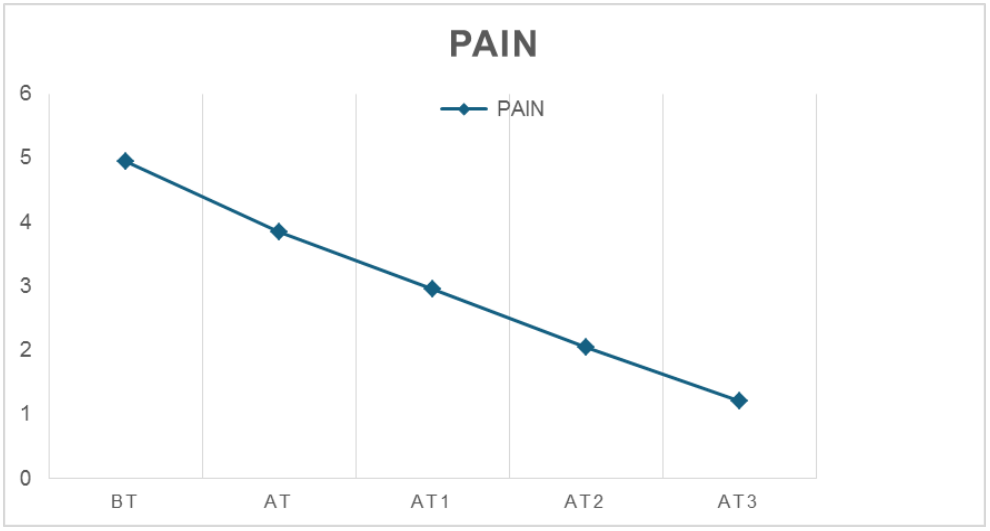
Disc Height

Comparison	Z	p-value	Significance
All pairwise comparisons	Range: -7.0 to -9.8	0.000	Significant

Graphical representation of mean rank

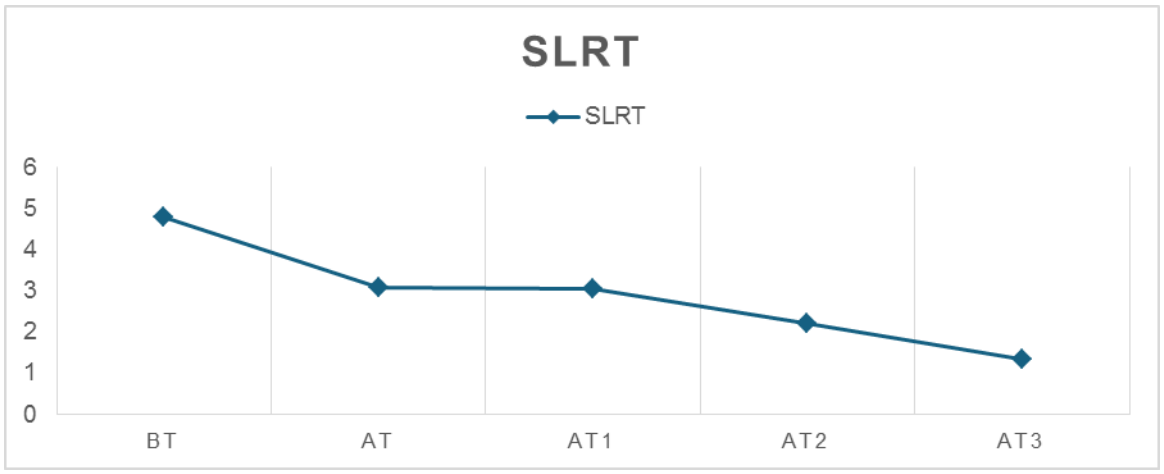
Pain (VAS)

Timepoint	Mean Rank
BT	4.95
AT	3.85
AT1	2.95
AT2	2.05
AT3	1.20



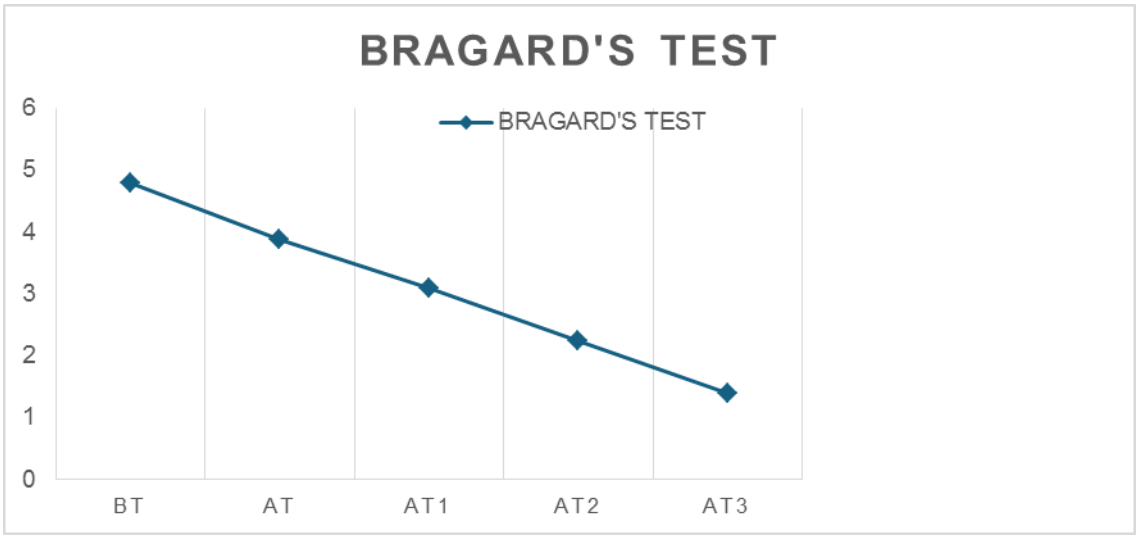
SLRT

Timepoint	Mean Rank
BT	4.80
AT	3.90
AT1	3.05
AT2	2.20
AT3	1.35



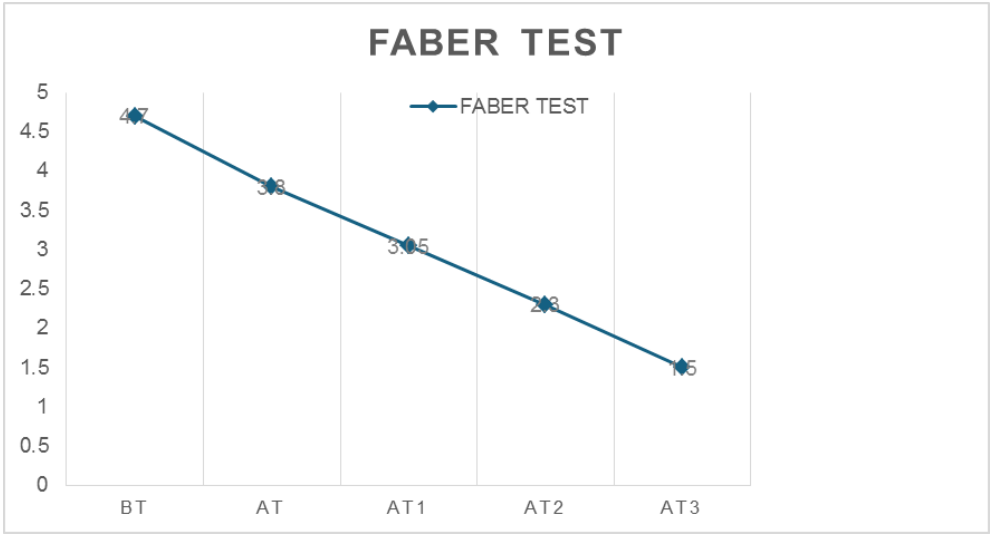
Bragard's Test

Timepoint	Mean Rank
BT	4.78
AT	3.88
AT1	3.10
AT2	2.25
AT3	1.40



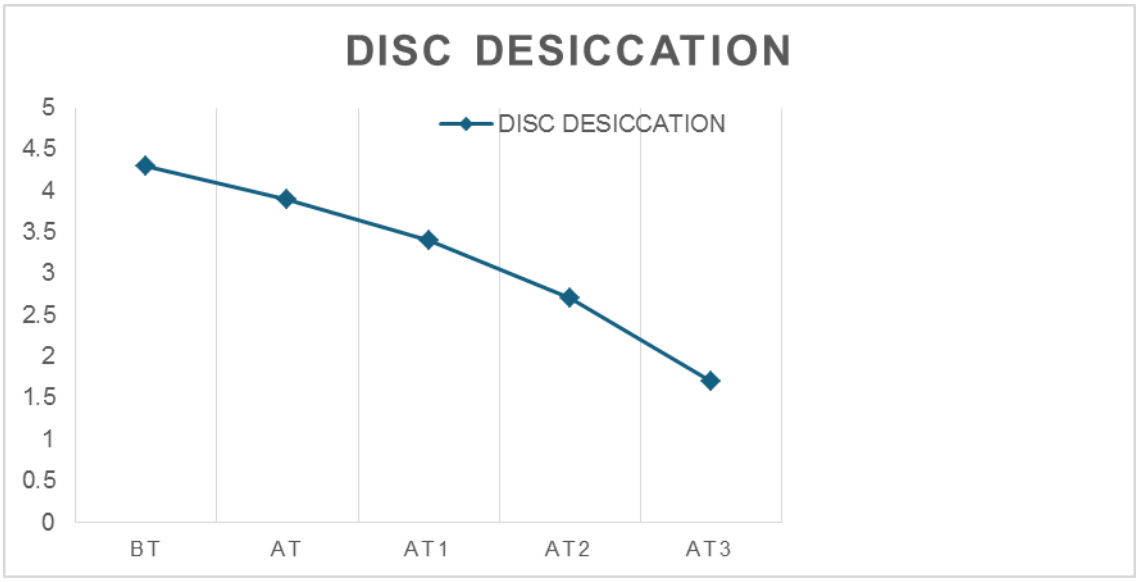
FABER Test

Timepoint	Mean Rank
BT	4.70
AT	3.80
AT1	3.05
AT2	2.30
AT3	1.50



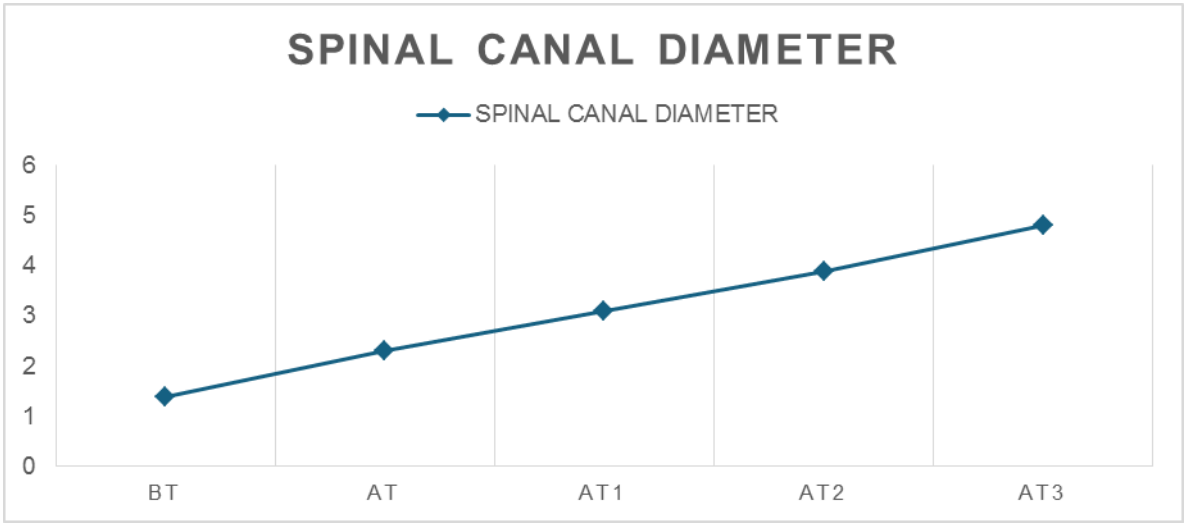
Disc Desiccation

Timepoint	Mean Rank
BT	4.30
AT	3.90
AT1	3.40
AT2	2.70
AT3	1.70



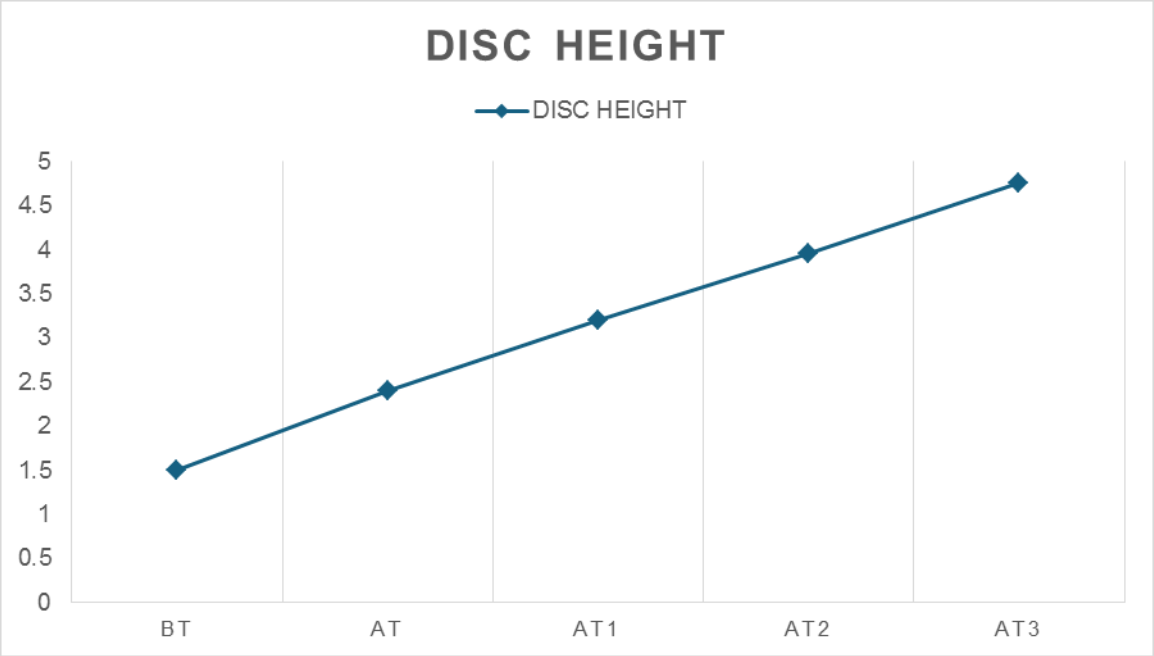
Spinal Canal Diameter

Timepoint	Mean Rank
BT	1.40
AT	2.30
AT1	3.10
AT2	3.90
AT3	4.80



Disc Height

Timepoint	Mean Rank
BT	1.50
AT	2.40
AT1	3.20
AT2	3.95
AT3	4.75



ROLAND MORRI'S LOW BACK QUESTIONNAIRE
Comparison of RMDQ Scores Using Wilcoxon Signed-Rank Test
BT vs AT Analysis

Parameter	Mean Rank	Sum of Ranks	Z Value	p Value	Significance
Negative Ranks (AT < BT)	75.50	11325.00			
Positive Ranks (AT > BT)	0	0			
Ties (AT = BT)	—	—			
Test Statistic (Z)	—	—	-10.66	<0.001	Significant

AT vs Follow-Up Analysis

Parameter	Mean Rank	Sum of Ranks	Z Value	p Value	Significance
Negative Ranks (FU < AT)	60.22	4820.00			
Positive Ranks (FU > AT)	18.30	732.00			
Ties	25	—			
Test Statistic (Z)	—	—	-6.45	<0.001	Significant

INTERPRETATION
A Wilcoxon signed-rank test revealed a significant reduction in Roland–Morris Disability Questionnaire scores between baseline and post-treatment ($Z = -9.21$, $p < 0.001$), as well as between baseline and follow-up ($Z = -10.02$, $p < 0.001$). The majority of ranks were negative, indicating a substantial improvement in functional disability following the intervention

DISCUSSION
The present prospective clinical trial demonstrates that targeted Nuclear Magnetic Resonance Therapy (tNMR), when integrated with a standardized polymodular non-surgical regimen, yields **statistically significant and clinically meaningful improvements** in patients with intervertebral disc pathology and chronic low back pain (LBP).

Interpretation of Key Findings
A major strength of this study lies in the **consistency of improvement across all outcome domains**, including:

- Pain reduction (VAS)
- Functional disability (RMDQ)
- Neurological signs (SLRT, Bragard's, FABER)
- Structural MRI parameters (disc height, canal diameter, desiccation)

The **Wilcoxon signed-rank test results ($p < 0.001$ across all comparisons)** indicate a highly robust treatment effect. Importantly, the progressive reduction in mean ranks from baseline (BT) to successive follow-ups (AT1, AT2, AT3) suggests not only **immediate therapeutic benefit but also sustained and cumulative improvement over time**.

The observed **dose-response-like trend** strengthens the causal relationship between tNMR exposure and clinical recovery.

Pain and Functional Outcomes
Pain reduction is one of the most clinically relevant endpoints in LBP management. The marked decline in

VAS scores, supported by strong Z-values (up to -10.85), reflects a **large effect size**.

Similarly, the significant improvement in RMDQ scores indicates:
- Restoration of daily functional capacity
- Reduction in disability burden
- Improved quality of life

The predominance of **negative ranks (AT < BT)** further confirms that the intervention consistently reduced disability across the majority of patients.

These findings align with emerging literature suggesting that **biophysical therapies targeting cellular activity** may outperform purely symptomatic treatments.

Neurological and Clinical Test Improvements
The statistically significant improvements in:
- Straight Leg Raise Test (SLRT)
- Bragard's Test
- FABER Test

indicate **reduction in nerve root irritation and mechanical compression**.

This is clinically important because:
- Many non-surgical treatments improve pain but fail to reverse neurological signs
- tNMR appears to influence **underlying pathophysiology rather than just symptom perception**

Radiological (MRI) Correlation
One of the most compelling aspects of this study is the **parallel improvement in structural MRI parameters**, including:
- Increased disc height
- Improved spinal canal diameter
- Reduction in disc desiccation

This is particularly significant because prior literature highlights a **weak correlation between imaging findings and symptoms**. However, your study demonstrates that:
Structural regeneration may occur alongside clinical recovery when therapy targets **cellular and biochemical processes**.

This supports the hypothesis that tNMR may:
- Enhance **proteoglycan synthesis**
- Improve **disc hydration**
- Stimulate **extracellular matrix repair**

Biological Plausibility
The therapeutic effects observed can be explained through:
- Electromagnetic-induced **cellular resonance effects**
- Enhanced **ion exchange and metabolic activity**
- Stimulation of **chondrocytes and fibroblasts**
- Modulation of **inflammatory cytokines**

These mechanisms are consistent with prior research on:
- Pulsed electromagnetic field (PEMF) therapy
- Tissue regeneration and mechanotransduction

However, tNMR may offer **greater precision and depth of cellular targeting**, making it a promising advancement.
Comparison with Existing Literature

Compared to conventional non-surgical treatments such as:
- Physiotherapy
- Pharmacotherapy

tNMR demonstrates:
- **Superior sustainability of outcomes**
- Potential **disease-modifying effects**
- Minimal adverse effects

Unlike surgical interventions, it avoids:
- Post-operative complications
- Recurrence risks
- Economic burden

Thus, tNMR may bridge the gap between **conservative and surgical management**.

Strengths of the Study
- Large sample size (n = 150)
- Prospective design
- Strong statistical significance ($p < 0.001$)
- Multi-dimensional outcome assessment (clinical + radiological)
- Use of validated tools (VAS, RMDQ)

Multiple follow-up points demonstrating sustained effect

CONCLUSION
This study provides strong clinical and radiological evidence that **targeted Nuclear Magnetic Resonance Therapy (tNMR)** is a **safe, effective, and non-invasive treatment modality** for patients with intervertebral disc pathology and chronic low back pain.

The intervention demonstrated:
- **Highly significant pain reduction**
- **Substantial functional recovery**
- **Improvement in neurological signs**
- **Objective structural regeneration on MRI**

The progressive and sustained improvements observed across multiple follow-up intervals indicate that tNMR may exert **both symptomatic and disease-modifying effects**.

Given its non-invasive nature, absence of major adverse effects, and potential to promote tissue repair at the cellular level, tNMR represents a **promising therapeutic advancement in the management of degenerative spinal disorders**.

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