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NON-INVASIVE MANAGEMENT OF LUMBAR DISC HERNIATION USING NMRT: A PROSPECTIVE STUDY ON PAIN RELIEF AND NEUROLOGICAL PRESERVATION

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ABSTRACT

Aim: The aim is to evaluate the efficacy of therapeutic nuclear magnetic resonance therapy (tNMR) treatment on intervertebral disc prolapse. **Method**: The study was designed as a Comparative clinical study. This study includes all participants suffering from Lower Back discomfort who had been admitted to a tertiary health care hospital, from 2020-2023 (3 years of duration). A total of 50 patients (28 or 56 % were female and 22 or 44% were male) were examined and the mean age of the patients was noted at 41.42 ± 12.85. All the patients were diagnosed by doctors using clinical history, examination, X-Ray, and magnetic resonance imaging (MRI) of the Spine as confirmatory cases of disc prolapse. For the assessment of the disability caused by chronic lower back discomfort, the Oswestry Lower Back Discomfort impairment Questionnaire recommended by Fairbank et al and the Roland Morris disability questionnaire were used. **Outcomes:** The outcomes of this research suggest that the therapy was effective in reducing the level of functional impairment in individuals with lower back discomfort, as measured by the Oswestry Low Back Discomfort impairment score. The fact that all individuals improved to the minimal disability category after 3 months of therapy is a positive outcome. **Conclusion:** Nuclear magnetic resonance treatment is a different supplemental therapeutic approach that is simple to use and only requires short therapeutic procedures.

KEYWORDS: Chronic low back pain, Nuclear Magnetic Resonance Therapy, Oswestry Low Back Discomfort Questionnaires, Roland Morris disability Questionnaires.

INTRODUCTION

Chronic lower back pain (LBP) is a very common, expensive, and incapacitating ailment that is not well addressed.[1] most people get LBP from their intervertebral discs, which may degenerate and change in shape, composition, structure, and volume.[2]

Uncertainty surrounds the relationship between intervertebral disc degeneration (DD) and persistent lower back pain (LBP), as DD symptoms are present in 30% of persons without LBP.[3,4,5] Because of this, investigations using MRI cannot distinguish between painful and non-painful degenerating discs.[6] Additionally, even though nerve compression is rarely seen by magnetic resonance imaging methods, spreading pain is frequently linked to LBP. 7 Hence, additional elements that cannot be seen by imaging must be involved in the pathophysiological processes that differentiate between painful and non-painful intervertebral DD. The methods that should be pursued for pain treatment will be identified with a better understanding of these elements.[8]

New rehabilitation theories are currently being researched to provide new multidisciplinary methods for treating problems brought on by pain. Such multi-modal

rehabilitation strategies for the treatment of individuals with persistent low back discomfort include therapies such as thermotherapy to supplement active and passive physiotherapy-based treatments. To relieve pain, people use cryotherapy, soft laser treatment, electrotherapy, and the use of magnetic fields.[9]

No results have been provided for the treatment using static magnetic fields created by permanent magnets that were acquired in comparative research (comparisons before and after treatment,), so that survive scientific scrutiny.[10] Permanent magnets' static magnetic fields, which were once used to treat persistent lower back pain, must now be disregarded.[11]

Osteoporosis injuries were effectively treated with pulsating electromagnetic fields (PEMF). The understanding that electromagnetic fields may activate cells in response to variations in mechanical stress serves as the foundation for this therapy.[12] While the electrical activity in cartilage tissue and connective tissue structures is a little more complicated than in bone tissue, the previously discussed idea is still applicable. The transfer of electrical impulses to and from the tissue structures is induced by variations in tension within collagen structures produced by variations in mechanical stress, and as a result, has a favorable impact on metabolism.[13] It has been demonstrated that the use of pulsing electromagnetic fields (PEMF) stimulates beneficial biological processes including cell division, matrix synthesis, etc.[14] The outcomes of the research are hardly compared because of the highly dissimilar technological and physical foundations.

Recently, Nuclear Magnetic Resonance Therapy—a specialized type of nuclear magnetic resonance technology and a treatment method based on nuclear magnetic resonance—was created. The active principle is focused upon the same ideas as diagnostic devices for nuclear magnetic resonance imaging (MRI).[15]

Nuclear Magnetic Resonance Treatment has been demonstrated to repair cartilage structures[16] and nuclear resonance tomography served as evidence for these findings. That analysis unequivocally demonstrated that individuals with osteoarthritis of the knee had increased cartilage volume and thickness. In a recently released double-blind, randomized research, a nuclear resonance stimulator was used to treat chondrocytes and osteoblasts (MBST-Therapy). When compared to the rates of growth of the treatment group, this nuclear resonance therapy significantly increased the rates of growth of the cell.

PEMF has been utilized to treat degenerative disc disorder, and chronic lower back discomfort, following spinal fusions[18,19] making an objective assessment of persistent lower back pain is by no means simple. The fact that "pain" cannot be measured is the fundamental contributor to this issue. Yet this objectively non-quantifiable symptom, or, to put it another way, the patient's limitations and functional capacity, or, to put it another way, their inability for, and diminution of, their daily activities, is what governs them.

It is important to utilize professionally created and authenticate questionnaires for the examination of non-specific LBP to record therapy success (for example The Oswestry Low Back discomfort impairment Questionnaire[20] and the Roland Morris impairment questionnaire.[21]

These surveys capture all relevant information, including damage, activity, involvement, and surrounding circumstances. Such documented therapy outcomes can provide significant supporting evidence for the assessment of rehabilitation progress.

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.

Research design

The study was conducted at Svasthi Orthopaedic and Respiratory Health Care, Bengaluru (from January 2020 to March 2023). The Center of Excellence for Orthopaedic Pain Management conducted this prospective, comparative clinical trial. The regional Medical Ethics Review Board approved the research protocol, and informed consent was obtained from all patients. Participants were examined clinically and radiologically and randomly assigned to a tNMR treatment group (TG). Written informed consent was obtained from each participant. Polymodular nonsurgical therapy was performed in all cases.

The therapy device manufacturer provided coded **RADIO-FREQUENCY IDENTIFICATION** (**RFID**) cards for device operation and a sealed envelope containing group assignments for randomization. The envelope was not opened until the information collection was completed. As a result, case assignment was hidden from the patients, the orthopedic surgeons who performed the tNMR treatment, and the radiologists who evaluated the MRI scans.

Methods

The study was designed as a Performance evaluation clinical study. This study includes all participants suffering from Lower Back discomfort who had been admitted to a tertiary health care hospital, from 2020-2023 (3 years of duration). A total of 50 patients (28 or 56 % were female and 22 or 44% were male) were examined and the mean age of the patients was noted at 41.42 ± 12.85. All the patients were diagnosed by doctors using clinical history, examination, X-Ray, and magnetic resonance imaging (MRI) of the Spine as

confirmatory cases of disc prolapse. 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, St.p. ICD-, insulin pumps, alcohol week after abuse, pregnancy, and lactation were excluded from the research.

At the beginning of the research, participants involved in the research were given brief details about all aspects of the research as well as a published information brochure about the treatment rest applied in the research and the participants signed a paper stating that he/she approved to be a part of the research following the Helsinki Declaration.[22]

Clinical examinations of each patient included evaluations of their neurological health. To assess morphological variations and record the location of ruptured discs, lumbar and cervical MRI images were examined.

Socio-demographic characteristics, the intensity of the pain, duration of the sickness before presence, and absence from work were all noted. Discomfort intensity was evaluated by the VAS[23] on a scale from 0 (absolutely no discomfort) to 10 (maximum pain).

Nine applications of the tNMR therapies within 9 consecutive days were performed, each with a duration of 1 hour per day in a nuclear magnetic resonance open-air coil system (**QRST - Quantum-bio Regenerative Stimulation Technology**). 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. A computer chip card is used to load the programmer into the appliance before the therapy even starts. Thus, the parts of the body that need to be treated can receive precise doses of tNMR Treatment with a predetermined nuclear magnetic resonance field in turn generating the suitable Radio Frequency (RF). The uncomfortable area of the participant spine was positioned into the coil of the QRST device with the appropriate part of the body as the participant lay comfortably on a couch. Post-therapy patients undergo spinal rehabilitation with posture correction, posture training, and appropriate spinal muscle exercises to be followed for the next six months.

At the time of admission to the rehabilitation clinic, each participant had a thorough clinical assessment. After that, significant clinical variables were assessed on Day 0 of the tNMR Study, After the conclusion of therapy, and three months after the end of therapy. The points to be taken for assessment were A) the peak level of discomfort, B) the mean level of discomfort while moving, and C) the level of discomfort at rest. The 10-part Visual Analogue Scale (VAS) was employed for the assessment.

For the estimation of the disability caused by chronic lower back pain, the Oswestry Low Back Pain disablement Questionnaire recommended by Fairbank et al[20] and the Roland Morris disability questionnaire[21] were used. This updated version of the validated clinical questionnaire for low back pain has 52 single items divided into 8 sections (Pain intensity, lifting of heavy objects, sitting, body care, standing, sleeping, walking, and mobility for travel). The survey is intended to provide a numerical assessment. The Oswestry Low Back Pain impairment Questionnaire)[20] and Roland Morris impairment questionnaire[21] were collected before the therapy, 3 months and 6 months after therapy.

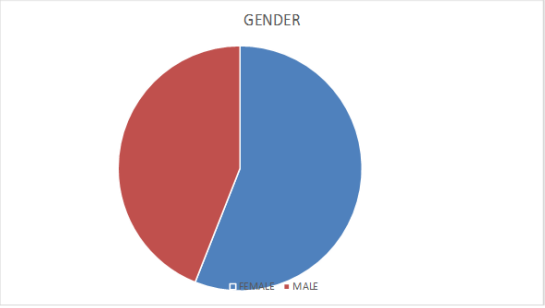
Statistical analysis

The statistical investigation was carried out using BM SPSS Statistics for Windows, version 22.0 (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. The Student's test and paired T-test were used for inter- and intra-group comparisons of quantitative variables, respectively. For comparisons among more than two groups, the ANOVA test for a single factor was used. A significance level of $p < 0.05$ was considered for all statistical inferences.

RESULT

Table 1: Gender distribution of cases.

Gender	Cases	Percentage
Female	28	56%
Male	22	44%
Total	50	100%

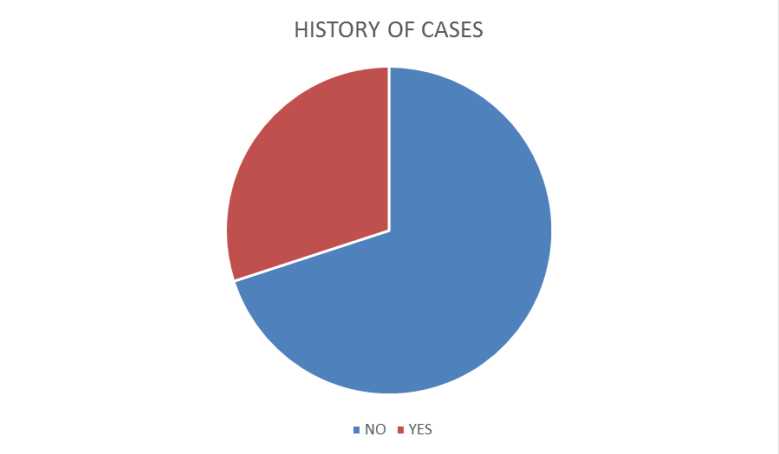


Graph-1: Gender distribution of cases.

The mean age of the study population were 41.42 ± 12.85 years. From the table we see that out of a total of 40 cases, 21, or 52.50% are female, and 19, or 47.50% are male.

Table-2: History of cases (similar past history).

Past History	Cases	Percentage
No	35	70%
Yes	15	30%
Total	50	100%



Graph 2: History of cases.

Table-2 demonstration that out of a total of 50 cases, 35, or 70% have no past medical history, and 15, or 30% have a past medical history.

Table 3: Scale of pain.

Scale of Pain	Mean ± SD	p-value
Before therapy	7.5 ± 1.51	<0.00001
After Therapy	0.35 ± 0.62	

The mean pain level was 7.5 with a standard deviation of 1.51, and after therapy, the mean pain level was 0.35 with a standard deviation of 0.62. The p-value is also provided and is less than 0.00001, indicating a statistically significant difference between the before and after therapy pain levels.

Table-4: Classification of current pain.

How do you classify your current pain	Before therapy Mean ± SD	3 months after Mean ± SD	P value
Top-level pain (acute pain)	7.15 ± 2.14	0.325 ± 0.61	<0.00001
Average pain at stress	7.5 ± 2.17	0.325 ± 0.61	<0.00001
Rest pain	5.475 ± 3.10	0.0 ± 0.0	0

For top-level pain (acute pain), the mean pain level significantly decreased from 7.15 before therapy to 0.325 after 3 months of therapy. This is supported by a very low p-value (<0.00001), indicating a statistically significant difference before and after therapy.

Similarly, for average pain at stress, there was a significant reduction from 7.5 before therapy to 0.325 after therapy, as supported by a very low p-value (<0.0001).

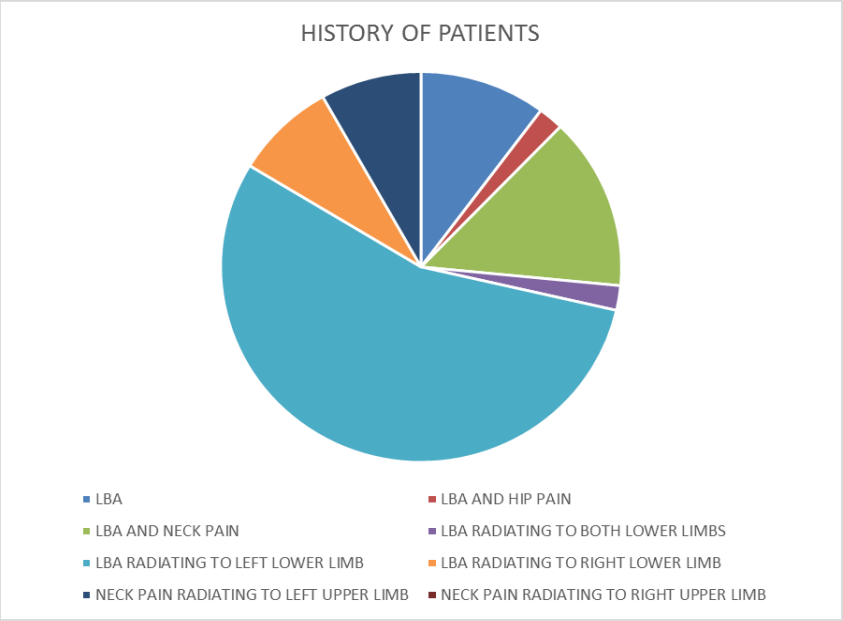
For rest pain, the mean pain level decreased from 5.475 before therapy to 0.0 after therapy, indicating a significant reduction in pain level. The p-value of 0 also supports this significant difference between the rest pain level before and after therapy.

Overall, the data presented in these tables suggest that the therapy used was effective in reducing different types of pain levels, including acute pain, average pain at stress, and rest pain.

Table-5: History of patients.

History	Cases	Percentage
LBA	5	10%
LBA AND HIP PAIN	1	2%
LBA AND NECK PAIN	7	14%
LBA RADIATING TO BOTH LOWER LIMBS	1	2%

LBA RADIATING TO THE LEFT LOWER LIMB	27	54%
LBA RADIATING TO THE RIGHT LOWER LIMB	4	8%
NECK PAIN RADIATING TO LEFT UPPER LIMB	4	8%
NECK RADIATING TO RIGHT UPPER LIMB	1	2%



Graph 5: History of patients.

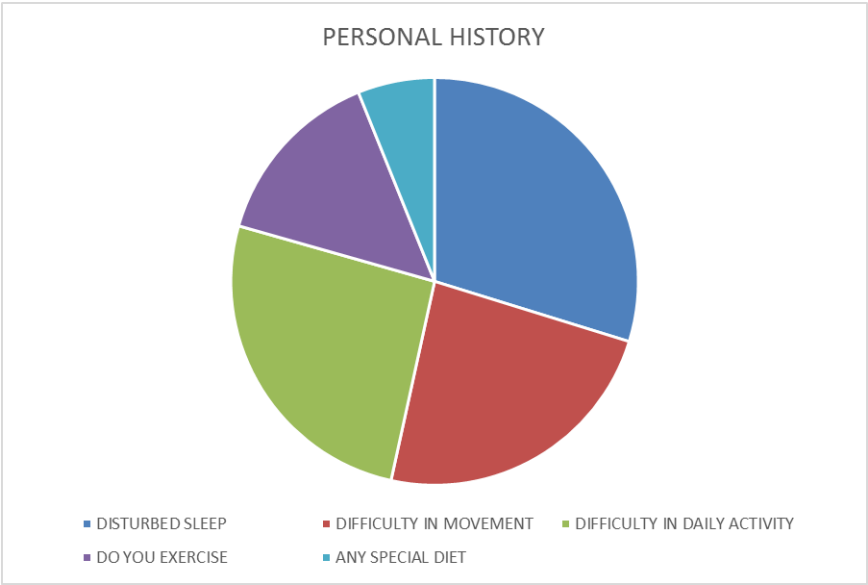
The table indicates that out of the total cases, 5 (10%) had pain in the lower back (LBA), 1 (2%) had both LBA and Hip pain, 7 (14%) had LBA and Neck pain, 1 (2%) had LBA radiating to Both Lower limbs, 27 (54%) had LBA radiating to the left lower limb, and 4 (8%) had LBA radiating to the right lower limb.

Additionally, the table shows that 4 (8%) had Neck discomfort Radiating to the Left Upper limb, and 1 (2%) had Neck discomfort Radiating to the Right Upper limb.

The most common type of discomfort reported was LBA radiating to the Left Lower limb, while the least common type of pain was Neck pain Radiating to the Right Upper limb.

Table 6: Personal History of patients.

Personal History	Cases	Percentage
Disturbed Sleep	39	78%
Difficulty in Movements	31	62%
Difficulty in daily activities	34	68%
Do you exercise	19	38%
Any Special Diet	8	16%



Graph 6: Personal History of patients.

The table provided shows the frequency distribution of personal history among the population or sample studied.

According to the table, 39 (78%) individuals reported having disturbed sleep, while the number of individuals 31 (62%) reported experiencing difficulty in movements. The number of individuals 34 (68%) also reported difficulty in performing daily activities.

In terms of exercise, only 19 (38%) individuals reported engaging in exercise, while 8 (16%) individuals reported following a special diet.

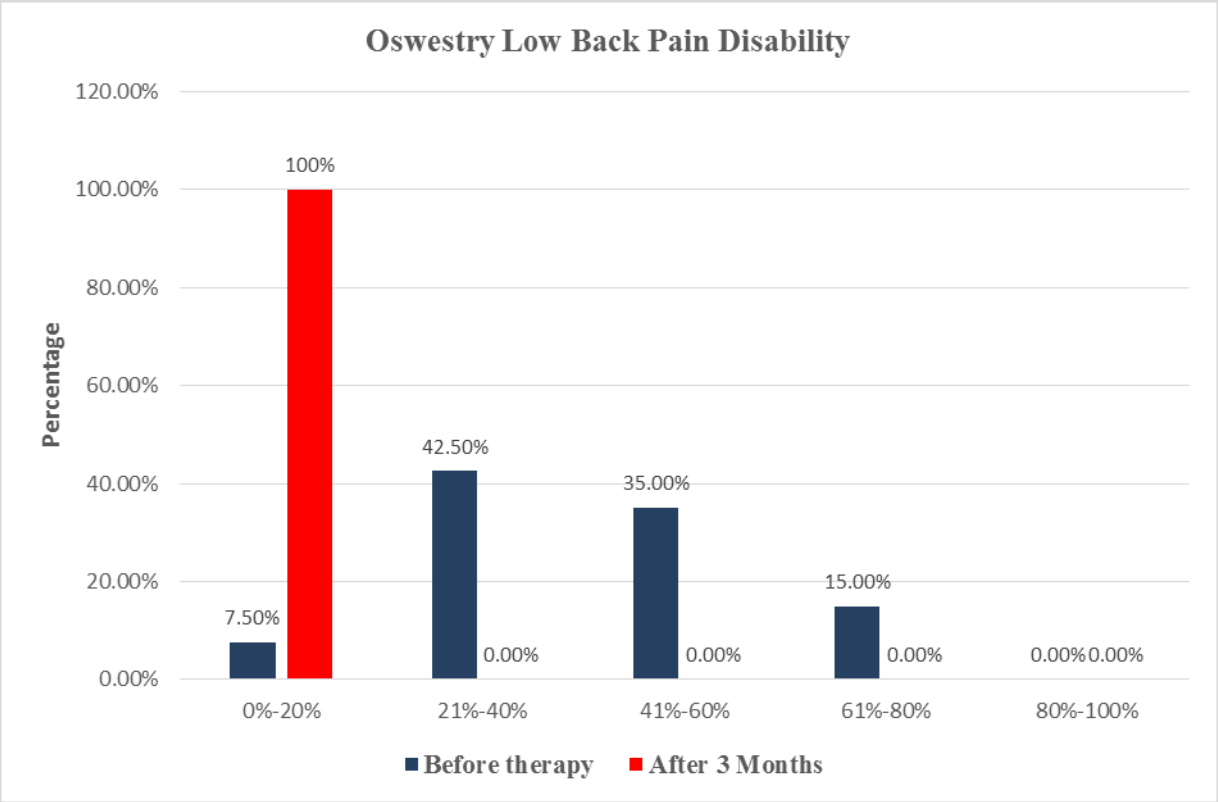
Overall, this table provides important information on the personal history of individuals in the population or sample studied.

Table-7: Roland-Morris Lower Back Discomfort and disablement.

Roland-Morris Lower Back Pain and Discomfort	Mean ± SD	F value	P value
Pre Therapy (score)	13.875 ± 5.80	142.4	<0.001
Post-therapy (3 months)	1.95 ± 3.59		
Post-therapy (6 months)	0.125 ± 0.56		

The results show that before therapy, the mean Roland-Morris Low Back Discomfort and disablement score was 13.875, with a standard deviation of 5.80. After therapy at 3 months, the mean score decreased significantly to 1.95, with a standard deviation of 3.59. After therapy at 6 months, the mean score decreased further to 0.125, with a standard deviation of 0.56.

The F-value of 142.4 and p-value of less than 0.001 suggest a statistically significant difference between the pre-therapy and post-therapy scores. This means that the therapy was effective in reducing the Roland-Morris Low Back Discomfort and Disability score in the population or sample studied.



Graph-7: Oswestry Low Back Pain Disability.

Before therapy, the majority of individuals (42.50%) had a score in the 21%-40% range, which indicates moderate disability. After 3 months of therapy, all individuals improved to the 0%-20% range, which indicates minimal disability. Additionally, 35.00% of individuals had a score in the 41%-60% range before therapy, indicating moderate to severe disability, but all improved to 0% after 3 months of therapy.

These results suggest that the therapy was effective in reducing the level of functional disability in participants with lower back discomfort, as measured by the Oswestry Lower Back Discomfort Disability score. The fact that all individuals improved to the minimal disability category after 3 months of therapy is a positive outcome.

DISCUSSION

The occurrence of lower back discomfort, or the percentage of people that experience discomfort from degenerative disc disease at some point in their life, is thought to range from 50 to 80%.[24,25] Because of the high frequency of low back pain, the health care system incurs significant expenditures, which play a significant role in the whole socio-medical context of our lives.[26] Nowadays, therapeutic outcomes are often assessed concerning back-specific function, discomfort, common fitness condition, adequacy, and overall patient contentment.[27] The Roland Morris disability questionnaire is the most common tool for assessing lower back pain patients' physical functionality.[28] It takes into account the intricate everyday routines. The questionnaire is also accessible in many languages, and it has been approved as a reliable tool for documenting patients with lower back pain functional levels in all languages. For assessing the effects of Lower Back Discomfort therapy for discomfort, incapacity, and physical advancement, the Roland & Morris questionnaire and the ten-part Visual Analogue Scale (VAS) are helpful.[29] One-third of patients receiving traditional physical treatment for persistent low back pain have improvements in pain and daily functioning, which amply indicates the need for alternative approaches in this area.

Cells can be stimulated by electromagnetic fields in response to changes in mechanical stress.[30] The electrical activity in cartilage tissue and connective tissue structures is a little more complicated than in bone tissue, but the above-discussed principle still holds. The transfer of electrical impulses to and from the tissue structures is induced by changes in tension within collagen structures brought on by variations in mechanical stress, and this has a favorable impact on metabolism.[31] It has been demonstrated that pulsing electromagnetic fields stimulate beneficial biological processes including cell growth and matrix synthesis.[32] A highly interesting and powerful new electrotherapy technique for repairing cartilage or cartilage-like structures is called nuclear magnetic resonance therapy.

tNMR is a brand-new, extremely technical therapeutic method, and because its mechanism of action was directly developed from nuclear resonance tomography, it cannot and should not be compared to or confused with PEMF or complicated PEMF.

The nuclear magnetic resonance therapy devices produce a three-dimensional radio frequency field and a static magnetic field, which together create a nuclear magnetic resonance field at the location of the target tissue. The cell biorhythm frequency in the nuclear resonance field is essentially amplitude modulated with a frequency that is related to the nuclear resonance frequency. The goal is to maximize actively directed resonant energy transmission while utilizing the least amount of field strength. A high-frequency nuclear magnetic resonance field deposits energy into cells, which may impact their metabolism and induce the production of certain proteins.[33]

According to the findings of our study on treatment options for patients with persistent lower back pain, significant functional gains can be analyzed using conventional rehabilitation techniques during inpatient rehabilitation, as determined by the Oswestry Lower Back discomfort impairment Questionnaire for lower back discomfort. The Roland & Morris global score improvement was maintained in patients who received nuclear magnetic resonance.

During the final three months of the assessment period, for instance, patients. It's also interesting to observe that after 5 days of finishing nuclear magnetic resonance therapy, there was a noticeable reduction in sleep issues brought on by low back pain and that improvement persisted for the whole three-month assessment period. Though, in respect of the enhancement of discomfort under pressure, a very different benefit had been detected in the participant that had been part of the active tNMR treatment. All those different benefit was to be detected throughout the complete observation. Above mention pointed towards a result through the modification of structures. Notably after a six month the amendment in structures was observed.

A post week of NMR therapy the discomfort such as weight relevancy has been reduced. That suggest the enhancement in the effect of quickly pain reliving. A similar finding was found in H. Salfinger et al[34] and W. Kullich et al study.[35]

CONCLUSIONS

Nuclear magnetic resonance therapy is a different supplemental treatment approach that is simple to use and just needs quick therapeutic procedures. A nuclear magnetic field can effectively boost therapeutic effectiveness in the **recovery** of individuals undergoing lower back discomfort, without unfavorable results. For the participants, the major consequence is the enhancement of day-to-day activities.

REFERENCE

1. Kroenke K, Krebs EE, Bair MJ. Pharmacotherapy of chronic pain: a synthesis of recommendations from systematic reviews. General hospital psychiatry, 2009; 31: 206–219. [PubMed: 19410099].
2. Buckwalter JA. Aging and degeneration of the human intervertebral disc. Spine (Phila Pa 1976), 1995; 20: 1307–1314. [PubMed: 7660243].
3. Boden SD, Davis DO, Dina TS, Patronas NJ, Wiesel SW. Abnormal magnetic-resonance scans of the lumbar spine in asymptomatic subjects. A prospective investigation. J Bone Joint Surg Am., 1990; 72: 403–408. [PubMed: 2312537]
4. Jensen MC, Brant-Zawadzki MN, Obuchowski N, Modic MT, Malkasian D, Ross JS. Magnetic

resonance imaging of the lumbar spine in people without back pain. N Engl J Med., 1994; 331: 69–73. [PubMed: 8208267]
5. Matsumoto M, Fujimura Y, Suzuki N, Nishi Y, Nakamura M, Yabe Y, Shiga H. MRI of cervical intervertebral discs in asymptomatic subjects. J Bone Joint Surg Br., 1998; 80: 19–24. [PubMed: 9460946]
6. Horton WC, Daftari TK. Which disc as visualized by magnetic resonance imaging is a source of pain? A correlation between magnetic resonance imaging and discography. Spine (Phila Pa 1976), 1992; 17: S164–171. [PubMed: 1385901]
7. Freemont AJ, Peacock TE, Goupille P, Hoyland JA, O'Brien J, Jayson MI. Nerve ingrowth into the diseased intervertebral disc in chronic back pain. Lancet, 1997; 350: 178–181. [PubMed: 9250186]
8. Tony K.Y. Lim et al, Evidence for a role of nerve injury in painful intervertebral disc degeneration: A cross-sectional proteomic analysis of human cerebrospinal fluid, J Pain. Author manuscript; available in PMC, 2018 October 01.
9. W. KULLICH et al. additional outcome improvement in the rehabilitation of chronic low back pain after nuclear resonance therapy. Povodna praca, 2006; 17-12.
10. Collacott, E.A., Zimmerman, J.T., White, D.W., Rindone, J.P.: Bipolar permanent magnets for the treatment of chronic low back pain: a pilot study. J Amer Med Ass, 2000; 283(10): 1322-1325.
11. Ammer, K.: Passive physikalische Maßnahmen beim chronischen unspezifischen Kreuzschmerz 45-49, In: Wagner, E., Ulreich, A. (Eds) Rehabilitation beim chronischen unspezifischen Kreuzschmerz. Wien, Manz Crossmedia, 2000.
12. Lipiello, L, Chakkalakal, D., Conolly, F.: Pulsing direct current induced repair of articular cartilage in rabbit osteochondral defects. J Orthop Res, 1990; 8: 266 275.
13. Rothschild, B.: Cartilage as a target organ in arthritis: New approaches. Compre Ther., 1996; 22(11): 727-730.
14. Sakal, A., Suzuki, K., Nakamura, T., Norimura, T., Tsuchiya, T.: Effects of elektromagnetic fields on cultured cartilage cells. Int Orthop, 1991; 15.
15. Klapsch, W.: MBST-Kernspinresonanztherapie. Therapieoption bei degenerativen und traumatischen Gelenksveränderungen. 27. Tagung der Österreichischen Gesellschaft für Orthopädie, Graz, 2003.
16. Froböse, I., Eckey, U., Reiser, M., Glaser, C., Englmeier, F., Assheuer, J., Breitgraf, G.: Evaluation der Effektivität dreidimensiona- ler pulsierender elektromagnetischer Felder der MultiBioSignal-Thera- pie (MBST) auf die Regeneration von Knorpelstrukturen. Orthopädische Praxis, 2000; 36(8): 510-515.
17. Artmann, A.T., Linder, P., Kayser, P., Digel, L. Artmann, G.M., Lucker, P: NMR In Vitro Effects on Proliferation, Apoptosis, and Viability of Human Chondrocytes and Osteoblasts. Methods Find Exp Clin Pharmacol, 2005; 27(0): 1-4.
18. Marks, R.A.: Spine fusion for discogenic low back pain: outcomes in patients treated with or without pulsed electromagnetic field stimulation. Adv Ther., 2000; 17(2): 57-67.
19. Di Massa, A., Misuriello, I., Olivieri, M.C., Rigato, M.: Pulsed magnetic fields. Observations in 353 patients suffering from chronic pain. Minerva Anestesiol, 1989; 55, 7-8, 295-299.
20. Fairbank, J.C.T., Couper, J., Davies, J.B., O'Brien, J.P.: The Oswestry low back pain questionnaire. Physiotherapy, 1980; 66: 271-273.
21. Wiesinger G, Nuhr M, Quittan M, Ebenbichler G, Wolfl G, FialaMoser V (1999) Crosscultural adaption of the Roland-Morris questionnaire for German-speaking patients with low back pain. Spine (Phila Pa., 1976; 24: 1099–1103.
22. World Medical Association General Assembly. Tokio 2004: World Medical Association Declaration Helsinki: ethical principles for medical research involving human subjects. Int Bioethique, 2004; 15(1): 124-129.
23. Funke F (2010) Internet-based measurement with visual analogue scales. An experimental investigation. Dissertation, Eberhard Karls Universita¨t Tu¨bingen.
24. B. Schreiber, U. Bandemer-Greulich. K. Uhlemann, K. Miller,J. Müller-Pfeil, A. Kreutzfeldt, E. Fikentscher and U. Bahrke, Treatment specificity in chronic low back pain: is opti- mized rehabilitation assignment enough? Rehabilitati, 2004; 43(3): 142-151.
25. A. Ulreich, Differentialdiagnose des Kreuzschmerzes, Arzt & Praxis, 1997; 51: 346-350.
26. W. Siegmeth, Epidemiologie und Risikofaktoren des chronis- chen Rückenschmerzes, in: Rehabilitation beim chronischen unspezifischen Kreuzschmerz, E. Wagner and A. Ulreich, eds.1211 Manz Crossmedia, Wien, 2003; 11-19.
27. C. Bombardier, J. Hayden and D.E. Beaton, Minimal clinically important difference. Low back pain: outcome measures. J Rheumatol, 2001; 28: 431-438.
28. G.F. Wiesinger, M. Nuhr, M. Quittan, G. Ebenbichler, G. Wolf! and V. Fialka-Moser, Cross-cultural adaptation of the Roland- Morris questionnaire for German-speaking patients with low back pain, Spine, 1999; 24(11): 1099-1103.
29. LH. Pengel, K.M. Refshauge and CG Maher, Responsive- ness of pain, disability, and physical impairment outcomes in patients with low back pain, Spine, 2004; 29(8): 879-81.
30. M. Nagai and M. Ora. Pulsating elektromagnetic field stimu lates mRNA expression of bone morphogenetic protein-2 and 4. J Dent Res., 1994; 7310: 1601-1605.
31. B. Rothschild. Cartilage as a target organ in arthritis: New approaches, Compre Ther., 1996; 22(11): 727-730.

32. A. Sakai, K. Suzuki, T. Nakamura, T. Norimura and T. Tsuchiya, Effects of elektromagnetic fields on cultured carti- lage cells, Int Orthop, 1991; 15.
33. L Lipiello, D. Chakkalakal and F. Conolly. Pulsing direct current-induced repair of articular cartilage in rabbit osteo- chondral defects, J Orthop Res., 1990; 8: 266-275.
34. H. Salfinger. J. Hahne. J. Holzapfel. M. Friedrich. Nuclear magnetic resonance therapy in lumbar disc herniation with lumbar radicular syndrome: effects of the intervention on pain intensity, health-related quality of life, disease-related disability, consumption of pain medication, duration of sick leave and MRI analysis. Eur Spine J., 2015; 24: 1296–1308.
35. W. Kullicha, J. Overbeckb and H.U. Spiegelc. One-year-survey with multicenter data of more than 4,500 patients with degenerative rheumatic diseases treated with therapeutic nuclear magnetic resonance. Journal of Back and Musculoskeletal Rehabilitation, 2013; 26: 93–104. DOI 10.3233/BMR-2012-00362