



Efficacy of Ozone Neucleoplasty against Physiotherapy in Cases of Chronic Discogenic Low Back Pain

Authors

**Dr Sourav Iswarari¹, Dr Dibyendu Das², Dr Mouli Madhav Ghatak³,
Dr Susanta Kumar Gauri⁴, Dr Jayanta Kumar Rout⁵**

¹MBBS, MD (PM&R), Associate Professor, Department of Physical Medicine and Rehabilitation, R. G. Kar Medical College and Hospital, Kolkata (West Bengal) -700004, India

²MBBS, MD (PM&R), Associate Professor, Department of Physical Medicine and Rehabilitation, Burdwan Medical College, Bardhaman (West Bengal), India

³MBBS, MD (PM&R) Associate Professor, Consultant and Director of PM&R Department, TRA Hospital, Kolkata (West Bengal), India

⁴B. Tech (Textile Technology), M. Tech (Quality Reliability and Operations Research), PhD, Statistical Quality Control and Operations Research, Indian Statistical Institute, Kolkata- 700108

⁵MBBS, MD (Biochemistry), Assistant Professor, Department of Biochemistry, R. G. Kar Medical College and Hospital, Kolkata (West Bengal) -700004, India

ABSTRACT

Objectives: Efficacy of ozone nucleoplasty against physiotherapy in cases of chronic discogenic low back pain.

Methods: This is an open level prospective study, involving patients with chronic low back pain of more than 6 weeks. On diagnosis made by imaging and clinics as per published protocol we selected 383 consecutive patients for ozone nucleoplasty whereas consecutive 145 patients were enrolled for physiotherapy. Only 283 and 56 patients completed ozone Neucleoplasty and physiotherapy studies in NRSMC&H and TRA Hospitals respectively. Ozone Neucleoplasty had 49.12% female, 50.88% male with 51.78% female and 48.21% male patients undergoing physiotherapy. Pre treatment assessments were done and followed up at 3 weeks, 3 months and 6 months in 10 point VAS & ODI scales. Results were analyzed to see the effect of treatment on the selected cohort.

For both the treatments, the average VAS scores reduce substantially after 3rd week after which it plateaus off, paired t-test were applied at said time points, statistically significant reduction of VAS & ODI scores were observed at 3 weeks but reduction was not significant when we paired VAS at 3week and 3month, 3 month and 6 month. It is noted that 59.36% of the patients undergoing Neucleoplasty experience excellent reduction in VAS score whereas only 3.57% of the patients undergoing physiotherapy experience excellent reduction ($\geq 50\%$) in VAS score after 3 weeks. Most of the patients (48.21%) under physiotherapy achieve only nominal improvement after 3 weeks in terms of reduction of VAS score. The results of χ^2 (chi-square) test show that the amount of reduction of VAS score depends on the type of treatment given to a patient. However, effectiveness of treatment modalities does not depend on age or gender variable.

Conclusion: Both Neucleoplasty and physiotherapy helps in reducing pain and disability scores significantly, but Neucleoplasty emerged as the better treatment option. Both the treatment were found independent of age and sex variable.

Keywords: Chronic, discogenic, low back pain, ozone, nucleoplasty, physiotherapy.

Introduction

Chronic low back pain is the second most common cause of visit to a physician ⁽¹⁻²⁾. Experimental studies suggest that low back pain may originate from many spinal structures ⁽³⁻⁵⁾. One of the commonest site of affection is the intervertebral disks. However, 85% of patients with isolated low back pain cannot be given a precise patho-anatomical diagnosis ⁽⁵⁻⁶⁾. The association between symptoms and imaging is also weak ^(1-2, 5-6). There have been evidences of excessive imaging and surgery for low back pain. Many experts opine that the problem is “over medicalized” ⁽⁴⁻⁶⁾.

Neucleolysis or Neucleoplasty is a technique used to achieve disc decompression. Conventional spinal surgeries stand on the pillar of assumption that the entire problem is mechanical compression. This overlooks the neuro-inflammatory and vascular components which can be the cause of chronic pain. A few recent papers ⁽⁷⁻⁹⁾ reveals role of ozone in inflammatory, vascular as well as compressive factors which are responsible for pain. Although studies of effect of ozone Neucleoplasty and physiotherapy separately on low back pain has proven to be effective in chronic low back pain ⁽⁷⁻¹⁵⁾, we did not come across any data evaluating both the approaches in a single study.

Methodology

It was decided to carry out an open label prospective study over a period of three years at two centres - 1) Physical Medicine & Rehabilitation (PM&R), Nilratan Sirkar Medical College & Hospital (NRSMC&H), Kolkata, West Bengal, India and 2) TRA Hospital, Medical Rehabilitation Centre, Kolkata, West Bengal, India. The investigations were carried out by the same set of investigators. After obtaining permission from the ethical committee and investigational review board, the study was carried out during November 2009 to November 2012 at the two centres.

Inclusion criteria

Patients satisfying the following criterion were considered to be eligible for participation in the clinical trials under the planned study:

- a) Adults of age between 18-75 years
- b) Low back pain > 6 weeks
- c) Radiculopathy \geq 6 weeks
- d) Neural claudication \geq 6 weeks

Exclusion criteria

Patients with the following medical conditions were considered to be excluded from the clinical trials under the planned study.

- a) Red Flag Cases ⁽¹⁵⁾ as established in our protocol described in section 2.3
- b) WADDEL signs ⁽¹⁶⁾ \geq 3
- c) Vascular Claudication
- d) Those that have Fear avoidance ⁽¹⁷⁾ established as the cause of pain
- e) Those with other systemic, psychiatric or neurological diseases
- f) Pain arising from other spinal structure.

Protocol

We applied the protocol institutionalized in NRSMC&H by dept of PM&R for chronic low back pain ⁽¹⁸⁾. The arms of the protocol are as follows.

Part I: Screening by red flag questionnaires and the inclusion and exclusion criteria.

Part II: A battery of clinical test performed.

Part III: MRI was done for image based diagnosis.

Part IV: A discometry performed with 4 cc of non ionic contrast in cases where the image based diagnosis on MRI matched clinical diagnosis. However those receiving physiotherapy invasive discometry was not done, they directly proceeded to physiotherapy on match of clinical and imaging diagnosis.

Part V: For positive discometry cases ozone Neucleoplasty was done.

Treatment Procedures

Ozone Neucleoplasty

These procedures were performed under fluroscopic guide. It was done under conscious

sedation with midazolam. Intra venous access was done.

The patient position was prone. Intervening area was draped and dressed aseptically. Under an oblique fluroscopic view a 23 G, spinal needle was gun barreled down to the disc under local anesthesia. The point of entry was just lateral to the “Scotty dog’s ear” in oblique view. A discogram and discometry is done, on positive confirmation we injected 3-7 ml of oxygen-ozone mixture at a concentration of 29-32 mc/ml in the disc by ozone resistant syringe over a period of 15-20 seconds. Patients were discharged after an hour of observation.

Physiotherapy

The physiotherapeutic exercise regimen and rehabilitation consisted of aerobic conditioning exercise, core activation exercise and spinal mobilization in conformity with Mackenzie’s principle⁽¹⁹⁾.

The Study and the Collected Data

Before initiating any treatment, each patient was scored for pain by 10 point Visual Analog Scale (VAS) (the primary scale of the study)(20) as well as on Oswestry Disability Index (ODI) (the secondary measure of disability)⁽²¹⁾. These scores along with the age and sex of the patients were recorded in Excel sheet. Then, all the eligible patients in NRSMC&H were given ozone nucleoplasty and all the eligible patients in TRA Hospital were given the conventional

physiotherapy treatment. It may be noted that no blinding was done and the patient was fully informed about the type of intervention planned and written consent was taken up for the study. Since NRSMC&H is much bigger than TRA Hospital, inflow of patients in NRSMC&H is much higher than in TRA Hospital. In NRSMC&H, 383 patients were enrolled for ozone Neucleoplasty treatment whereas in TRA Hospital 145 patients were enrolled for Physiotherapy treatment. Each patient that had received a treatment was again interviewed after 3 weeks, 3 months and 6 months to assess the pain and disability level perceived by the patient on the same VAS and ODI scale.

During or after treatment sessions those patients who left any arm of treatment under study or opted for another mode of treatment within 6 months of starting treatment were considered out of the study. It was found that only 283 and 56 patients completed ozone Neucleoplasty and physiotherapy studies in NRSMC&H and TRA Hospital respectively. So the data collection sheet contained VAS and ODI scores of 339 patients, measured at four different time points including the pre-treatment stage.

It is found that patients undergoing ozone Neucleoplasty had 49.12% female patients and 50.88% male patients. On the other hand patients undergoing physiotherapy includes 51.78% female patients and 48.21% male patients. The other summary statistics of the patients under the two treatment groups are shown in Table1.

Table 1. Summary statistics of the patients in the two treatment groups for other parameters

| Parameters | NRS treatment (Ozone nucleoplasty) | | | | TRA treatment (Physiotherapy) | | | |
|-------------------------|---------------------------------------|------|-------|-------|----------------------------------|------|-------|-------|
| | Mean | Min | Max | SD* | Mean | Min | Max | SD |
| Age of patients (years) | 39.67 | 20 | 71 | 11.15 | 38.46 | 21 | 72 | 11.46 |
| Pre-treatment VAS score | 8.13 | 5.00 | 10.00 | 1.50 | 8.07 | 5.00 | 10.00 | 1.38 |
| Pre-treatment ODI score | 58.27 | 7.70 | 92.00 | 19.94 | 56.02 | 6.00 | 90.00 | 22.60 |

SD* implied standard deviation

It may be observed from Table 1 that the age of the included patients in both the treatment groups ranges from about 20 years to 72 years and the

overall average age of the patients is about 39 years. This is in agreement with the existing knowledge about the ages when the people usually

experiences low back pain ⁽²²⁾. It is further noted that the patients included in the two treatment groups are also well matched with respect to pre-treatment VAS score as well as pre-treatment ODI score. In addition, both the study centres are located in the same city which implies that the patients in the two treatment groups are exposed to the same socio-economic, cultural and other backgrounds/factors. Therefore, the treatment effects in the two groups of patients are well comparable.

Analysis and Results

Table 2 shows the summary statistics of VAS score at different time points for the patients given NRS and TRA treatments. It is observed from

Table 2 that under both the treatments, SD of VAS scores at pre-treatment stage is considerably less than the SD of VAS scores at the subsequent time points. Pain perception was reduced after the subsequent treatments were delivered. Several past investigators ⁽¹⁰⁻¹⁴⁾ had also noted the same thing. On the other hand, it is observed that under both the treatments, the average VAS scores reduce substantially after 3rd week, which are in agreement with the findings of Muto and Avella ⁽¹⁰⁾ and Das et al ⁽¹¹⁾. But afterwards the reduction in VAS score plateaus off. The plots of average VAS score at different time points (see Fig. 1) for the two treatments reveal that the reduction in VAS score is much greater in case of NRS treatment than the physiotherapy treatment.

Table 2. Summary of VAS score of the patients undergoing NRS and TRA treatments

| Statistics | Pre-treatment | | After 3 weeks | | After 3 months | | After 6 months | |
|------------|---------------|------|---------------|------|----------------|------|----------------|------|
| | NRS | TRA | NRS | TRA | NRS | TRA | NRS | TRA |
| Mean | 8.13 | 8.07 | 4.10 | 6.93 | 4.08 | 6.49 | 3.96 | 6.03 |
| SD | 1.50 | 1.38 | 2.28 | 1.56 | 2.19 | 2.16 | 2.51 | 2.07 |

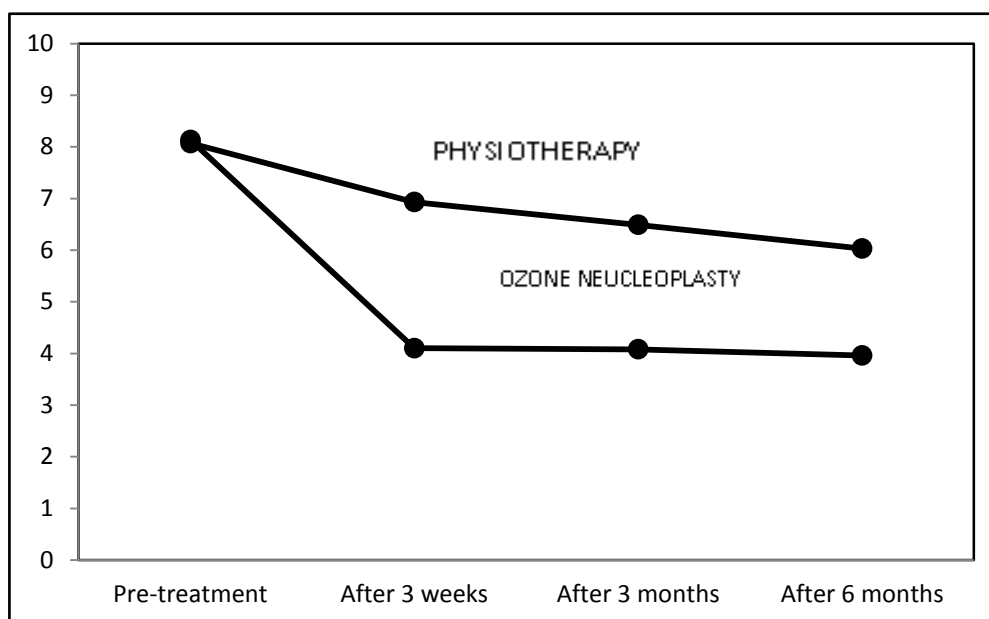


Fig. 1. Average VAS score at different time points under NRS and TRA treatments

The summary statistics of ODI score for the patients under the two treatment groups are given in Table 3. Fig. 2 shows the changes of the average ODI values over different time points for the patients under the two treatment groups. Comparison of Fig. 1 and Fig. 2 reveals that the

patterns of reduction of VAS score and ODI score over the time are very similar.

Table 3. Summary of ‘ODI score’ of the patients given NRS and TRA treatments

| Statistics | Pre-treatment | | After 3 weeks | | After 3 months | | After 6 months | |
|------------|---------------|-------|---------------|-------|----------------|-------|----------------|-------|
| | NRS | TRA | NRS | TRA | NRS | TRA | NRS | TRA |
| Mean | 58.27 | 56.02 | 30.08 | 49.07 | 29.42 | 43.54 | 29.95 | 37.14 |
| SD | 19.94 | 22.60 | 20.50 | 22.06 | 18.63 | 23.70 | 19.57 | 22.17 |

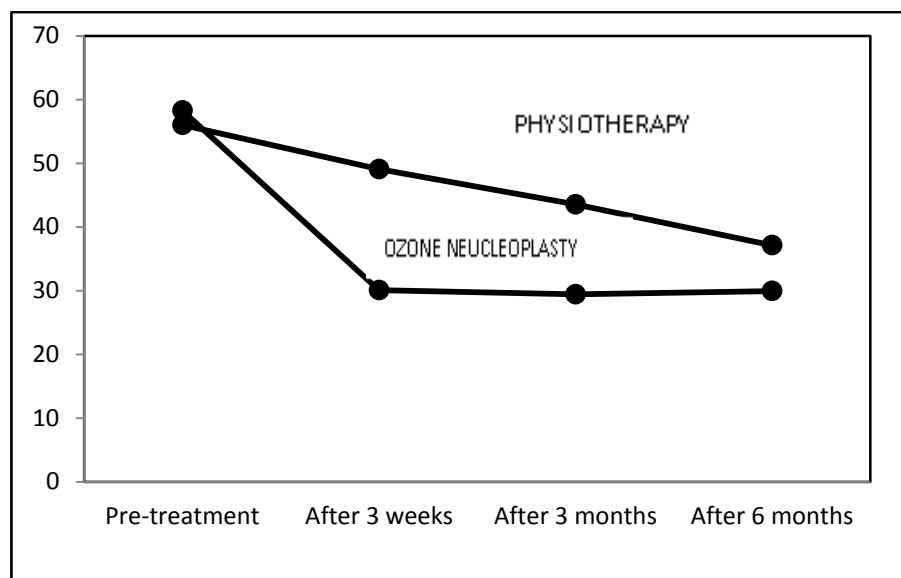


Fig. 2. Average ODI score at different time points under NRS and TRA treatments

With the aim to understand if the reductions in VAS or ODI scores at the successive time points are statistically significant or not, a number of paired *t*-tests⁽²³⁾ are carried out. All the tests are carried out at 1% level of significance. Based on the results of these statistical tests, it is concluded that i) For the patients undergoing ozone nucleoplasty, the pain reduces substantially after 3 weeks but then it stabilize, and ii) For the patients undergoing physiotherapy, the pain reduces maximum after 3 weeks and it continue to reduce further throughout the 6 months period. However, average VAS score after 6 months for the patients undergoing ozone nucleoplasty remained substantially higher than the average VAS score of the patients undergoing ozone nucleoplasty. This implies that total reduction of pain level achieved by physiotherapy over 6 months period is lesser than the reduction of pain level that is achieved by ozone nucleoplasty treatment in a period of 3 weeks only.

With the aim to statistically evaluate and quantify the relative effectiveness of the two types of

treatments, the percent reductions in VAS score after the 3 weeks are stratified into five classes and then, overall 339 patients are cross classified by treatment (of two types) and percent reduction (of five classes). The cross classified patients are shown in Table 4. The figures in brackets in Table 4 are the percentage values. In order to understand if the reduction in VAS score truly depends on the treatment given to the patients, χ^2 (chi-square) test is carried out. The computed χ^2 value is found to be statistically significant at 1% level, which implies that the amount of reduction of VAS score truly depends on the type of treatment given to a patient and so the percentage values are comparable. It is noted that 59.36% of the patients undergoing NRS treatment experience excellent reduction in VAS score whereas only 3.57% of the patients undergoing TRA treatment experience excellent reduction in VAS score after 3 weeks. Most of the patients (48.21%) undergoing TRA treatment achieve only nominal improvement after 3 weeks in terms of reduction of VAS score.

Table 4. Cross classified patients w.r.t. treatment and reduction of VAS score after 3 weeks

| Treatment | Reduction of VAS score after 3 weeks | | | | | Total |
|-----------|--------------------------------------|-----------------|---------------|---------------|------------------|-------|
| | Worse (<0) | Nominal (0-20%) | Fair (20-35%) | Good (35-50%) | Excellent (>50%) | |
| NRS | 15 (5.30) | 24 (8.48) | 18 (6.36) | 58 (20.49) | 168 (59.36) | 283 |
| TRA | 9 (16.07) | 27 (48.21) | 15 (26.79) | 3 (5.36) | 2 (3.57) | 56 |
| Total | 24 | 51 | 34 | 60 | 170 | 339 |

Table 5 shows the percentage of patients falling in different classes after 6 months under the two types of treatments. It is noticed that in spite of continuous reduction of VAS score over 6 months period, only 19.64% of patients undergoing physiotherapy fall in 'Excellent' category, which is in agreement with the conclusion of Hayden et

al⁽¹⁴⁾. On the other hand, although there is no significant reduction of VAS scores after the 3 weeks, as high as 64.66% of patients undergoing ozone nucleoplasty fall in the 'Excellent' category after 6 months. This implies that ozone Neucleoplasty is certainly much more effective than the physiotherapy treatment.

Table 5. Percentage of patients in different classes after 6 months

| Treatment | Reduction of VAS score after 6 months | | | | |
|-----------|---------------------------------------|---------|-------|-------|-----------|
| | Worse | Nominal | Fair | Good | Excellent |
| NRS | 8.13 | 1.41 | 15.55 | 10.25 | 64.66 |
| TRA | 7.14 | 42.86 | 19.64 | 10.71 | 19.64 |

It is worth to mention here that the significant efficacy of ozone Neucleoplasty of our study is in very close conformity with the results of randomised controlled trials presented by Paoloni et al⁽²⁴⁾. Paoloni et al⁽²⁴⁾ have found that about 61 % of patients undergoing ozone nucleoplasty experienced complete pain relief. However, similar studies carried out by Zambello et al⁽²⁵⁾, Bonetti et al⁽²⁶⁾ and Gallucci et al⁽²⁷⁾ claim higher success of the ozone based treatment. One possible reason behind it may be that these researchers⁽²⁵⁻²⁷⁾ had used other interventions like local infiltration of nerve root and epidural space with ozone, anesthetics and steroids along with Neucleoplasty, whereas in the present study only ozone nucleoplasty was done.

The statistical significances of the effects of gender and age of patients on the effectiveness of a given treatment are studied further using χ^2 (chi-square) test. The results show that the effectiveness of no treatment depends neither on the gender nor on the age of the patients, which conflicts the findings of Oder et al⁽¹³⁾ that the patients younger than 50 years respond better to

ozone Neucleoplasty. However, there are recent reports⁽²⁸⁾ which suggest that VAS and ODI scores are insensitive in detecting differences between young and old patients.

Conclusion

Both Neucleoplasty and physiotherapy significantly helps in reducing pain and disability scores in chronic low back pain due to disc, and efficacies of both the treatments are independent of age and gender variable. Neucleoplasty however emerged as the better treatment option in regard to reducing pain and disability. Neucleoplasty was found to reduce the baseline pain and disability scores within 3 weeks of intervention where as physiotherapy took a protracted course to bring significant relief at 6 month which is significantly less than the score achieved at 3 week by ozone Neucleoplasty. Moreover significant improvement by ozone Neucleoplasty was maintained at 6 month post procedure suggesting long term relief.

References

1. Bocci. OZONE A New Medical Drug .2nd edition, Springer; 2010. Hart L.G, Deyo R.A, Cherkin D.C.: Physician office visits for low back pain :frequency, clinical evaluation and treatment patterns from U.S. national survey. Spine 1995;20:11-9.
2. Andersson G.B.J.: Epidemiologic features of chronic low back pain. Lancet 1993;354:581-5.
3. Frymoyer J.W.: Back pain and sciatica. N Engl J Med 1988; 318:291-300.
4. Bogduk N, McGurik B. : Causes and sources of chronic low back pain. In Bogduk N, McGurik B.(eds). Medical management of Acute and Chronic Low Back pain. An Evidence –Based Approach: Pain Research and Clinical Management , Vol 13, Amsterdam, Elsevier Science B V, 2002 : 115-26.
5. Bogduk N, McGurik B. : Causes and sources of chronic low back pain. In Bogduk N, McGurik B.(eds). Medical management of Acute and Chronic Low Back pain. An Evidence –Based Approach: Pain Research and Clinical Management , Vol 13, Amsterdam, Elsevier Science B V, 2002 : 127-38.
6. Konberg M.: Discography and magnetic resonance imaging in diagnosing of lumbar disc disruption. Spine 1989: 14: 1368-72.
7. Bernard T.N. Jr : Lumbar discography followed by computed tomography : Refining the diagnosis of low back pain. Spine 1991; 5: 690-707.
8. Andreula C F SL, Santis F. Minimally invasive oxygen-ozone therapy for lumbar disk herniation. Am J Neuroradiology 2003; 24:996-1000.
9. Editorial TNF-a blockade for herniated intervertebral disc-induced sciatica: a way forward at last? Rheumatology 2004;43:119–121
10. Muto M, Avella F. Percutaneous treatment of herniated lumbar disc by intradiscal oxygen-ozone injection. Interventional Neuroradiology. 1998;4:279–286.
11. G. Das, S. Ray, S. Ishwarari, M. Roy, P Ghosh. Ozone Nucleolysis for Management of Pain and Disability in Prolapsed Lumbar Intervertebral Disc. A Prospective Cohort Study. Interv Neuroradiol. 2009 September; 15(3): 330–334.
12. Muto M, Andreula C, Leonardi M. Treatment of herniated lumbar disc by intradiscal or intraforaminal oxygen-ozone (O₂-O₃) injection. J Neuroradiol. 2004; 31:183–189.
13. Oder B, Loewe M, Reissegger M, Lang W, Ilias W, Thurnher SA. CT-guided ozone/steroid therapy for the treatment of degenerative spinal disease: Effect of age, gender, disc pathology and multi-segmental changes. Neuroradiology 2008; 50:777-785.
14. Hayden J, van Tulder M, Malmivaara A, Koes B (2005). "Exercise therapy for treatment of non-specific low back pain." Cochrane Database Syst Rev (3)
15. Michael S. Wildstein, Eugene J. Carragee Firestein: Kelley's Textbook of Rheumatology. 7th ed, W. B. Saunders Company ;2005. Chapter 39 ,Low Back Pain; p 588-590.
16. Waddell, Gordon; John McCulloch, Ed Kummel, Robert Venner. Nonorganic Physical Signs in Low-Back Pain. Spine 1980; 5 (2): 117–125.
17. Gordon, Waddell, Mary Newtona, Iain Hendersona, Douglas Somervillea and Chris J. A Fear-Avoidance Beliefs Questionnaire (FABQ) and the role of fear-avoidance beliefs in chronic low back pain and disability .Main Pain Volume February 1993;52(2):157-168.
18. Sourav Iswarari, Ranen Kumar Ghatak, Sujit Narayan Nandi, Kiran Kumar Mukherjee, Abhijit Bandyopadhyay, Biplob Acharjee- Diagnosis and treatment of chronic low

- back pain by differential intervention of disc, nerve root, facet joint: an open level prospective study: NRS protocol. IJPMR (22) SEPTEMBER 2011, 5-18.
19. DeLisa, Joel A et.al- Physical Medicine & Rehabilitation: Principles and Practice, 4th Edition. Lippincott Williams & Wilkins 2005. Chapter 28, Low back pain :p 668-674.
 20. Gillian A. Hawker. Samira Mian. Tetyana Kendzerska.Melisa French-Measures of Adult Pain. Arthritis Care & Research November 2011; 63(S 11) ,240-252.
 21. Jeremy C. T. Fairbank,Paul B. Pynsent-The Oswestry Disability Index .Spine 2000 ;25 (22), 2940–2953.
 22. Andersson GBJ- The epidemiology of spinal disorders. In: Frymoyer JW, ed. The adult spine: principles and practice, 2nd ed. Philadelphia: Lippincott-Raven, 1997:93-141.
 23. Montgomery DC. Design and Analysis of Experiments, 5th edition, John Wiley & Sons, Inc, New York, 2000.
 24. Paoloni M DSL et.al-Intramuscular oxygen-ozone therapy in the treatment of acute back pain with lumbar disc herniation. Spine 2009;34:1337-1344.
 25. Zambello A, Fara B, Tabaracci G, Bianchi M. Epidural steroid injection vs paravertebral O2-O3 infiltration for symptomatic herniated disc refractory to conventional treatment: A prospective random ized study. Rivista di Neuroradiologia 2006;5:123-127.
 26. Bonetti M, Fontana A, Cotticelli B, Volta GD, Guindani M, Leonardi M. Intraforaminal O2-O3 versus periradicular steroidal infiltrations in lower back pain: Randomized controlled study. AJNR Am J Neuroradiol 2005; 26:996-1000.
 27. Gallucci M et.al-Sciatica: Treatment with intradiscal and intraforaminal injections of steroid and oxygen-ozone versus steroid only. Radiology 2007; 242:907-913.
 28. Yasuchika Aoki et al. -Evaluation of Nonspecific Low Back Pain Using a New Detailed Visual Analogue Scale for Patients in Motion, Standing, and Sitting: Characterizing Nonspecific Low Back Pain in Elderly Patients.Pain Research and Treatment Volume 2012 (2012), Article ID 680496.