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Cover: Lizard endemic to the rain forest of Puerto Rico  
(Photo by M. Bonetti)

# Percutaneous Treatment of Lumbar Disc Herniation by Oxygen-Ozone Injection

## A Clinical Study of 322 Cases

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**Key words:** oxygen-ozone, lumbar disc herniation, curative effect

**SUMMARY** – We studied the clinical effect of oxygen-ozone treatment of lumbar disc herniation. Oxygen-ozone was administered by percutaneous injection (35-yong/ml), 6-15 ml into the intralumbar disc, and a few patients needed re-injection 48 hours later. We treated 323 patients with 433 discs with a total effective rate of 77.7%. Treatment of lumbar disc herniation by oxygen-ozone was simple, safe and effective. With minimal trauma, oxygen-ozone not only oxidizes the proteoglycan in the nucleus, leading to its contraction, but also has an anti-inflammatory effect and alleviates pain. No complications of treatment have been encountered so far.

### Introduction

The application of ozone ( $O_2-O_3$ ) in the treatment in lumbar disc herniation is a therapy devised in Europe, but not yet widely used in clinical practice in China. Animal experiments<sup>1</sup> have confirmed the technical usefulness and safety of the treatment. The mechanism of the treatment is ozone oxidization of the proteoglycan in the nucleus, leading to its contraction, and at the same time ozone alleviates symptoms quickly<sup>3,5</sup>. We applied this technique in 600 patients with lumbar disc herniation two years ago, and 323 cases were followed up for three to 12 months.

### Material and Method

Of 323 cases with lumbar disc herniation, 185 patients were men, 138 women, 19-76 years old, mean age 46 years; the longest disease history was 22 years, the shortest five days. Clinical assessment: 97 cases had pain only in the lumbar spine; 158 cases had pain in lumbar spine with numbness in one or both legs; 68 cases had pain or numbness only in the legs. All patients underwent CT or

MRI scans. Of 323 cases, 11 were in L2-3, 41 in L3-4, 217 in L4-5, 193 in L5-S1. 41 cases involved three kinds of disc herniation for each patient, 177 cases involved two and 105 cases involved only 1.

**Apparatus:** Ozonizer (Shanxi RuiBo Corp. ROG-C2), X-ray machine with C type arm, ozone appropriation No. 6 needle.

**Operation methods:** In a sterile surgical operating room, the patient lies on the surgical bed face down with a cushion under the lower abdomen. After local anaesthesia, under the C type arm X-ray surveillance, the disc was punctured with the needle, keeping it 40-45° to the middle line of the body. The tip of the needle reached the middle of the disc, checking the point of needle position accuracy without error and injecting into density as 35- 45 µg/ml of combined air 6-15 ml including  $O_2-O_3$  and air, then withdrawing the needle to the fibrous ring and injecting 5-10 ml. The skin wound can be glued to seal after injection. After treatment, the patients were kept lying supine for four to six hours, and then told to rest in a firm bed for three days.

After the operation, patients should be given intravenous antibiotics, and 20% mannitol 250 ml, dexamethasone 5 mg for three days.

## Results

Short-term outcome: After injection of ozone, symptoms disappeared immediately at 17 cases (5.26%), according to the improvement of the symptoms and the Macnab standard, the effect can be divided into Excellent, Good, Satisfactory and Poor. The total effective rate was 60.05%.

Table 1

Cases improved in the first week immediately				
	1 day	3 days	7 days	
Excellent	17	41	76	91 (28.17%)
Good	29	64	87	103 (31.88%)
Satisfactory	96	101	83	66 (20.43%)
Poor	181	117	77	63 (19.50%)

Every patient had a file in the hospital, and was followed by phone for three to 12 months, the final results were assessed by Macnab curative effect standard: excellent: 127 cases (39.31%); Good: 124 cases (38.39%); Satisfactory: 49 cases (15.17%); Poor: 23 cases (12.69%); the total success rate was 77.7%.

The condition of the fibrous ring is closely related to the curative effect. The curative effect was significantly higher in the group with broken fibrous ring than in the unbroken ring group.

Table 2 Fibrous ring condition

	excellent	good	satisfactory	poor	total
Complete	97	71	17	6	191
Not complete	30	35	22	17	132

The curative effect of patients whose herniation was 30% of vertebral tube width or less was better than those above 30%.

Table 3 Fibrous ring condition

Degree of herniation	excellent	good	satisfactory	poor
Less or equal 30%	59	61	28	17
Above 30%	32	42	38	46

## Discussion

### Mechanism of therapy

1) *Oxidization of proteoglycan.* The normal nucleus consists of proteoglycan, collagen fibers and nucleus cells. The proteoglycan is one of the major components of the macromolecular material in the nucleus and the main factor maintaining the osmotic pressure and water in the nucleus. After the injection of ozone, the proteoglycan is oxidized directly<sup>2</sup>, and this is thought to destroy the amino acid and CH group in the proteoglycan complex, losing fixing charge density. Osmotic pressure then decreases and the water is lost<sup>6</sup>.

2) *Destruction of the nucleus cell.* Animal experiment<sup>1</sup> confirms that ozone can degenerate the cells, which are then lysed ending finally in death. The necrosis was more severe in the repeat-injection group.

3) *Anti-inflammatory effect.* Pressure on the spinal dura mater and blood vessels around the nerves caused by the lumbar disc herniation is thought to block the venous circulation leading to tissue edema. Meanwhile the herniation will release some chemical substance triggering an immune response. An asptic inflammation study<sup>3,4</sup> shows that ozone functions in the following ways: a) stimulating the over expression of anti-oxidized enzyme; b) stimulating the release of cell-reactive factors and immune-inhibitors; c) stimulating endothelial cells to release NO and PDGF to cause blood vessel dilation and improve the inflammation.

4) *Pain relief.* The herniation mechanically compresses the nerve root and stimulates nerves extensively distributed in the small joint, intervertebral disc surface and nearby tissues. At the same time the substance released by the herniation will sensitize the nerve and stimulate the muscles to spasm, causing pain in the lumbar spine or legs<sup>5</sup>. The ozone shrinks the herniation, releasing the pressure on the nerve and decreasing the inflammatory response with an alleviation of pain.

5) *Factors involved in the curative effect.* Published data showed<sup>7,8</sup> that the success rate of ozone in the treatment of lumbar disc herniation was around 76%. The success rate in our group was 77.7% consistent with literature reports. The factors related to the curative effect of the ozone treatment include general factors, such as choosing the indication before surgery; consistency between imaging features and clinical assessment; the technical level of the doctor; the standard of curative effect evaluation; the time of follow-up and the patient's mental state, etc. Our results suggest that the curative effect was closely related to the fibrous ring

condition. The curative effect was significantly higher in the group with a broken fibrous ring than in the unbroken ring group. This may be because ozone not only oxidizes the proteoglycan inside the disc, but also has anti-inflammatory functions, decreasing the inflammatory response and alleviating the pain. The larger the herniation, the harder the treatment.

### *Indications and contraindications*

**Indications:** Clinical performance is waist backache and/or neuralgia without severe nerve function impairment confirmed by CT or MR findings of mild or moderate disc herniation and consistent with the clinical position assessment; FBSS after surgery.

**Contraindications:** Lumbar disc herniation combined with severe nerve function impairment; severe stenosis of the vertebral canal; calcification in the herniation; herniation exceeding 30% of the vertebral canal; Free herniation inside the vertebral canal; with displacement of vertebrae; with surgical risk and mental disorder.

### *Complications and management*

As far as we know, there have been no serious complications. Only a few patients had mild pain in the lumbar spine or leg after the injection of ozone, which disappeared automatically in several

minutes without intervention. Only eight cases had mild respiratory impairment; dyspnea and cornea stimulates similar to the typical respiratory symptoms of allergy to ozone. These symptoms on leaving the ozone environment, inhaling oxygen and calming the patient. No nerve injury, infection or serious allergy occurred.

### *The advantage of ozone treatment*

This method not only has the same advantages as interventional therapy, such as minimal trauma, preservation of the normal configuration, few complications, very little pain, good success rate and rapid recovery, etc., but also has the following particular advantages: a) The ozone can not only decrease the pressure inside the disc and cause the contraction effectively, but also improves inflammation and alleviates pain. This is the advantage that other minimally invasive treatments do not offer. b) The ozone can strongly destroy the nucleus, but with no obvious negative effect on the surrounding tissues. As ozone is very instable, it is readily decomposed to become stable oxygen, and hence does not lead to pollution or damage tissues. c) The surgical method is simple, with no obvious injury or pain and minimal discomfort. The treatment can be performed at the outpatients' clinic. d) Ozone has the function of disinfection, thereby reducing disc infection after surgery. e) The equipment for ozone treatment is simple, and the technique can be easily grasped and diffused.

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