*Comparative Analysis*

# ULTRASOUND-GUIDED OXYGEN-OZONE THERAPY: A NOVEL APPROACH FOR MANAGING SPINAL PATHOLOGIES

C. Reverberi

Pain Therapy, Lazzaro Spallanzani Clinic, Reggio Emilia, Italy

**Correspondence to*:
Claudio Reverberi, MD
Pain Therapy,
Lazzaro Spallanzani Clinic,
Reggio Emilia, Italy
e-mail: c.reverberi@gmail.com

## ABSTRACT

This document presents an overview of oxygen-ozone ($O_2$-$O_3$) therapy for spinal pathologies, focusing on ultrasound-guided infiltration techniques. The ultrasound method appears to be suitable alongside traditional closed-sky, X-ray, and Computer Tomography (CT)-guided techniques due to its characteristics, such as the absence of ionizing radiation, enhanced specificity in targeting pain points, and a reduced number of required treatment sessions. The procedure entails detailed patient preparation, informed consent, and careful ultrasound guidance for infiltration at lumbar, cervical, and dorsal levels, along with considerations for potential complications and contraindications. Indications include zygapophyseal syndromes and extruded disc herniations. Overall, this therapeutic approach is positioned as a valuable option in treating spinal disorders, maximizing efficacy while minimizing risks.

**KEYWORDS**: *pain, therapy, oxygen, ozone, infiltration techniques, oxygen-ozone therapy, spine, disorders*

## INTRODUCTION

In addition to traditional closed-sky, X-ray, and Computed Tomography (CT)-guided techniques employed in paravertebral spinal ozone infiltration therapy (1-20), the ultrasound-guided method warrants particular attention due to its evolving role in contemporary clinical practice (21-26).

This article intends to delineate the authors' experiences in applying oxygen-ozone therapy for the management of spinal pathologies. The objective of this document is to conduct a comparative analysis of the various protocols and procedures that have been established within this domain.

By engaging with existing methodologies, practitioners may critically evaluate and enhance their clinical approaches, informed by empirical evidence and the latest advancements in the field. Such examination not only contributes to the state of the art in spinal therapy but also fosters the optimization of patient outcomes through more refined and targeted treatment strategies. The main peculiarities of this method are as follows:

1. absence of exposure of the operator and patient to ionizing radiation;
2. possibility of performing paraforaminal infiltrations (especially at the lumbar level) and zygapophyseal infiltrations;
3. reduction in the number of sessions required due to the greater specificity and precision of the infiltrations compared to classic paravertebral intramuscular injections (a maximum of 2-3 infiltrations required for facet syndromes).

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**INFILTRATIVE TECHNIQUE**

Upon securing comprehensive informed consent from the patient, steps are undertaken to proceed with the infiltrative technique.

*Lumbar and lumbosacral level*

The patient is placed in the prone position, and a thorough disinfection of the skin in the area to be treated is performed. A 2-4 MHz curved probe is used, protected with an appropriate transparent sterile probe cover. In the longitudinal section, the spinous processes are counted in a caudo-cranial direction starting from the posterior margin of the sacral profile (Fig. 1).

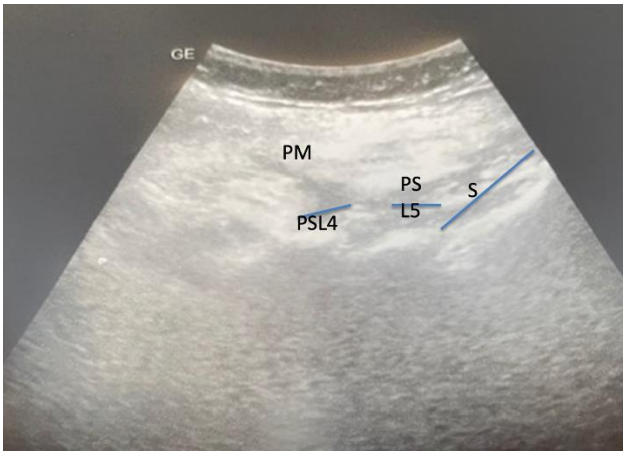


**Fig. 1**. *Sacral (**S**); spinal process L5 (**PS L5**); spinal process L4 (**PS L4**); paravertebral muscle (**PM**).*

Once the spinous process of the level to be treated has been reached, the probe is rotated on the transverse plane, and the profile of the vertebra with the central spinous process, laminae, zygapophyseal joints, and transverse processes appears (Fig. 2).

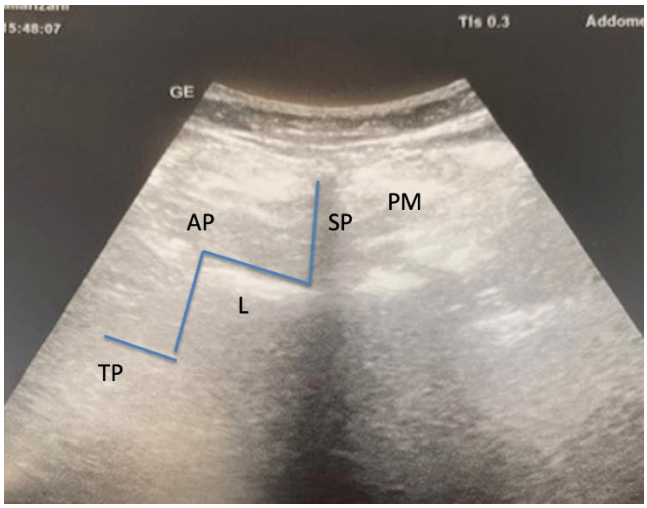


**Fig. 2**. *Spinal process (**SP**); lamina (**l**); articular process (**AP**); transverse process (**TP**); paravertebral muscle (**PM**).*

An eco-reflective needle (21-22 G, 100-120 mm) is introduced laterally to the probe and directed with a lateral-medial inclination of 15-20° under ultrasound guidance at the joint, transverse, or paraforaminal level depending on the pathology to be treated. Once the correct position of the needle has been documented with a photo (Fig. 3), 5 ml of a concentrated oxygen-ozone ($O_2$-$O_3$) mixture (20 mcg/ml) is infused (mono or bilaterally) at a deep level, after aspiration, and 5 ml of the same mixture on a paravertebral intramuscular level after retracting the needle by 3-5 cm. At the end of

the procedure, the needles are removed and the area is kept compressed for 30-60 seconds. The expansion of the gas can cause transient lumbar pain, potentially radiating to the groin or abdomen and more rarely to the lower limbs; the patient must be informed of this before the procedure.

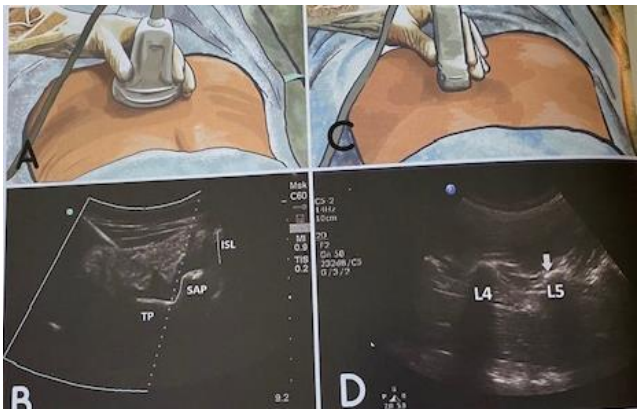


**Fig. 3**. *Needle (**N**); transverse process (**TP**); superior articular process (**SAP**); intra spinal ligament (**ISL**).*

The patient is then placed in a sitting position, after which he is placed in an upright position and after approximately 10 minutes of observation, discharged from the outpatient setting. The procedure can be repeated for three sessions spaced 7-10 days apart.

*Cervical level*

After obtaining adequate written consent as specified above, the patient is placed in a prone position with a pillow under the chest, hyperflexing the head with hands crossed under the forehead. A 5-7 MHz linear probe, protected by an appropriate sterile probe cover, is used to count the spinous processes in a cranio-caudal direction from C1 to C7 (Fig. 4).

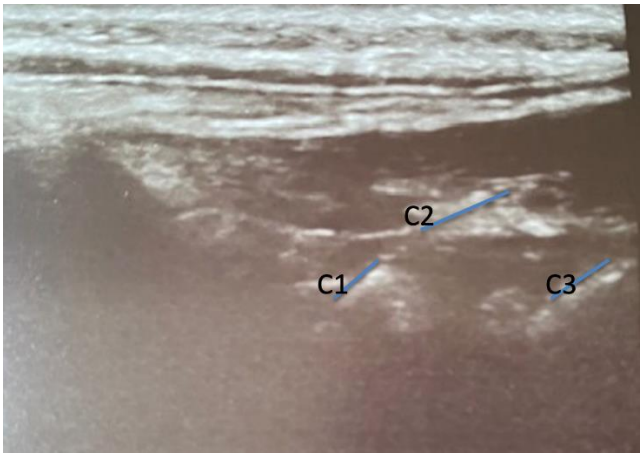


**Fig. 4**. *Spinal process C1-C2-C3.*

Once the level to be treated has been identified, the probe is placed in a cross-section to visualize the central spinous process, the two lateral laminae, and the horizontal articular processes (Fig. 5).

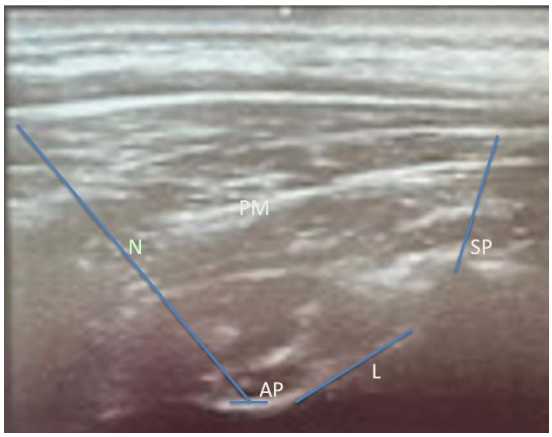


**Fig. 5**. *needle (**N**); articular process (**AP**); lamina (**L**); spinal process (**SP**); paravertebral muscle (**PM**).*

A 22 G L 50 mm echo-reflecting needle is inserted into the side of the probe and, under ultrasound guidance, is advanced in the muscular plane with a 10-15° inclination towards the articular process (seeking bone contact and documenting the correct position of the needle with photos) (Fig. 6).

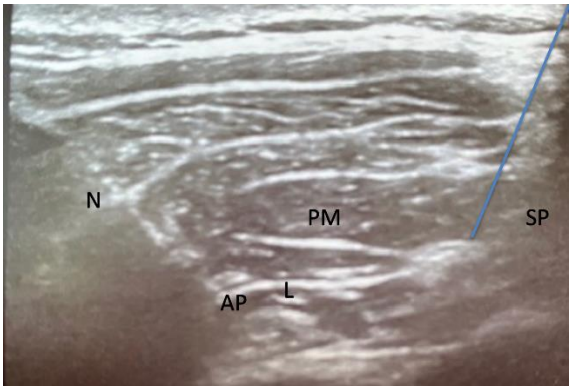


**Fig. 6**. *Needle (**N**); articular process (**AP**); lamina (**L**); spinal process (**SP**); paracervical muscle (**PM**).*

A second possible technique is the paravertebral one. Still using a 5-7 MHz linear probe in the longitudinal section, the spinous processes are highlighted, followed by placing the probe in the paravertebral position until the articular processes (convexity) and the intervertebral foramina (concavity) are highlighted (Fig. 7).

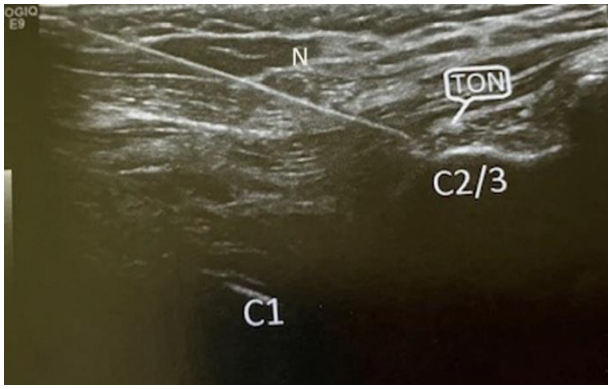


**Fig. 7**. *Needle (**N**); articular process (**C1, C2/3**); third occipital nerve (**TON**).*

Intra-articular processes from C2-C3 to C6-C7 are counted, and the level to be treated is identified. The needle is positioned (inserted in a cranio-caudal direction) on the caudal margin of the joint convexity, always seeking bone

contact (Fig. 8). At this point, 5 ml of a gaseous $O_2$-$O_3$ mixture (concentration 15 mcg/ml) is infused mono or bilaterally; 3 ml is injected at the joint plane, and 2 ml at the intramuscular plane after retracting the needle by 2-3 cm.

For zygapophyseal syndrome at the single-level cervical, the closed technique is more suitable in cases of cervicalgia due to cervicouncoarthrosis, as it is simpler and less burdened by side effects. An ultrasound-guided technique with 3 sessions spaced 7-10 days apart is often sufficient.

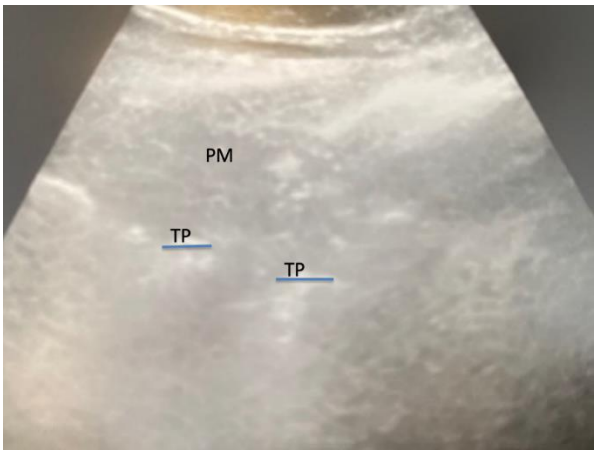


**Fig. 8**. *transverse process (**TP**); paravertebral muscle (**PM**).*

*Dorsal level*

After obtaining adequate written consent, the patient is positioned prone, with a cushion placed at the epigastric level to accentuate physiological dorsal kyphosis. Back pain localized to one segment may be due to a MID (Minor Intervertebral Disorder) or, less frequently, to zygapophyseal arthrosis or an extruded herniated disc. Therefore, it is essential, at the lumbar and cervical levels, to evaluate MRI for correct diagnosis.

Once the point to be treated has been identified and marked (often unilateral), a 5-7 MHz linear probe is positioned in the transverse plane to visualize the spinous process, laminae, zygoapophyseal processes, and costo-transverse joints (Fig. 9).

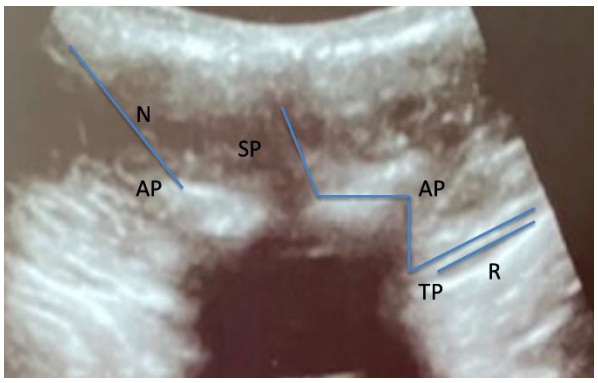


**Fig. 9**. *spinal process (**SP**); articular process (**AP**); transverse process (**TP**); rib (**R**); needle (**N**).*

The 21 or 22 G L 50-70 mm needle is inserted laterally to the probe and, with a 10-15° inclination, is directed to the lateral angle of the vertebral profile, the site of the zygoapophyseal joint, looking for bone contact and documenting the position of the needle (Fig. 9).

Then, 5 ml of $O_2$-$O_3$ gas mixture (concentration 15 mcg/ml) is infused: 3 ml on the joint plane and 2 ml on the paravertebral intramuscular plane, after retracting the needle by 2-3 cm, depending on the type of patient.

Ultrasound-guided dorsal infiltrations are particularly indicated, as noted earlier, in cases of DIM or facet syndrome at a single level or extruded disc herniations with intercostal neuritis. In the case of diffuse, multilevel, and bilateral back pain, the closed technique is more suitable due to fewer side effects.

*Indications and advantages of ultrasound-guided techniques*

As previously mentioned, ultrasound-guided ozone infiltration techniques are particularly indicated in treating extruded disc herniation and vertebral zygoapophyseal syndrome. In these cases, they can represent a valid alternative to closed-air and X-ray or CT-guided techniques, even if these latter two remain the most effective for the treatments mentioned above.

A significant advantage of ultrasound-guided techniques is the patient's non-exposure to ionizing radiation. Compared to closed-air techniques, the needle is placed closer to the area to be treated (intra-articular and paraforaminal), which should increase the therapeutic efficacy of the ozone while reducing the number of sessions required.

## DISCUSSION

The combination of oxygen-ozone therapy and ultrasound-guided infiltration represents a contemporary approach allowing precise intervention in various spinal pathologies. Compared to traditional methods, this technique provides advantages regarding safety and patient comfort. The reduced exposure to ionizing radiation and greater specificity in infiltrating target areas can potentially lead to better clinical outcomes, including reduced pain and fewer repeat procedures.

This article aims to demonstrate that the choice of technique can affect patient safety and treatment efficiency. By comparing different protocols, practitioners can gain insights into their effectiveness, optimize their practices, and enhance patient care.

## CONCLUSIONS

Ultrasound-guided ozone infiltration techniques are the middle ground between closed-sky methods and guided X-ray and CT techniques. They are particularly indicated in treating facet syndromes and vertebral extruded disc herniation compared to classic paravertebral intramuscular injections.

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