Case Report

WHOLE BLOOD OZONATED WITH PROCAINE. A CASE REPORT ON ULNAR NERVE DISLOCATION

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ABSTRACT

Ulnar nerve dislocation is a complex and challenging condition characterized by the displacement of the ulnar nerve from its anatomical position in the epitrochleo-olecranon groove. This condition can lead to pain, a “snapping elbow” sensation, and, in more advanced cases, sensory and motor deficits. Among the innovative therapeutic options, Platelet-Rich Plasma (PRP) has shown promise in promoting healing and alleviating symptoms. However, the high cost and limited accessibility of PRP pose a barrier for many patients. An alternative therapeutic approach involves mixing ozonated whole blood with procaine, which combines the inflammatory effects of whole blood with the anti-inflammatory effects of oxygen-ozone therapy and procaine. This study is based on a case report of a single patient with a dislocated right elbow ulnar nerve. The solution was prepared by mixing 9 mL of whole blood, 1 mL of procaine (10 mg/mL), and 9 mL of oxygen-ozone (20 gamma) in two 20 mL syringes connected to a three-way system. The infiltration was performed without ultrasound guidance, following the guidelines and best clinical practices of the New Italian Oxygen-Ozone Federation (Nuova FIO). A single infiltration of ozonated whole blood with procaine yielded clinically and ultrasonographically significant results as early as the first week. The patient's subjective "discomfort" correlated with objective observations of a tendency toward ulnar nerve subluxation during dynamic ultrasound maneuvers. Magnetic resonance imaging performed approximately three months post-treatment revealed a thickened, taut Osborne ligament in continuity with a thin fibrous scar tissue on STIR sequences. Although a single infiltration and prolonged immobilization for approximately one month led to noticeable improvements, they were insufficient to ensure complete healing of the ulnar nerve dislocation. This outcome is comparable to PRP studies, as regenerative treatments generally require multiple sessions. Further studies are needed to explore the potential application of this innovative regenerative treatment in other ligamentous and/or tendinous injuries involving substance loss.

KEYWORDS: *ulnar nerve, dislocation, ozone therapy, ozonated whole blood, procaine, conservative treatment*

INTRODUCTION

Ulnar nerve dislocation is a pathological condition that occurs when the ulnar nerve, one of the major nerves of the arm, is displaced from its normal position in the epitrochleo-olecranon groove. This dislocation is commonly associated with direct trauma, particularly in contact sports or automobile accidents, but it can also result from repetitive elbow movements or degenerative conditions such as osteoarthritis.

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The ulnar nerve is a branch of the brachial plexus, derived from the C8 and T1 spinal nerves. It runs along the arm, entering the elbow behind the epitrochlea. This position makes the nerve vulnerable to trauma and compression. The ulnar nerve innervates the medial part of the hand, including the fourth and fifth fingers, and plays a crucial role in both motor and sensory function. Preclinical studies have highlighted the importance of proper ulnar nerve function in maintaining fine hand functionality, essential for daily and professional activities.

Ulnar nerve dislocations are primarily caused by direct trauma to the elbow, which can occur in a variety of contexts, ranging from direct blows in contact sports to falls on the elbow. However, repetitive movements or traction forces can also be damaging, particularly in athletes engaged in activities that involve intensive arm use. Anatomical anomalies, such as a shallow epitrochleo-olecranon groove, or conditions like cubital tunnel syndrome, can increase susceptibility to this type of dislocation. Clinical symptoms include paresthesia (tingling or numbness), localized elbow pain, muscle weakness, and atrophy in chronic cases, as well as the characteristic "snap" sensation during elbow movements. These manifestations can vary significantly in intensity and duration, making diagnosis and treatment often challenging.

The diagnosis of ulnar nerve dislocation is based on careful clinical evaluation, supported by ultrasound imaging and, if necessary, magnetic resonance imaging. Ultrasound allows real-time visualization of the ulnar nerve and its position relative to the epitrochleo-olecranon groove, providing crucial information regarding the nerve dislocation. If left untreated, dislocation can lead to significant complications, including permanent nerve damage and functional impairment. Therapeutic options for ulnar nerve dislocation include both conservative and surgical approaches. Conservative treatments include rest, physical therapy, and the use of anti-inflammatory medications. However, in many cases, these measures are insufficient to ensure complete recovery. Surgical procedures, such as anterior transposition of the ulnar nerve or cubital tunnel decompression, are often required to restore nerve function and prevent permanent damage.

In recent years, several biological therapies have emerged as promising options. In particular, Platelet-Rich Plasma (PRP) has shown positive results in tissue regeneration and promoting healing. PRP is an autologous biological therapy that utilizes a concentration of platelets extracted from the patient's blood, aimed at stimulating tissue regeneration and enhancing healing. The preparation of PRP involves blood collection, centrifugation to obtain the platelet concentrate, and its administration through perineural, intra-articular injections, or during surgical procedures. PRP is rich in growth factors, including PDGF, IGF, VEGF, and TGF-β, which promote cell proliferation, angiogenesis, and reduce inflammation, aiding nerve regeneration, particularly in cases of ulnar nerve dislocation.

Clinical studies have demonstrated that PRP effectively reduces pain, enhances joint functionality, and accelerates nerve regeneration. Despite the documented benefits, the treatment has some disadvantages, including variability in outcomes due to differences in preparation protocols and the need for further research to establish precise indications and optimize therapeutic protocols. PRP emerges as a promising therapeutic procedure, but additional studies are needed to confirm its long-term efficacy and address issues related to cost and insurance coverage (1-4). However, the preparation and administration of PRP incur high costs, which may limit its accessibility for some patients (5-14).

In this context, the use of ozonated whole blood mixed with procaine emerges as an innovative and more accessible option. This combination harnesses the powerful properties of ozone, known for its anti-inflammatory capabilities, and the anesthetic properties of procaine. Oxygen-ozone therapy is gaining popularity as a treatment for many musculoskeletal conditions due to its ability to improve tissue oxygenation and stimulate the repair of damaged tissues (15-22).

The aim of our study is to present the therapeutic approach with ozonated whole blood and procaine for the treatment of ulnar nerve dislocation at the elbow, providing a detailed analysis of the clinical results, implications for managing the condition, and the opportunities offered by this therapeutic approach.

CASE REPORT

A 30-year-old male patient, an active rugby player, sustained an ulnar nerve dislocation at the right elbow during a training session. During the traumatic event, the patient experienced a direct impact to the elbow, immediately followed by intense pain and debilitating weakness in the right hand. On initial clinical examination, the patient reported a sensation of tingling and numbness radiating along the medial side of the forearm and was unable to perform hand flexion movements. The kinetic chain was compromised, resulting in significant difficulty grasping and holding objects.

The patient underwent a thorough clinical assessment, which included:

- **medical history**: no significant past medical conditions and no previous symptoms at the elbow was detected.

- **physical examination**: acute localized pain in the elbow region, with an inability to perform flexion movements beyond 90° was found. Muscle strength in the right hand was significantly reduced, scoring 3/5 on the Medical Research Council (MRC) scale. A neurological exam revealed a reduction in sensation in the areas innervated by the ulnar nerve.

To confirm the diagnosis, the patient underwent a series of instrumental investigations, including:

- **ultrasound**: showed dislocation of the ulnar nerve from the epitrochlear-olecranon groove, with signs of surrounding tissue edema;
- **MRI**: revealed a lesion of the Osborne ligament, characterized by thickening and disruption of its continuity, complicated by stationary edema.

Following these evaluations, the diagnosis of ulnar nerve dislocation at the right elbow was confirmed. Given the patient's clinical condition and the desire to avoid surgery, a conservative therapeutic strategy was initiated, involving the infiltration of ozonated whole blood in combination with procaine. The primary goal of this approach was pain reduction and the promotion of regeneration of the damaged tissues.

Procedure

The treatment began with the extraction of 9 ml of whole blood, performed using a needle-cannula system for venous blood collection. The blood was then mixed in a syringe with 1 ml of procaine at a concentration of 10 mg/ml and 9 ml of an ozone-oxygen mixture at 20 gamma. The preparation of the mixture was carried out in accordance with strict safety protocols to ensure adequate oxygenation and optimize therapeutic effectiveness.

The infiltration was performed at three targeted points in the elbow, chosen based on the distribution of the injury and the areas of pain reported by the patient:

1. **point 1**: infiltration near the olecranon to relieve localized pain;
2. **point 2**: infiltration along the course of the Osborne ligament, aiming to reduce inflammation and stimulate tissue regeneration;
3. **point 3**: infiltration in the epitrochlear region, to address the mechanical component of the ulnar nerve dislocation.

The procedure was performed with the patient in the supine position and the elbow flexed to approximately 90° to facilitate access to the infiltration sites. The intervention was performed without ultrasound guidance to simplify execution and minimize patient discomfort.

Follow-up

The patient underwent periodic follow-up visits to monitor the progress of treatment and the response to the intervention, with scheduled visits at one week, two weeks, one month, and three months post-infiltration.

1. **follow-up (1 week)**: The patient reported significant pain reduction, with a VAS score decrease from 8/10 to 3/10. Ultrasound revealed a reduction in edema, accompanied by initial scar tissue formation around the nerve.
2. **follow-up (2 weeks)**: Continuous clinical improvement was observed, with the VAS score further decreasing to 1/10. Ultrasound revealed an improved positioning of the nerve, accompanied by a progressive reduction in edema. Additionally, muscle strength showed signs of recovery, with the MRC score rising to 4/5.
3. **follow-up (1 month)**: The patient reported further improvement, with a VAS score of zero, indicating the absence of pain. Ultrasound findings showed improved continuity of the nerve, with stability of the Osborne ligament. Although mild dynamic subluxation was present, the patient resumed normal daily activities without experiencing pain.
4. **follow-up (3 months)**: After three months, the patient demonstrated complete recovery of elbow and hand functionality. Ultrasound and MRI confirmed significant nerve repair, with no signs of dislocation or residual pain. Muscle strength reached the maximum score of 5/5, indicating full functional recovery.

Despite the overall positive results, a single infiltration of ozonated whole blood was insufficient to guarantee complete healing of the ulnar nerve dislocation. It was recommended that consideration be given to additional treatments and revisiting the infiltration approach for patients with similar conditions.

RESULTS

The treatment, which involved infiltrations of ozonated whole blood and procaine, showed promising results in the patient's recovery. The treatment with ozonated whole blood and procaine infiltrations produced favorable outcomes in the recovery of the patient suffering from ulnar nerve dislocation.

- **Pre-treatment:** before the infiltration, dynamic ultrasound showed ulnar nerve subluxation, with the nerve tending to shift within the epitrochlear-olecranon groove at the first degrees of arm supination maneuvers and elbow flexion, and clear signs of dislocation of the nerve to the last degrees of arm supination maneuvers and elbow flexion (Fig. 1, 2).

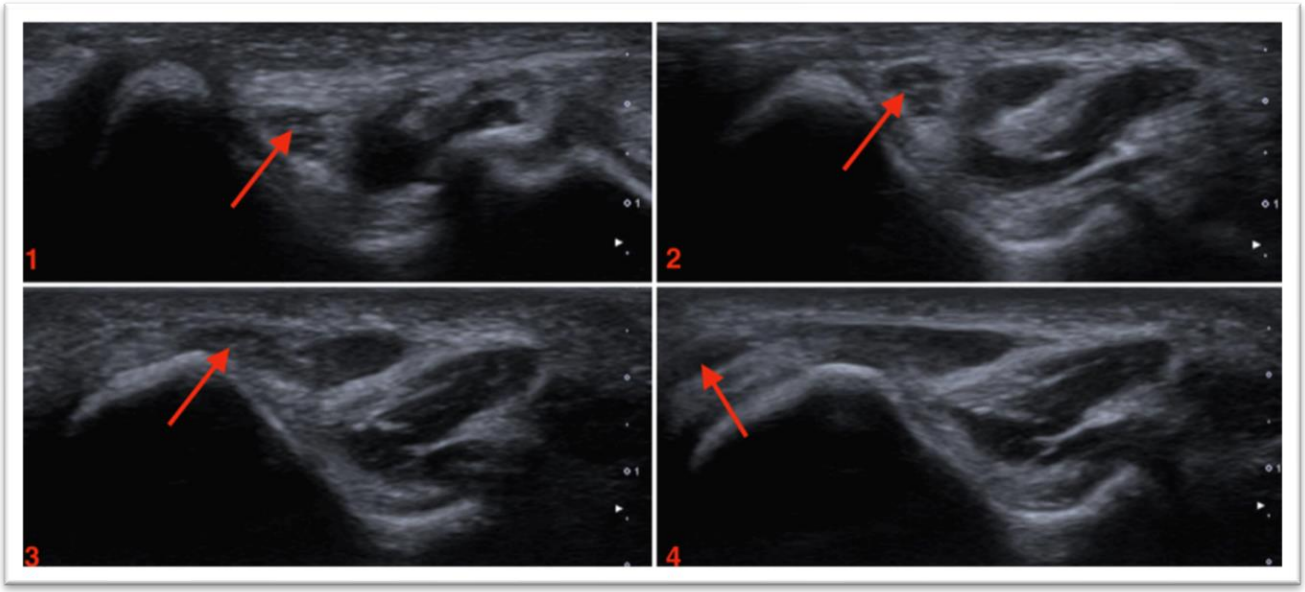

Fig. 1. *The patient exhibited an ulnar nerve dislocation (**red arrow**) during full forearm supination and maximum elbow flexion, as demonstrated by dynamic ultrasound testing.*

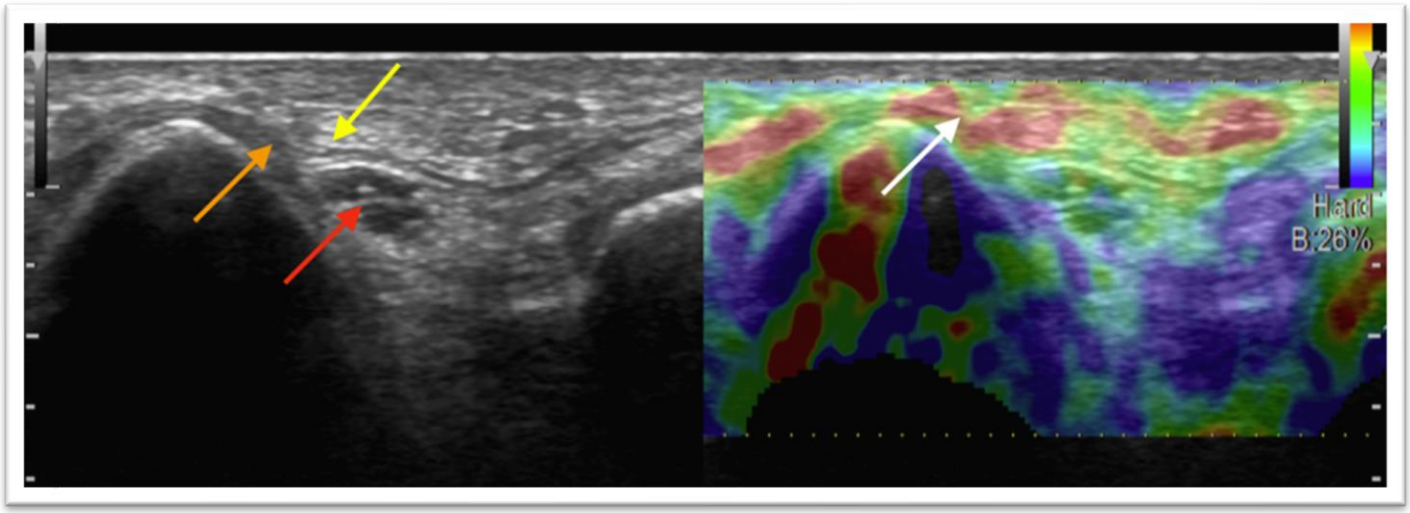

Fig. 2. *The patient with a supinated forearm and extended elbow pre-treatment. The B-mode image shows the tendency of the hypoechoic and enlarged ulnar nerve to localize in the epicondylar portion of the epitrochlear-olecranon groove (**red arrow**) and the discontinuity of the hyperechoic Osborne ligament (yellow arrow) due to the interposition of a hypoechoic epitrochlear tissue (orange arrow). The elastosonographic image demonstrates the soft consistency of the epitrochlear tissue, similar to that of subcutaneous tissue (**white arrow**). The thickness of the Osborne ligament was 0.57 mm, measured above the ulnar nerve.*

- **One-week post-treatment:** one week after the infiltration, the ultrasound showed a reduction in edema and the beginning of scar tissue formation around the ulnar nerve. During dynamic maneuvers, a mild subluxation of the ulnar nerve was observed, but with a significant reduction in pain reported by the patient (Fig. 3).

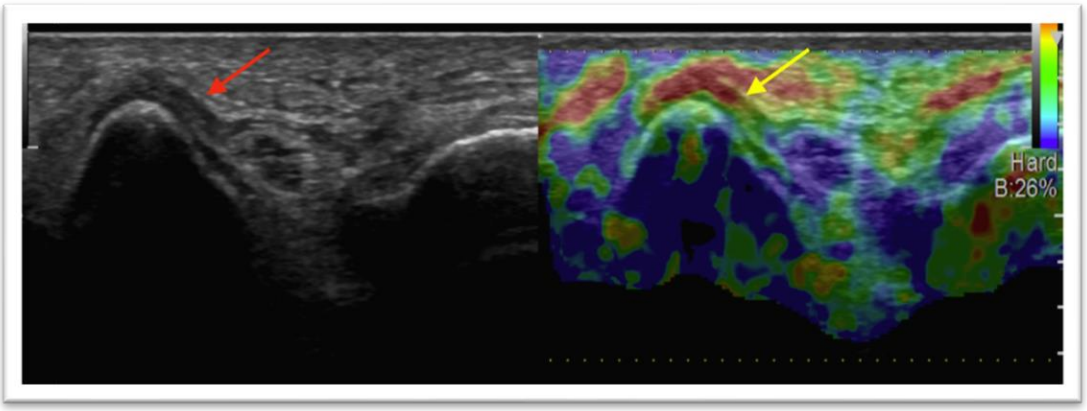

Fig. 3. *Patient with supinated forearm and extended elbow at approximately 1 week post-treatment. The B-mode image shows the formation of hyperechoic, triangular-shaped scar tissue in the interval between the Osborne ligament and the epitrochlear tissue (**red arrow**). The elastosonographic image reveals the firm consistency of the scar tissue, comparable to that of the underlying Osborne ligament (**yellow arrow**). The thickness of the Osborne ligament is 0.50 mm, measured above the ulnar nerve.*

During dynamic maneuvers of forearm supination and elbow flexion at approximately 1 week post-treatment, a tendency for ulnar nerve subluxation was observed beyond 80° of elbow flexion, accompanied by the onset of a "discomfort" sensation from the patient, measured as 3/10 on the visual analog scale (VAS).

- **Two weeks post-treatment:** the ultrasound showed improvement in the position of the ulnar nerve and progressive absorption of the edema. The Osborne ligament demonstrated significant improvement, with a reduction in swelling and increased stability (Fig. 4-5).

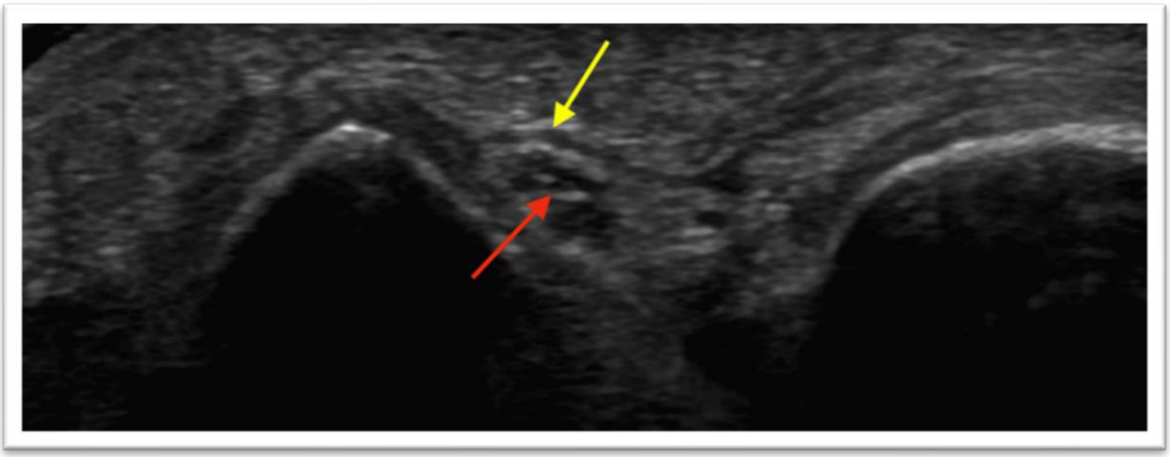

Fig. 4. *Patient with elbow extended and forearm supinated at approximately 2 weeks post-treatment. The thickness of the Osborne ligament (**red arrow**) is 0.50 mm measured above the ulnar nerve (**yellow arrow**).*

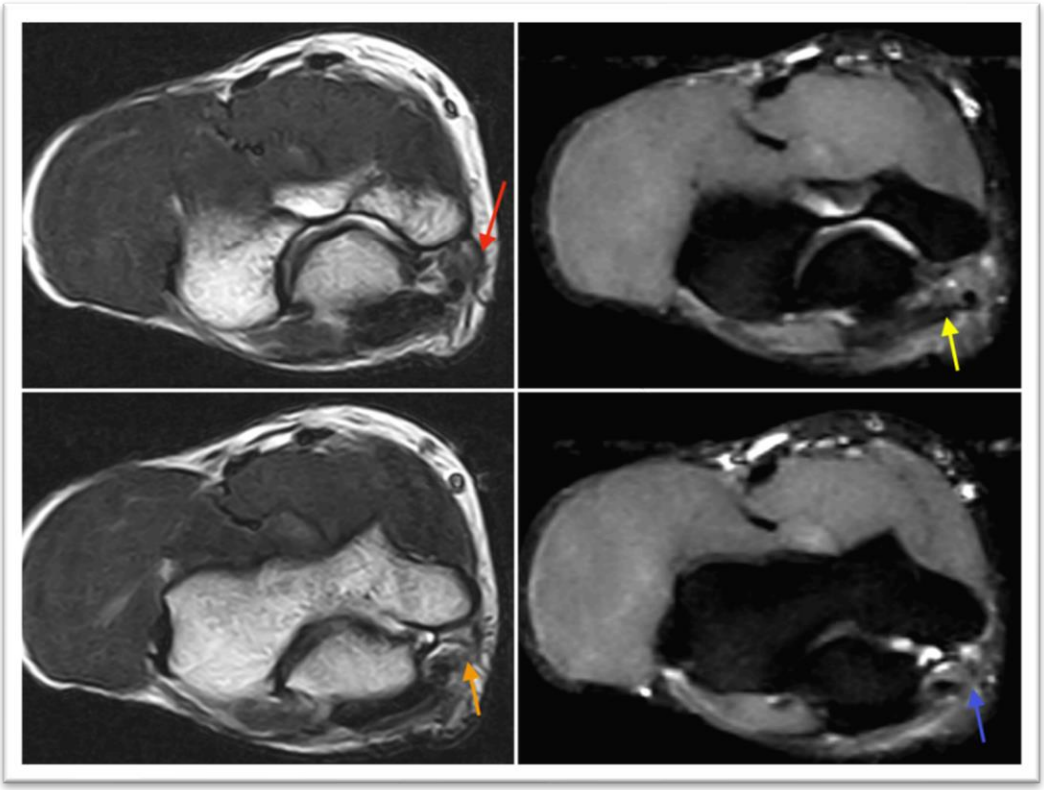

Fig. 5. *Patient with forearm supinated and elbow extended at approximately 2 weeks post-treatment. In the upper portion of the section, the T2 sequence shows the presence of a hypointense scar tissue in a linear shape, surrounding the ulnar nerve from the epicondyle and extending superficially into the subcutaneous tissue towards the olecranon (**red arrow**). In contrast, the STIR sequence shows that this structure is not fibrous compared to the underlying Osborne ligament, which is discontinuous and retracted (**yellow arrow**). In the lower portion of the section, the T2 sequence shows the presence of a thickened, retracted Osborne ligament connected to the ulnar nerve through heterogeneous scar tissue (**orange arrow**), not visualized in the STIR sequence (**blue arrow**).*

During dynamic maneuvers of forearm supination and elbow flexion at approximately 2 weeks post-treatment, a tendency for ulnar nerve subluxation was observed beyond 100° of elbow flexion, accompanied by a reduction in patient discomfort, measured as 1/10 on the visual analog scale (VAS).

- **One month post-treatment**: after one month, ultrasound confirmed continued positive evolution, showing the Osborne ligament becoming tighter and connected to the ulnar nerve via homogeneous scar tissue. The dynamic subluxation persisted, but the nerve demonstrated greater stability during ultrasound maneuvers (Fig. 7-8).

During dynamic maneuvers of forearm supination and elbow flexion at approximately 1 month post-treatment, and after the removal of the brace (Fig. 6), a tendency for ulnar nerve dislocation was observed at the final degrees of forearm supination and elbow flexion, similar to the pre-treatment condition, with the reappearance of "elbow snapping" but without any "discomfort" from the patient, measured as 0/10 on the visual analog scale (VAS).

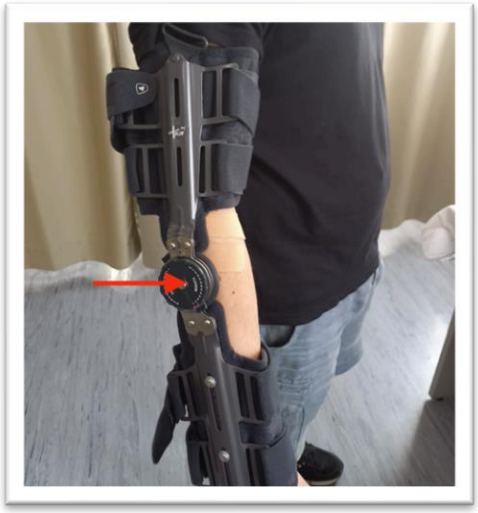

Fig. 6. *Elbow articulated brace (**right side**).*

Fig. 7. *Patient with supinated forearm and extended elbow at approximately 1 month post-treatment. The Osborne ligament is more taut and thinned (**red arrow**). The thickness of the Osborne ligament is 0.46 mm measured above the ulnar nerve.*

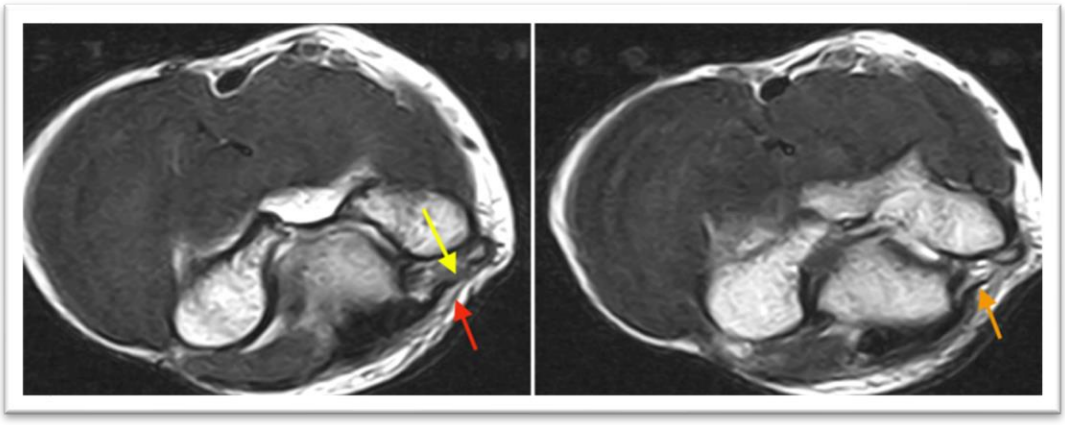

Fig. 8. *Patient with supinated forearm and extended elbow at approximately 1 month post-treatment. In the upper portion of the section, the T2 sequence shows the resorption of the hypointense linear scar (**red arrow**), while the Osborne ligament appears less deflected and partially connected to the ulnar nerve through an area of heterogeneous scar tissue (**yellow arrow**). In the lower portion of the section, the Osborne ligament appears discontinuous, thinned, and retracted (**orange arrow**).*

- **Three months post-treatment:** at three months, the ultrasound confirmed the complete repair of the Osborne ligament, with denser scar tissue and the disappearance of the ulnar nerve subluxation. The ultrasound also highlighted a thickened and tense Osborne ligament, with no signs of discontinuity (Fig. 9-10).

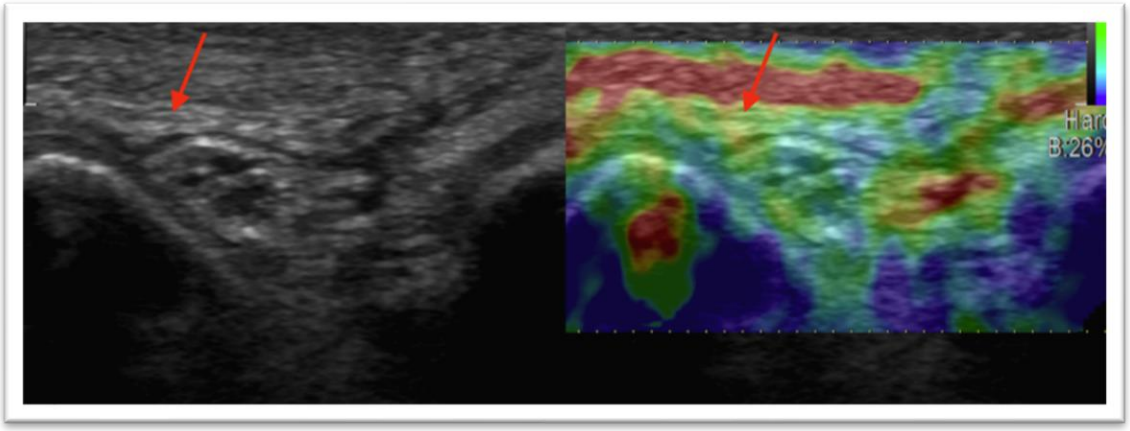

Fig. 9. *Patient with the forearm supinated and the elbow extended at approximately 3 months post-treatment. The B-mode and elastosonography images show thickening and expansion of the scar tissue (**red arrow**). The thickness of the Osborne ligament and scar tissue is 0.67 mm, measured above the ulnar nerve.*

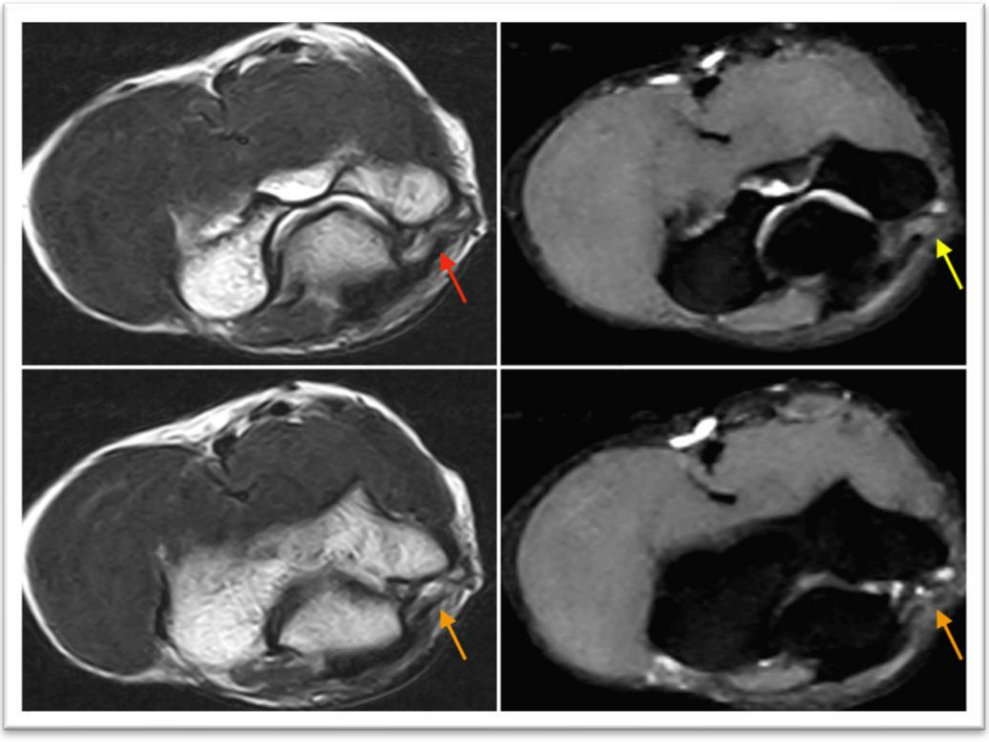

Fig. 10. *Patient with elbow extended and forearm supinated at approximately 3 months post-treatment. In the upper portion of the section, the T2 sequence shows the presence of a very thickened, tense Osborne ligament in continuity with soft scar tissue (**red arrow**), while the STIR sequence demonstrates the fibrous nature of the thin scar tissue (**yellow arrow**). In the lower portion of the section, the Osborne ligament remains discontinuous but is now more tense and thickened (**orange arrow**).*

Clinical and functional evaluation

- **VAS Score (Visual Analog Scale):** before the treatment, the patient reported intense pain (VAS 8/10). One week after treatment, the pain significantly decreased (VAS 3/10), and after two weeks, the score dropped further to 1/10. By the one-month mark, the patient reported no pain (VAS 0/10).
- **Muscle Strength (MRC):** the MRC score for muscle strength increased from 3/5 before treatment to 4/5 two weeks after the infiltration. By one month, muscle strength returned to normal, with a score of 5/5.
- **MRI Imaging:** three months post-treatment, MRI confirmed significant repair of the Osborne ligament, which appeared thickened and tense, with evident fibrous scar tissue in continuity with the ulnar nerve. The initial discontinuity of the ligament was fully resolved, with complete absence of nerve dislocation.

Functional conclusions

The patient reported resuming normal daily activities without limitations one month after infiltration, although a slight dynamic subluxation persisted, which did not significantly affect function. After three months, no signs of residual subluxation were observed, and the patient achieved full muscle strength, with a complete recovery of the motor functions of the arm and hand.

In summary, treatment with ozonized whole blood and procaine resulted in a significant recovery of the ulnar nerve dislocation, with tangible clinical and instrumental improvements within the first week and a full functional recovery at three months.

DISCUSSION

The treatment of ulnar nerve dislocation at the elbow is a complex therapeutic challenge, and despite advances in the medical field, treatment options remain limited. Platelet-rich plasma (PRP) has gained attention as a regenerative approach, utilizing the properties of platelets to stimulate tissue healing and enhance nerve stability. However, its high cost and limited availability make PRP a treatment that is not always accessible to all patients. As a result, alternatives, such as ozonized whole blood combined with procaine, have been explored.

In our study, the infiltration of ozonized whole blood with procaine showed positive clinical and ultrasound results as early as the first week, with a significant reduction in pain (measured as 3/10 on the Visual Analog Scale, VAS) and a trend toward resolution of ulnar nerve subluxation during dynamic ultrasound maneuvers. These results suggest that the proposed approach could be a valid alternative to PRP, with the advantage of being more accessible and potentially less costly, while maintaining similar therapeutic efficacy. However, a single infiltration was not sufficient to ensure complete healing of the dislocation, indicating the need for repeated therapy to achieve optimal results, as is also the case with PRP.

The use of ultrasound guidance for the infiltration could further enhance the treatment's effectiveness by optimizing the distribution of ozonized whole blood and procaine in the lesion areas. The absence of ultrasound guidance in our case represented a limitation, as it may have affected the accuracy of the infiltration, compromising the quality of the restored ligament and the overall effectiveness of the treatment. Post-treatment ultrasound observations, however, highlighted thickening of the Osborne ligament and formation of scar tissue, suggesting that while complete healing was not achieved, signs of tissue damage repair had emerged.

It should also be considered that the healing of a lesion such as ulnar nerve dislocation follows a complex process, involving phases of inflammation, granulation tissue formation, and tissue remodeling. Therefore, the combination of ozonized whole blood and procaine, while effective, cannot be considered a quick solution; the treatment may require a second infiltration after approximately 2-3 months, as recommended to optimize results and promote complete regeneration.

CONCLUSIONS

Platelet-rich plasma (PRP) is a promising treatment for ulnar nerve dislocations, but its high cost limits accessibility for many patients. In this context, the use of ozonized whole blood combined with procaine emerges as an interesting alternative, with the potential to offer a more affordable yet effective solution. The treatment has shown significant benefits as early as the first week, with pain reduction and clinical improvement. However, a second infiltration will be necessary to achieve complete healing of the ulnar nerve dislocation, especially in the absence of ultrasound guidance.

Recommendations derived from the results of this study include the use of ultrasound guidance to improve infiltration accuracy and the possibility of a second treatment administration at 2-3 months for more complex cases. It is essential that the removal of the brace is gradual and based on clinical signals to avoid muscle atrophy due to disuse.

In conclusion, ozonized whole blood with procaine represents a viable alternative to PRP for ulnar nerve dislocation; however, further studies are necessary to confirm the effectiveness of this combination and optimize therapeutic protocols, including the integration of ultrasound guidance and long-term treatment management. This approach may also be applicable to other tendon or ligament injuries, providing new therapeutic opportunities in the regenerative field.

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