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Case Report

Focus Extracorporeal Shockwave Therapy for Non-union Fractures: A Case Report

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Article Information

Received: 31-05-2023;
Accepted: 02-06-2023;
Published: 06-06-2023.

Abstract

Focus extracorporeal shockwave therapy (fESWT) involves the administration of focused pressure pulses to the body, to stimulate the proliferation of growth factors. Although this therapy has shown promise in the treatment of ulcers, kidney stones and burns, its effectiveness in treating non-union fractures has not been adequately elucidated. This report monitors the response of a 30-year-old patient with a non-union fracture of the tibia and fibula, to 6 weeks of fESWT. Regular ultrasound images and X-ray images were procured to assess observable bone growth and DASH scores were used to assess the degree of disability. At the end of the treatment period, both the X-ray images and DASH scores indicated a significant improvement in bone growth and bone function (45.3% before treatment and 2.7% after treatment). These results indicate that fESWT is a feasible treatment option for non-union fractures and large-scale studies need to be undertaken to examine its widespread application.

Keywords: Non-union Fracture; Focus Shockwave Therapy; Extracorporeal Shockwave Therapy.

Introduction

A non-union fracture, or pseudarthrosis, is a type of fracture where the bone fragments fail to heal and unite within the expected time period [1]. The failure of the bone to unite can be owed to the constant biological and mechanical stresses it is subjected to [2]. A treatment option that has gained significance in recent years is FOCUS wave therapy, also called focus extracorporeal shock wave therapy (fESWT). This procedure has been developed from extracorporeal shock wave lithotripsy, and involves a device applied outside the body, emitting focused pressure pulses [3]. These pulses of pressure have shown to induce various growth factors, which aid in wound healing, osteogenesis and subchondral bone formation [4-6]. This therapy has also shown promise in the treatment of chronic diabetic ulcers, foot ulcers, venous leg ulcers, pressure ulcers and burns, leading to an increased rate of healing and wound closure [7-9,10]. Most importantly, this procedure has proven to be effective in treating non-union fractures in both humans and other animals [11-16].

Case presentation

A 30-year-old male working in a hotel fell from a ladder, at a height of 10 feet. He landed on his feet and twisted his right ankle into a varus sprain. The fall resulted in a distal fracture of the tibia and fibula of the right leg. The injury occurred on the 17th of October 2021.

Treatment

Initially, the surgeon stabilized the tibial and fibular fractures using a plate and screws. However, imaging done three months after the fracture indicated no signs of bone healing. Hence, the surgeon implanted a bone stimulator on the 1st of February, for a period of three months. Despite this, no bone growth was seen at the fracture site and the fracture remained in a state of non-union. Consequently, the surgeon performed a bone graft on the 20th of June 2022, and the patient was referred to physical therapy for treatment of the pain. The patient was also advised to start some low-level exercise on the 11th of August. However, there was still no bone growth within the fracture sites. Upon the recommendation of the physical therapist, focus extracorporeal shock wave therapy or FOCUS wave therapy (Chattanooga electronics, Chattanooga Tennessee) was initiated. The shock waves were administered to the fracture site, on the distal right tibia and fibula. The FOCUS wave device (emitting electromagnetic beams) was set at a depth of 6 cm, with the energy set at 30-40 joules. The therapy was administered 5 days per week, for a period of 6 weeks. Ultrasound images and X-rays were obtained pre and post-therapy to evaluate the extent of healing. Moreover, the patient's bone function was assessed using DASH scores, which are useful in assessing patients with musculoskeletal disorders. The scores range from 0 (no disability) to 100 (most severe disability).

Imaging

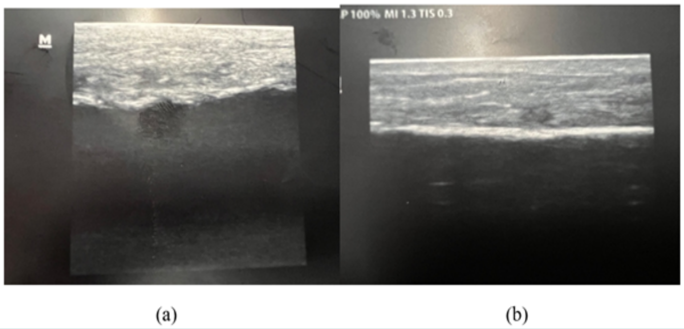

Figure 1: Ultrasound images captured before (a) and after (b) 6 weeks of the therapy.

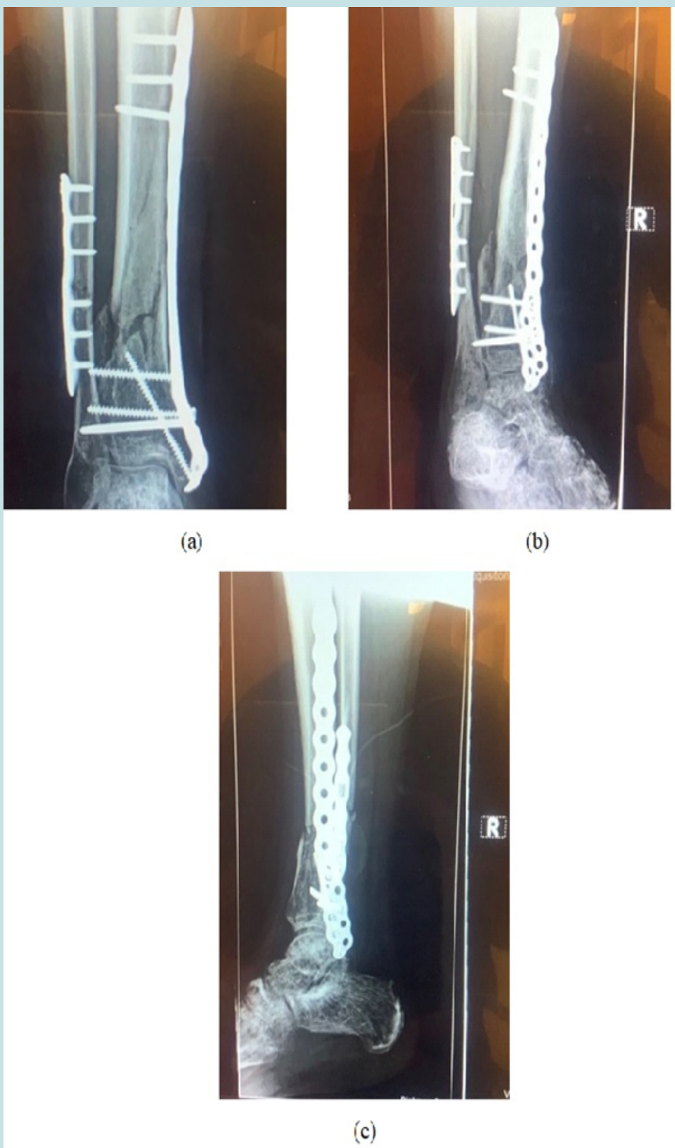

Figure 2: X-rays (a,b,c) captured before the initiation of fESWT.

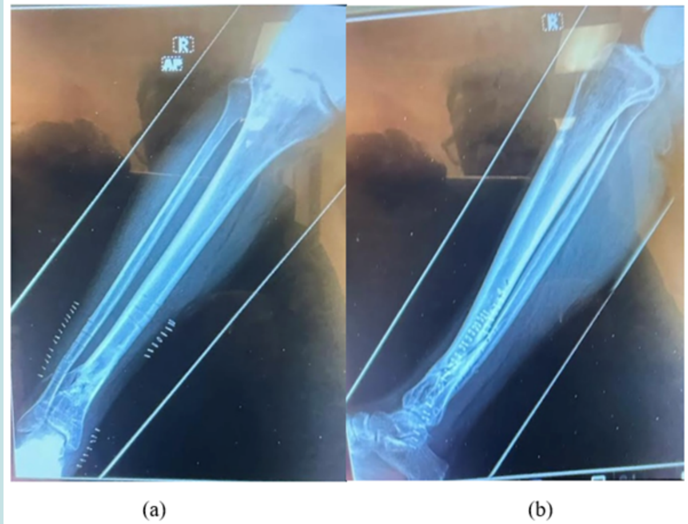

Figure 3: X-rays (a,b) captured after 6 weeks of fESWT.

Outcomes

At the final treatment session, the re-evaluation demonstrated 100% bone growth at both the fracture sites on the tibia and fibula. Reduction in pain with weight bearing was also noted. The DASH score before the treatment was 45.3%. The final DASH score was 2.7%. The overall difference in DASH scores was 42.6%. This difference is both statistically and clinically significant. It indicates a drastic improvement in bone function and healing. X-rays taken before (Figure 2) and after (Figure 3) also support this improvement.

Discussion

In this pilot study, there is a clear improvement in bone density and growth in the right distal tibia and fibula following 6 weeks of shockwave therapy. This is not only indicated by the reduced DASH scores, but also by the ultrasound and X-ray images captured pre- and post- therapy. Figure 1(a) shows an uneven and rough cortical bone along with the presence of a fibrotic artifact (probably a hematoma). In figure 1(b), the periosteal surface is smoother and the artifact has reduced in size and been internalized. This indicates that fESWT may need to be administered for a longer period of time to allow complete ossification and regeneration of the bone tissue. Nevertheless, figure 3 clearly shows a drastic improvement in overall bone health, enabling the removal of the staples and screws that supported the non-union fracture. This underlines the effectiveness of focussed extracorporeal shockwave therapy.

However, it is also important to note that fESWT has shown less promise in the treatment of atrophic non-union fractures, as compared to hypertrophic long bone non-unions [16-18]. So, further research would be required to accurately test the effectiveness of this therapy in such cases.

Nevertheless, the significant improvement in bone health indicates the wider and advantageous role of focus shockwave therapy as a treatment option for non-union fractures. Currently, the primary surgical treatment option for this condition involves the use of autologous bone grafts, in combination with the Ilizarov external fixator [19]. However, due to the lengthy and uncertain nature of this procedure, various other non-surgical techniques are gaining importance. These include stem cell therapy, bone morphogenetic proteins and vascular endothelial growth factors [20-22]. However, these practices have not been adequately documented in humans and further research is required to prove their practical application and long term effectiveness [19,23,24].

Conclusion

It is safe to say that focus shockwave therapy is a feasible treatment option for non-union fractures. It has no major side effects and has yielded promising results. However, its mainstream application is still not established. This can be attributed to the absence of reliable large-scale studies evaluating its efficacy in the long term. Moreover, the reliance on surgical interventions further prevents it from becoming the standardized treatment protocol. Hopefully, this case can be considered an agent, which proves its effectiveness and leads to its wider application.

Acknowledgements

None.

Conflicts of Interests

Authors declare that there are no conflicts between others.

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Citation: Donatelli R. Focus Extracorporeal Shockwave Therapy for Non-union Fractures: A Case Report. Medp Case Rep Clin Image. 2023; 1(2): mpcrci–202305001.