

Delayed Union Treated By Ultrasound-Guided ESWT Without Anaesthesia: A Retrospective Case Series

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INTRODUCTION

Treating delayed union with High-Energy Focussed ESWT (HE-fESWT) is the earliest orthopaedic indication for ESWT¹. Tradition and Guidelines suggest the use of regional or general anaesthesia for pain control, and x-ray localization for accuracy². Both these measures, however, entail costs and resources additional to ESWT.

Point-Of-Care Ultrasound scanning can be used to visualise bone surface disruptions in many fractures. When matched against fracture lines seen on x-ray, an ESWT device which incorporates real-time ultrasound guidance (Dornier EPOS-Ultra) can target fractures with reasonable accuracy.

Gradual increments of ESWT energy, with or without prior oral analgesia and other measures such as vibration anaesthesia, may facilitate tolerance to high-energy treatment, thus potentially eliminating the need for general or regional anaesthesia.

The purpose of this case series was to determine the efficacy of ESWT in delayed union treatment without x-ray and anaesthesia.

I. MATERIALS AND METHOD

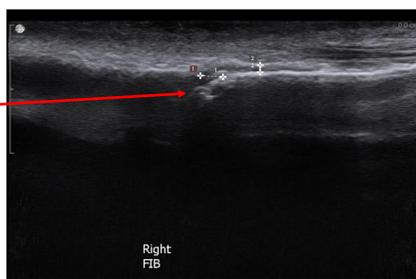
A retrospective survey of delayed union treated by ultrasound-guided HE-fESWT without anaesthesia was carried out. The survey covered a 5-year period and was based on patient records at one treatment centre.

Delayed Union was diagnosed where X-ray union failed to occur after three months³, regardless of whether internal fixation had or had not been carried out. After excluding contraindications, suitability for ESWT was then assessed based on the presence of a fracture gap less than 5mm with relative stability, and visibility of the fracture by ultrasound.

ESWT Treatments were carried out using an electromagnetic device (Dornier EPOS Ultra) with real time ultrasound guidance, without local, regional or general anaesthesia. Patients could use oral analgesia (paracetamol) prior to treatments if they wished. Where needed, vibration anaesthesia was used during treatment. A base protocol of 3 sessions 1 week apart was used, with further sessions added on if deemed necessary.



Localisation of a Weber Type B Fracture site by a combination of X-Ray and Point-Of-Care Ultrasound



US-guided Targeting of Focussed ESWT to fibular fracture line.



Device: Dornier EPOS-Ultra; An Electromagnetic Focussed ESWT device incorporating iso-centric off-axis real-time monitoring of focal zone

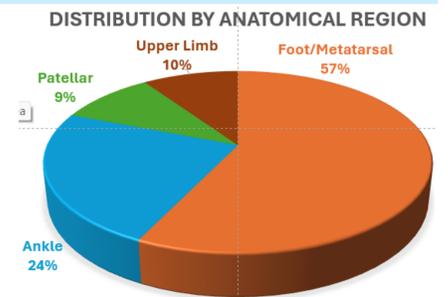
Outcomes were assessed through post-treatment X-rays reviewed by the referring surgeon after treatment during follow-up visits.

Patients who had missed their follow up X-rays or appointments were contacted by phone, text or email to inquire about any post-treatment imaging done, and/or progressions of symptoms following treatment.

II. RESULTS

20 patient were identified.

- 12 cases involved the foot. (10 fifth metatarsal, 1 fourth metatarsal, 1 calcaneum),
- 5 involved the ankle and distal tibia/fibula,
- 2 cases were patellar fractures, and
- 2 cases involved the upper limb.



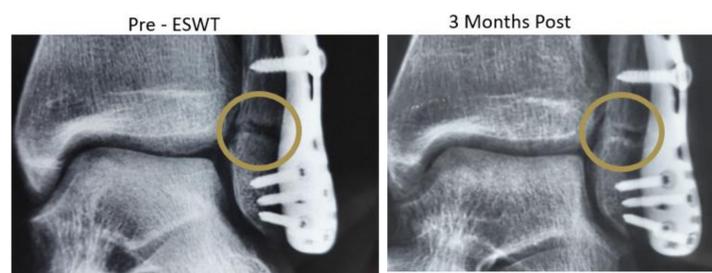
7 patients had previously undergone surgical fixation, of which 2 presented with fractured implants. The average time interval from fracture to ESWT treatment was 13.1 weeks (range 12 to 50 weeks). All patients received fESWT comprising 2000-3000 shocks within an EFD range of 0.28 to 0.7 mJ/mm². The average number of sessions was 3.1 (range 2 to 5). Treatments were generally well tolerated with only 1 patient who opted not to undergo a 3rd session.

Immobilisation as prescribed by the referring surgeon was maintained for the duration of ESWT treatment, and for 3 to 4 weeks thereafter.

Post-treatment X-Rays were carried out after an average of 10.5 weeks on 16 patients. Of the 4 patients who did not undergo follow-up imaging, 3 were contactable. 1 patient (with a 5th MT base fracture) remained uncontactable and was excluded from further analysis.

Status of Healing	No.	%
XR – United	12	63.2
XR - Progression towards Uniting	4	21.0
Symptomatic improvement	3	15.8
Non-union, required surgery	0	0.0

No adverse effects were recorded. One patient with a broken calcaneal implant remained in malunion with minimal symptoms



III. DISCUSSION

- ESWT treatment for Delayed Union has a reported average efficacy of 86% according to one systemic review³, or 69.25% (53 – 86%) according to another recent review⁴. Our series compares favourably with a combined total of 84.2% of fractures united (63.2%) or progressing towards unit (21%) based on X-ray.
- Additional costs, anaesthetic risks and excessive radiation exposure could be avoided.
- Although an EFD of 0.35 or 0.4 to 0.7 mJ/mm² is normally recommended for bone treatment^{1, 2}, the minimum EFD used in this series was 0.28 mJ/mm². We postulate that this may be sufficient where fractures were relatively superficial and minimal energy attenuation through tissue planes is expected.
- For similar reasons, less pulses (2000-3000) were used than ISMST guideline recommendations of 4000 pulses². This allowed for shorter treatment times, and likely improved treatment tolerability without compromising results.

IV. CONCLUSION

Efficacy of HE-fESWT for delayed union remains uncompromised when using ultrasound control in place of x-ray, and no anaesthesia. This enables cost savings, lower risk, and lower radiation exposure when managing delayed union with ESWT.

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CONFLICTS OF INTEREST: NIL