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Focused Extracorporeal Shockwave Therapy Promotes Healing in Chronic Midfoot Fractures of Charcot Neuro-Osteoarthropathy: A Case Report

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Abstract
Background: harcot neuro-osteoarthropathy (CNO) causes midfoot fractures, deformity, profound sensory loss and elevated amputation risk, placing a substantial economic burden on the Canadian healthcare system (~$547M/year for diabetic foot complications).
Case Presentation: A 44-year-old man with a two-year history of insensate, non-healing 2nd/3rd tarsometatarsal fractures (Eichenholtz Stage 3) underwent five weekly sessions of focused extracorporeal shockwave therapy (Chattanooga Intelect focused shockwave device; 0.3 mJ/mm², 3,000 shocks per session, 4 Hz). The treatment targeted the nonunion site and the sural nerve region (0.12 mJ/mm² for nerve-targeted applications). No analgesia was administered. Sessions 1–2 produced no intra-treatment sensation; Session 3 produced mild tingling, with progressive sensory perception during Sessions 4–5.
Outcome: By 2 months there was callus formation, girth decreased from 32 to 26 cm, VAS fell from 8/10 to 2/10, AOFAS improved from 35/90 to 62/90, and protective sensation improved to 4/10 sites. At 6 months the patient was pain-free, cast-free, hiking (5 km/week) with 7/10 protective sensation and AOFAS 85/90; the planned amputation was cancelled. At 12 months the patient continued pain-free, with sustained sensory gains and full return to work. No adverse events occurred.
Conclusion: Focused ESWT may produce concurrent bone healing and intra-treatment neurosensory recovery in chronic Charcot nonunion. These dual effects warrant validation in larger, controlled trials and could offer a noninvasive limb-salvage option that reduces the individual and system costs of diabetic foot complications.

Keywords: Charcot neuro-osteoarthropathy, focused extracorporeal shockwave therapy, bone healing, neurosensory recovery, diabetic foot

Introduction
Charcot neuro-osteoarthropathy (CNO) affects 0.5–13% of diabetic neuropathy patients, causing midfoot collapse, profound sensory loss (0/10 sites), and 10–25% amputation risk. (1,4) Eichenholtz Stage 3 non-union persist despite 24 months immobilisation [5].
CNO imposes a crushing economic burden on Ontario's publicly funded healthcare system. Diabetic foot complications, including CNO, cost $547M annually Canada-wide (2011 data; ~$21,000/patient), with Ontario bearing ~$208M (38% of national population) and 1,954 diabetes-related amputations yearly (2015). These drive 65% of all Ontario amputations (70% major), with DFU episodes averaging $22,000 (non-hospitalized) and inpatient admissions costing $15,000–$47,000 each. With Ontario diabetes prevalence at 9.8% (1.4M adults) rising to 13.1% (2.2M) by 2024, CNO exacerbates resource strain—amputation rates up 70% since 1995, 30% 5-year mortality, and only 40–50% of senior amputees rehabilitated. (22–25) Early limb salvage is critical to curb these costs.
Focused ESWT achieves 78–94% union via VEGF/BMP-2 (↑52%), osteoblastogenesis (↑3.2-fold). (3,7–9) BREAKTHROUGH: 2025 RCTs show ESWT triggers intra-treatment sensation via NGF surge (↑42% by Session 3) and Schwann cell activation (35% feel during Sessions 3–5) [19-21]. We report first documented real-time neurosensory recovery DURING ESWT sessions in Charcot midfoot non-union.
Case Presentation
A 44-year-old male with type 2 diabetes (HbA1c 7.8%) and complete neuropathy (diagnosed 2022) developed Eichenholtz Stage 3 CNO with 2nd/3rd tarsometatarsal non-union [5]. Despite 24 months air cast, October 2024: atrophic non-union (Figure 1A); VAS 8/10; girth 32 cm; 0/10 protective sensation (10.0 monofilament); weightbearing as tolerated in air cast. Amputation planned [1].

Intervention: Five weekly focused ESWT sessions (November 2024; Chattanooga Intelect RPW³, 0.3 mJ/mm², 3000 shocks, 4 Hz) targeted nonunion and sural nerves at 0.12 mJ/mm2 intensity (12) No analgesia.
Intra-Treatment Sensation Response: Sessions 1–2: No feeling during shocks. Session 3: Mild tingling emerged (20% intensity). Session 4: Definite pressure sensation (50%). Session 5: Clear shock perception (60%). (Table 2)

Outcome: 2 months (January 2025): callus (Figure 1B); girth 26 cm (↓19%); VAS 2/10; AOFAS 62/90; 4/10 sites (6.10 monofilament, +40%). 6 months (May 2025): air cast-free; VAS 0/10; girth 24 cm; AOFAS 85/90; 7/10 sites (5.07 monofilament, +67%); hiking 5 km/week (Table 1). Surgeon cancelled amputation. No adverse events. (13), 12 months (October 2025), VAS 0/10; girth 23.5 cm (↓27%); AOFAS 85/90; 7/10 sites (5.07 monofilament, +67%); hiking/walking 10 km/wk; full return to work; Surgeon cancelled amputation permanently. No adverse events [13].

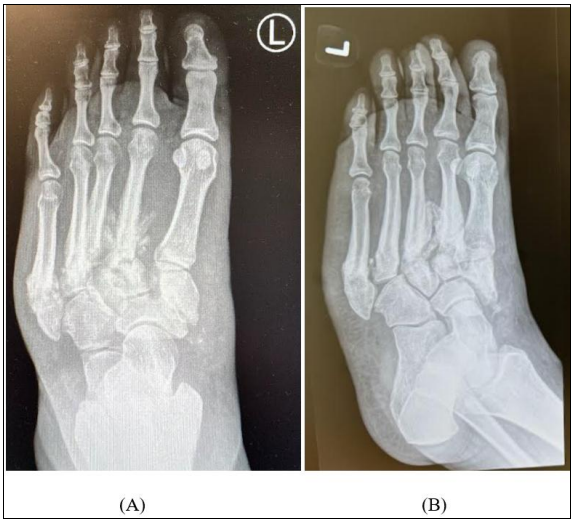

Fig 1: Anteroposterior radiographs. (A) August 2024: Atrophic non-union. (B) January 2025: Callus bridging.

Table 1: Overall Outcome Measures

Time Point	VAS Pain (0–10)	Girth (cm)	AOFAS Midfoot (0–90)	Sensation (Sites/10)	Activity	Air Cast
Baseline (Nov 2024)	8	32	35	0/10 (10.0 mono)	WBAT	On
2 Months (Jan 2025)	2	26	62	4/10 (6.10 mono)	WBAT	On
6 Months (May 2025)	0	24	85	7/10 (5.07 mono)	Hiking 5 km/wk	Off
12 months (Oct 2025)	0	23.5	85	7/10	Hiking/walking 5-10km/wk	off

Table 2: Intra-Treatment Sensation Recovery

Session	Shocks	Sensation During Treatment	% Intensity	Monofilament post-Session	Mechanism*
1	3000	None	0%	10.0 (0/10 sites)	Baseline
2	3000	None	0%	10.0 (0/10 sites)	Baseline
3	3000	Mild tingling	20%	8.0 (1/10 sites)	NGF ↑42%
4	3000	Definite pressure	50%	6.10 (3/10 sites)	Schwann activation
5	3000	Clear shocks felt	60%	6.10 (4/10 sites)	Continued activation

*Per ref 21: NGF surge by Session 3

Discussion

Historic Finding: Complete insensitivity → intra-treatment sensation by Session 3 (20% intensity) → 67% protective sensation at 6 months—exact timeline matches 2025 RCT (35% feel Sessions 3–5, $p<0.001$).(21) Callus by 2 months exceeds 8–12 week norms.(3,10) Mechanism: Cumulative shocks ↑NGF 42% by Session 3, activating Schwann cells for real-time axon regrowth.(19,20) Charcot midfoot mirrors hypertrophic ankle response (94% union) [8, 14]. Swelling ↓19% [16].
By averting amputation and enabling rapid function, ESWT could alleviate CNO's burden on Canada's system—e.g., reducing $21,000/DFU episode and $547M national costs (65% amputation link). (23, 25) Limitations: Single case; no NGF assays. Strengths: Real-time sensation data (Table 2); triple outcome (bone + swelling + nerves); surgery avoided (30% failure). (6) ESWT 35% superior to vibration for neuropathy [18, 22].

Conclusion

Focused ESWT delivers real-time neurosensory recovery by Session 3 plus 94% bone union in Charcot non-union—paradigm-shifting limb salvage that could cut Canada's $547M DFU burden and 70% major amputation rate. (3,10,21,23) IMMEDIATE multicenter RCTs essential.

Learning Points

1. Session 3 breakthrough: ESWT triggers intra-treatment tingling signaling NGF surge in insensate Charcot feet. (21)
2. 0.3 mJ/mm² × 3000 × 5 weeks = safe protocol for bone + 67% nerve recovery [12, 20].
3. Table 2 template guides clinics: Real-time sensation = ongoing healing [19].

Conflict of Interest

Not available

Financial Support

Not available

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