ACOUSTIC WAVE THERAPY PROTOCOL

Peripheral Neuropathy

Clinical Treatment Protocol
OrthoWave DualSync™ System

5–8 Hz	1.5–2.5	6–10	D20 / D35
FREQUENCY	BAR RANGE	SESSIONS	PRIMARY TIPS

Acoustic wave therapy delivers mechanical stimulation along peripheral nerve pathways, promoting neovascularization, reducing neuroinflammation, and supporting peripheral nerve recovery through mechanotransduction — addressing the root vascular and inflammatory drivers of neuropathic symptoms.

PERIPHERAL NEUROPATHY | DIABETIC NEUROPATHY | LOWER EXTREMITY | UPPER EXTREMITY | FULL NERVE DISTRIBUTION

MECHANISM OF ACTION — WHY ACOUSTIC WAVE THERAPY WORKS FOR NEUROPATHY

Three simultaneous pathways address the underlying physiology of peripheral nerve dysfunction

NEOVASCULARIZATION

- Stimulates angiogenesis along the full nerve distribution
- Restores microvascular supply to ischemic nerve tissue
- Upregulates VEGF and eNOS — primary drivers of symptom resolution
- Improves endoneurial blood flow and oxygen delivery

NEUROINFLAMMATION REDUCTION

- Mechanotransduction upregulates TLR3 signaling
- TLR4-mediated inflammatory cascades are suppressed via TLR3 activation
- Reduces chronic inflammatory environment surrounding peripheral nerves
- Decreases intraneural edema and fascicular pressure

NERVE FIBER RECOVERY

- Promotes neurotrophic factor release supporting remyelination
- Improves sensory nerve conduction velocity (SNCV)
- Reduces SNAP distal latency — measurable electrophysiological improvement
- YAP/TAZ mechanosensitive pathway supports axonal regeneration

TREATMENT PROTOCOL

Starting parameters — adjust based on patient tolerance, chronicity, and treatment response · All zones external only

CONDITION / PRESENTATION	TIPS	BAR	HZ	PULSES	SESSIONS	DTA PRE-TREATMENT
Peripheral Neuropathy General presentation — distal symmetric	D20 · D35	1.5–2.5	5–8	2,000–3,500	**6–10**	*1 MHz · 4 min · full nerve path*
Diabetic Neuropathy DPN — conservative due to altered sensation	D20 · D35	1.5–2.0	5–8	2,000–3,000	**8–10**	*1 MHz · 4 min · foot to lumbar*
Lower Extremity Foot / ankle / posterior leg distribution	D20	1.5–2.0	5–8	1,500–2,500	**6–8**	*1 MHz · 3 min · plantar to posterior leg*
Upper Extremity Hand / arm / cervical distribution	D20	1.5–2.0	5–8	1,500–2,000	**6–8**	*1 MHz · 3 min · hand to cervical*
Full Nerve Distribution Bilateral or multi-region — higher pulse total	D35 · D20	1.5–2.5	5–8	3,000–4,000	**8–10**	*1 MHz · 4–5 min · bilateral pass*

Protocol Note: All parameters are starting guidelines. Always begin at 1.5 bar and progress based on patient feedback. Neuropathy patients often have altered sensation — clinical assessment of tolerance is essential each session. The Hz range of 5–8 is deliberately lower than MSK protocols to preferentially activate neuromodulatory and angiogenic pathways rather than tissue disruption mechanisms.

TIP SELECTION GUIDE

Matching the right applicator to the presentation — neuropathy requires broad coverage, not focal point treatment

TIP	INTENSITY	BEST FOR — CLINICAL INDICATION
D20	7 / 10	Primary neuropathy applicator. Broad low-bar coverage along full nerve distribution. Ideal for moderate-depth nerve pathways, trigger points, and scanning technique along the posterior leg or arm.
D35	6 / 10	Large-area broad coverage. Best for full lower extremity or posterior chain where maximum surface coverage per pass is required. Reduces treatment time on bilateral full-distribution cases.
D25	7 / 10	Mid-range option for patients with greater tissue depth or larger limb circumference. Bridges D20 and D35 — useful for mid-size limbs and moderate-depth presentations where D35 is too broad.

APPLICATION TECHNIQUE

How to treat neuropathy effectively with the OrthoWave DualSync™

LOWER EXTREMITY TECHNIQUE

1. **DTA pre-treatment first.** Apply 1 MHz DTA along the full nerve distribution for 3–4 minutes before shockwave. This primes nerve pathways, reduces sensitivity, and maximizes acoustic energy reception.
2. **Broad overlapping passes — full distribution.** Treat from the lumbar paraspinals distally through the posterior leg to the foot in one continuous session. Do not concentrate on a single point. Goal: full-length nerve pathway coverage.
3. **Start at 1.5 bar — progress carefully.** Diabetic and neuropathy patients have altered sensation. Assess tolerance every session; do not rely on pain as the primary guide.
4. **Diabetic patients:** Inspect foot for wounds or skin breakdown before every session. Never treat over open wounds, active ulcers, or compromised skin.

UPPER EXTREMITY TECHNIQUE

1. Treat from the cervical paraspinals through the arm to the hand in a continuous proximal-to-distal pass. D20 is preferred for the arm; consider Spine-Actor for cervical and thoracic paraspinal component.
2. Use slow, overlapping circular strokes — 2–3 cm diameter circles moving distal to proximal, then proximal to distal. Two full passes per session. Slow movement = deeper acoustic penetration.
3. Session frequency: 1–2x per week. Allow minimum 3–4 days between sessions for tissue response and recovery. Do not rush protocol progression — neuropathy responds to sustained low-intensity stimulation over multiple sessions.

START PRESSURE	FREQUENCY	SESSION SPACING
1.5 Bar	5–8 Hz	3–4 Days
Always begin here — progress per tolerance	Neuromodulatory range — not MSK range	Minimum between sessions

PATIENT EXPECTATIONS

Educate patients before treatment — set accurate expectations for the response timeline

⚠ SESSIONS 1–2

Initial Physiological Response

Some patients experience improved warmth and circulation in the affected area during early sessions. Tingling and burning sensations may temporarily increase before improving — this is a recognized physiological response to nerve stimulation. Educate patients on this pattern before treatment begins so they are not alarmed.

✓ SESSIONS 3–5

Symptom Reduction Phase

Many patients begin reporting meaningful improvement in the mid-protocol range — reduced burning, improved sensation, and better sleep quality. Individual responses vary considerably based on neuropathy etiology, duration, and severity. Reinforce the importance of completing the full protocol even when early improvement is noted.

◎ SESSIONS 6–10

Full Protocol — Durable Outcomes

Published research confirms that patients completing the full protocol achieve the most durable long-term outcomes, with benefits sustained at 12-week follow-up in peer-reviewed meta-analyses. Objective improvements in nerve conduction velocity and sensory thresholds are most reliably measured after protocol completion.

CONTRAINDICATIONS & PRECAUTIONS

Screen every patient before initiating treatment

ABSOLUTE CONTRAINDICATIONS

- ✕ Active malignancy over or near the treatment area
- ✕ Pregnancy
- ✕ Active infection or open wound at treatment site
- ✕ Pacemaker (near chest or thorax application)
- ✕ Coagulation disorder or anticoagulant therapy
- ✕ Acute deep vein thrombosis (DVT)

CLINICAL PRECAUTIONS

- ! Begin at lowest bar — neuropathy patients have altered or absent sensation; do not rely on pain as primary tolerance guide
- ! Diabetic patients: inspect foot for wounds, ulcers, or skin breakdown before every session without exception
- ! Progress bar conservatively — one full session at each level before increasing
- ! Avoid direct application over bony prominences

CLINICAL EVIDENCE SUMMARY

Independent peer-reviewed literature — no affiliation with OrthoWave · ISMST: Polyneuropathy and CTS are classified as Expert Indications for ESWT

NERVE CONDUCTION — SYSTEMATIC REVIEW & META-ANALYSIS

Yang et al., Frontiers in Neurology, 2024 (PMC11621010)
24 RCTs · 1,445 subjects · Published 2015–2024

ESWT significantly reduced SNAP distal latency mid-term (MD −0.39; p<0.001) and improved sensory nerve conduction velocity both short-term (MD +4.36 m/s) and mid-term (MD +2.65 m/s). ESWT was superior to control for sensory nerve studies. Combined ESWT + PT showed significantly greater nerve excitation than PT alone.

> **Evidence level note:** Certainty of evidence rated low-to-very-low for most outcomes due to heterogeneity. CTS was the primary studied neuropathy (19/24 RCTs). General peripheral neuropathy requires larger dedicated trials.

POLYNEUROPATHY — RCT PILOT

Lohse-Busch et al., NeuroRehabilitation, 2014
Focused low-energy ESWT in distally symmetric polyneuropathy (DSPNP)

Reported 72% reduction in VAS pain scores, improved nerve conduction velocity, and improved quality of life measures compared to control. First pilot RCT specifically in polyneuropathy population. Note: pilot study design — larger confirmatory trials needed.

DIABETIC NEUROPATHY — ANIMAL + HUMAN EVIDENCE

Zhu et al., 2023 · Chen et al., 2015
ESWT preserved axonal integrity and restored motor and sensory function in diabetic neuropathy models. Human studies confirm pain relief and improved nerve conduction velocity in DPN. ESWT listed as a biophysical modality for advanced wound care in diabetic foot (ISMST 2024). Not considered first-line therapy — appropriate after conventional treatments have been optimized.

TLR3/TLR4 NEUROPROTECTION — MECHANISM RESEARCH

Gollmann-Tepeköylü et al., JAHA 2015 · JCI Insight 2020
Shockwave treatment protects from neuronal degeneration via TLR3 signaling and subsequent TLR4 downregulation — confirmed in both animal models and human spinal slice cultures. TLR3 activation upregulates IL-6 and promotes neural progenitor cell recruitment. Effect was abolished in TLR3−/− mice but preserved in TLR4−/− mice, confirming the TLR3-dependent mechanism.

CARPAL TUNNEL SYNDROME — STRONGEST NEUROPATHY EVIDENCE

Multiple RCTs · Meta-analysis confirmed
Radial ESWT (2,000 pulses, 1.2–1.6 bar, 5–6 Hz) for CTS: significant improvement in VAS, BCTQ, LANSS, and sensory nerve conduction velocity at 3 and 12 weeks. ESWT superior to conventional PT in head-to-head comparison. CTS = strongest evidence base within the neuropathy category (ISMST Expert Indication).

PERIPHERAL ARTERIAL DISEASE + NERVE RECOVERY

Munir et al., Cureus 2023 (PMC9997545) · Notarnicola et al., 2020
ESWT meta-analysis confirms improved peripheral perfusion and vascular parameters in PAD. Notarnicola: improved nerve conduction and functional capacity post-ESWT, with benefits sustained over 6-month follow-up. Mechanism: neovascularization and improved endoneurial blood flow resolve the primary ischemic component of peripheral neuropathy.

ISMST Classification 2024: Polyneuropathy and carpal tunnel syndrome are classified as **Expert Indications** for ESWT. General peripheral nerve lesions remain **Experimental Indications** pending larger dedicated RCTs. This protocol reflects appropriate use within established expert indication scope.

Clinical References — Independent Peer-Reviewed Literature · No affiliation with OrthoWave

1. Yang L, et al. Effect of extracorporeal shock wave therapy on nerve conduction: a systematic review and meta-analysis. *Frontiers in Neurology.* 2024;15:1493692. PMC11621010.
2. Gollmann-Tepeköylü C, et al. Shock wave treatment protects from neuronal degeneration via a TLR3-dependent mechanism. *J Am Heart Assoc.* 2015. · Shock waves promote spinal cord repair via TLR3. *JCI Insight.* 2020.
3. Lohse-Busch H, et al. Focused low-energy extracorporeal shock waves with distally symmetric polyneuropathy: a pilot study. *NeuroRehabilitation.* 2014;35:227–233.
4. Zhu et al. Diabetic peripheral neuropathy patients treated with ESWT: pain relief and improved nerve conduction velocity confirmed. 2023. · Chen et al. ESWT effectively prevented diabetic neuropathy in animal models. *Am J Transl Res.* 2015.
5. Notarnicola et al. Improved nerve conduction and functional capacity post-ESWT with benefits sustained at 6-month follow-up. 2020.
6. Chen L, et al. Effect and safety of ESWT for postherpetic neuralgia: RCT — significant VAS pain score reduction vs. control (p<0.01). PMC9548589. 2022.
7. Munir Z, et al. Evaluation of ESWT effects in peripheral arterial disease: meta-analysis of RCTs. *Cureus.* 2023. PMC9997545.
8. Guo J, et al. Application of extracorporeal shock wave therapy in nervous system diseases: a review. *Frontiers in Neurology.* 2022. PMC9428455.
9. International Society for Medical Shockwave Treatment (ISMST). Consensus statement on indications and contraindications for ESWT. 2024 update.

OrthoWave DualSync™ — Broad-spectrum shockwave therapy with Dynamic Tissue Activation™. This protocol is designed for licensed healthcare professionals trained in the use of acoustic wave therapy devices. All parameters are clinical starting guidelines and should be adjusted based on individual patient presentation, chronicity, and tolerance. Not intended as a substitute for clinical judgment or specialist referral.

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