AZ Draft proposal

RQ [2]: What constitutes the optimal suction pressure and duration in Negative Pressure Wound Therapy (NPWT)?

Section 1: Background (<300 words):

Open fractures are among the most challenging injuries encountered in orthopedic trauma . Successful management requires prompt surgical debridement, fracture stabilization, and timely soft-tissue coverage to minimize complications. Although early definitive wound closure is considered the ideal approach, this is not always feasible in clinical practice. Factors such as extensive soft-tissue damage, wound contamination, patient instability, or the presence of other life-threatening injuries. During this interval, temporary wound management plays a critical role in protecting the wound, controlling contamination, and preparing the wound bed for definitive coverage.

Negative Pressure Wound Therapy (NPWT) was introduced in 1997 by Argenta and Morykwas, describing the application of sub-atmospheric pressure to wound surfaces via a sealed foam dressing connected to a suction pump and drainage canister. It has since become one of the most widely adopted wound management modalities in orthopaedic and trauma surgery. Proven mechanisms of action include: (1) macro-deformation — approximation of wound edges through foam collapse; (2) micro-deformation — cellular-level strain promoting fibroblast proliferation and angiogenesis; (3) fluid removal — active drainage of oedema improving microcirculation; and (4) environmental control — a sealed, moist, warm wound environment. Secondary effects include granulation tissue stimulation, inflammation modulation, and variable effects on bacterial colonisation.

Despite widespread adoption, significant evidence gaps remain regarding two fundamental parameters: optimal suction pressure and optimal treatment duration. The most commonly applied pressure is -125 mmHg, derived from early animal studies by Morykwas et al. (1997) showing a 4-fold increase in subcutaneous blood flow(17). However, optimal pressure may vary by wound type, tissue composition, dressing material (foam vs gauze), and clinical objective (wound contraction, fluid extraction, or granulation). Similarly, dressing change intervals and total therapy duration lack consensus, ranging from 2-7 days per change and days to weeks in total.These parameters directly affect infection rates, granulation tissue quality, healing time, patient pain, and need for secondary reconstruction.

Nevertheless, despite its routine use and theoretical advantages, robust evidence demonstrating its superiority over conventional wound dressings remains limited. The evidence base has been complicated by conflicting RCT evidence — particularly the

landmark WOLLF trial (Costa et al. 2018, JAMA), which found no benefit of NPWT over standard dressings in severe open lower limb fractures. This review synthesises the full available evidence — including 16 papers — to inform a balanced consensus recommendation.

Section 2: Data Extraction Table

For each included study: Author/Year, Study Design, Sample Size, Population, Groups Compared, and Key Results (pressure and duration focus).

Papers 12-16 are additional literature identified by supplementary search. Paper 6 (FLOW trial) addresses surgical irrigation pressure — included for contextual relevance only.

S.no	Author, Year, Country	Study Design	Sample Size	Population	Groups Compared	Key Results — Pressure & Duration
1	Robert N., 2017 France	Narrative Review	N/A (review)	Orthopaedic/trauma wounds (acute & chronic); French HAS guidelines. Excluded - Bleeding wounds, uncontrolled wound infection, necrotic tissue requiring debridement , malignancy, severe PAD, caution with anticoagulants	Standard NPWT; continuous vs intermittent; foam types; pressure adjustments by wound type	Pressure: 125 mmHg standard. Reduce to 75 mmHg for bleeding wounds, skin grafts, pain. Increase to 175 mmHg with high-density WhiteFoam. Continuous preferred during wound detersion; mandatory for skin graft fixation. Intermittent (5 min on/2 min off) may enhance granulation post-detersion. Dressing change: 48-72 h (>=3x/week); infected wounds more frequently. Apply >=22 h per 24-h cycle. Stop if no improvement after 1 week.
2	Gray D. et al., 2008 UK/USA	Expert Consensus / Best Practice Statement	N/A (consensus panel)	Various wound types (acute, chronic, traumatic); gauze-based Chariker-Jeter NPWT	Gauze-based NPWT vs foam-based NPWT; pressure range comparison	Pressure 75-100 mmHg effective for gauze-based NPWT; lower than foam-based 125 mmHg. No single pressure proven superior. Continuous vs intermittent: no clear outcome difference for gauze-based systems. Dressing change: 48-72 h, adjusted for exudate, wound size, patient condition.
3	Moazen Jamshidi MM et al., 2022 Iran	Current Concept Review	N/A (review)	Open fractures (orthopaedic); Gustilo-Anderson types III; soft tissue injuries, fasciotomy wounds, chronic ulcers, burns, flap and graft procedures,	NPWT vs conventional dressings; mechanisms, indications, complications and duration reviewed	Standard pressure: 125 mmHg (Argenta/Morykwas VAC). Dressing changes: 2-4 days to minimise pain. Interrupted therapy significantly increases wound complication rates. Topical lidocaine (1%) before sponge removal reduces pain. More research needed for duration and exact pressure per wound type. Evidence

				postoperative wound complications, and complex orthopedic wounds Exclusion : • Untreated osteomyelitis • Fistulas (especially unexplored/non-enteric) • Necrotic tissue with eschar • Malignant wounds • Hypersensitivity to dressing components		regarding bacterial load reduction was inconsistent
4	Verma A. et al., 2022 India	Prospective RCT	60 patients; open leg fractures (GA II, IIIA, IIIB); mean age 42.2 yr	Adults 18-62 yr; open compound leg fractures after primary internal fixation. Excluded: osteomyelitis, neurovascular deficit, diabetes, malignancy, PVD	Primary internal fixation done as soon patient stable. (ILN 48, Plate - 10, LRS -2) VAC at 125 mmHg intermittent (n=56) or continuous (n=4) vs conventional dressings; follow-up 12 months	Pressure: intermittent 125 mmHg in 56/60. Dressing interval: 4-5 days. Mean wound reduction: 9.97 +/- 9.59 cm2 (21.22%), p=0.0481. No repeat debridement in 56/60. Excellent/Good outcome: 63.3%. Complications: deep infection 10%, joint stiffness 16.67%. • Secondary procedures after VAC- SSG (38), tissue transfer (4), debridement and secondary closure (6), direct closure (8), healing secondary intention (2)
5	Novak A. et al., 2014 UK	Evidence-based Narrative Review	N/A (multiple studies cited)	Trauma and orthopaedic wounds (open fractures, fasciotomy, skin grafts, diabetic foot, pressure ulcers, chronic wounds)	NPWT (VAC system) vs conventional dressings; standardised pressure regime table by wound type	Standard: 125 mmHg foam. Regime: Acute/traumatic - continuous 48 h then intermittent (5 min/2 min) at 125 mmHg; change 48-72 h >3x/week. Meshed grafts - continuous 75-125 mmHg; change 4-5 days. Diabetic foot - 50-125 mmHg; 48-72 h. Pressure ulcers - 125 mmHg continuous 48 h then intermittent.

						• Dressing change interval – 48-72 hrs , not more than 7 days • Contraindications – in bleeding, infection, allergy to foam or adhesives, mallignanacy, direct contact over vessels, nerves , organs or anastomotic sites
6	FLOW Investigators (Bhandari M et al.), 2015 International	Multicentre Blinded RCT (2x3 factorial)	2447 patients; open extremity fractures; 12-month follow-up	Adults >=18 yr; open extremity fractures (GA grades I-III). Excluded: pelvic/axial skeleton, hand/toe phalanges	Irrigation pressure: high (>20 psi) vs low (5-10 psi) vs very low (1-2 psi); castile soap vs normal saline. Endpoint: reoperation within 12 months	NOTE: Addresses surgical WOUND IRRIGATION pressure, not NPWT suction - included for contextual relevance. No difference in reoperation rates across pressure groups (p=0.80). Saline superior to soap (11.6% vs 14.8%, p=0.01). Key lesson: lower pressures do not compromise outcomes.
7	Rezzadeh KS et al., 2015 USA	Retrospective Cohort Study	32 patients; Gustilo IIIB/IIIC open tibial fractures; Level 1 trauma centre; 5-year period	Adults with severe open tibial fractures requiring free-flap reconstruction. Stratified: acute (<7 d), subacute (7-42 d), chronic (>42 d). MVA 78%	NPWT (n=12) vs wet-to-dry dressings (WDD, n=20) as bridge to free-flap surgery; outcomes: flap failure, SSI, osteomyelitis, nonunion, LOS	NPWT vs WDD: 0% vs 15% flap failure; lower SSI, osteomyelitis, nonunion regardless of surgical timing. Lowest complication rate: NPWT + acute surgery (<7 d). NPWT safely extends the reconstruction window. Specific pressure/interval not reported; institutional protocols used.
8	Desai KK et al., 2012 USA	Algorithm-based Evidence Review (Levels I-IV)	N/A (review; multiple RCTs and case series per wound type)	Multiple wound types: diabetic foot (Level I), open fractures, venous ulcers, sternal wounds, burns, skin grafts, open abdomen, flaps	NPWT algorithm; pressure evidence (25, 125, 500 mmHg); continuous vs intermittent; foam vs gauze; wound contact layer	125 mmHg standard - wounds at 25 mmHg failed to granulate; 500 mmHg = malformed granulation; 125 mmHg optimal but not compared to intermediate pressures. Continuous 125 mmHg preferred; reduce to 75 mmHg for pain. Skin grafts: continuous 75 mmHg. Intermittent theoretically superior for granulation but impractical clinically. NPWT achieves significantly higher wound healing in DMand venous foot ulcers, uptake of skin grafts
9	Osterhoff G et al., 2014 Switzerland	Retrospective Cohort Study	261 patients; 280 NPWT treatments; University Level 1 trauma centre (2011)	Mixed trauma patients: lower extremity 56%, upper extremity 20%, trunk 21%. Open fractures 34% of trauma cases; median age 46 yr. Comorbidities: smoking 23%, PVD 8%	Risk factor analysis for duration of NPWT to secondary wound closure. Dressing changes every 3-5 days in OR. Closure when cultures negative and granulation confirmed	Median NPWT duration: 6.0 days overall; 9.0 days with open fractures vs 5.0 without. Open fracture (p=0.002) and INCREASING age (p=0.004) independently predict prolonged duration (1.45x longer). Smoking/alcohol abuse predicted readmission. Prolonged NPWT associated with increased bacterial growth - minimise duration.

					Patients with versus without open fractures; smokers versus non-smokers; alcohol/drug abuse versus none; and other comorbidity-based subgroup comparisons.	
10	Holt AM et al., 2018 USA	Narrative Review (Resident Education)	N/A (review)	Orthopaedic patients: trauma (open fractures, fasciotomy), skin grafts, incisional wounds, implant infections; ciNPT and NPWTi reviewed	NPWT pressure settings (continuous vs intermittent); ciNPT (-50 or -125 mmHg); NPWTi; clinical applications across orthopaedics	Animal models: maximal wound contraction at -75 mmHg; maximal fluid extraction at -125 mmHg. Clinical standard: -125 mmHg continuous - balances both effects and minimises leak risk. Intermittent promotes greater granulation than continuous (Malmsjo 2012). Skin grafts: continuous -75 mmHg for 1 week. ciNPT: -50 mmHg (PVA) or -125 mmHg (PU foam). Dressing changes: 2-3 days.
11	Lok E. et al., 2024 Australia	Forum Article / Structured Review	38 articles included; PubMed and EMBASE (April 2023)	Lower extremity traumatic wounds: open fractures, degloving, soft tissue loss, fasciotomy, skin grafts, free flap reconstructions	Multiple NPWT modalities: standard NPWT, NPWTi-d, ciNPT, portable devices. Gauze-based (Chariker-Jeter, -80 mmHg) vs ROCF foam-based compared	Recommended pressure: -125 mmHg standard (Morykwas 1997: 4-fold perfusion increase)(17). Gauze-based (Chariker-Jeter): -80 mmHg. ROCF generates greater microdeformation than gauze at all pressure levels. Intermittent therapy: maximal microcirculation improvement. Dressing change: 48-72 h for foam. NPWTi-d: expert consensus recommends 10-min dwell time. 91.6% of high-energy extremity wounds reconstructed with skin grafts when NPWT used as bridge.
12	Birke-Sorensen H et al., 2011 International (16 countries)	International Expert Consensus (Evidence-based Recommendations)	28 international specialists; systematic review of evidence base for NPWT treatment variables	All wound types requiring NPWT; focus on treatment variable optimisation: pressure levels, wound filler (foam vs gauze) and contact layer selection	Expert panel review of evidence for: foam vs gauze filler performance; optimal pressure settings; contact layer selection; continuous vs intermittent modes	Pressure: -125 mmHg remains standard for foam-based NPWT; -80 mmHg recommended for gauze-based systems (most gauze-based manufacturers recommend -60 to -80 mmHg). Both foam and gauze can achieve clinically meaningful NPWT effects. Gauze should be considered to reduce pain and causes less tissue ingrowth, less bleeding on removal as compared to PU foam. Optimal range likely 75-125 (?50-150mmhg) mmHg depending on therapeutic objectives. Avoid higher negative

						pressures in wounds with compromised vascularity. Higher pressures are recommended when managing heavily exudative wounds. Reduction of bacteria is NOT a major mode of action of NPWT - other mechanisms predominate. NPWT should only be used as an adjunct to infection management and not as sole therapy. Intermittent pressure may provide superior granulation tissue stimulation. Dressing change: 48-72 h. Evidence base limited - further RCTs needed for definitive pressure recommendations. A non-adherent wound contact layer is recommended when foam-based NPWT is used over split-thickness skin grafts
13	Stannard JP, Volgas DA et al., 2009 USA (Level I trauma centre)	Prospective Randomized Study	59 patients enrolled; data available for 58 patients with 62 severe high-energy open fractures	Severe high-energy open fractures (predominantly Gustilo IIIA/IIIB). Academic Level 1 trauma centre. Mixed extremity locations	NPWT at -125 mmHg vs standard fine mesh gauze dressings after initial irrigation and debridement. Outcomes: deep infection, osteomyelitis, wound dehiscence, fracture union	Pressure used: -125 mmHg (standard). Control group: 7/25 fractures developed deep infection (28%) - 2 acute (8%), 5 delayed (20%). NPWT group: 2/37 fractures developed deep infection (5.4%) - 0 acute, 2 delayed. Significant difference (p=0.024). Relative risk 0.199 (95% CI 0.045-0.874): patients treated with NPWT were 5 times less likely to develop deep infection. NPWT represents a promising therapy for severe open fractures after high-energy trauma.
14	Costa ML, Achten J et al. (WOLLF Trial), 2018 UK (24 trauma centres)	Multicentre Pragmatic RCT (UK Major Trauma Network)	460 patients aged >=16 yr with severe open lower limb fractures; recruited July 2012 - December 2015; 12-month follow-up	Adults with severe open fracture of the lower limb (tibia, fibula, foot/ankle). 24 specialist trauma centres in UK Major Trauma Network. Gustilo II-IIIC fractures Inclusion Criteria • Age ≥16 years.	NPWT (applied after first surgical debridement) vs standard wound dressings. Primary outcome: 12-month Disability Rating Index (DRI, 0-100). Secondary: deep infection, QoL (EQ-5D), resource use	PRIMARY OUTCOME: No significant difference in 12-month DRI between NPWT and standard dressings (p>0.05). No difference in deep infection rates or quality of life. NPWT cost-ineffective: ICER £267,910/QALY gained (Petrou et al. Bone Joint J 2019) (18). Conclusion: NPWT does not provide clinical or economic benefit for open lower limb fractures vs standard dressings. Challenges previous smaller RCTs and guidelines recommending NPWT. Note: NPWT applied at -125 mmHg per standard protocol. Most important counterpoint study in the field.

				• Severe open fracture of the lower limb. • Wound could not be primarily closed after initial surgical debridement. • Gustilo Grade II or III open fractures. • Presentation to the treating hospital within 72 hours of injury Exclusion Criteria • Presentation > 72 hrs after injury. • Contraindication to anesthesia. • Inability to adhere to study procedures.		

				• Inability to complete questionnaires (e.g., severe dementia).		
15	Krug E, Berg L, Lee C et al. (NPWT-EP), 2011 International (16 countries)	International Expert Consensus (Evidence-based Recommendations)	International Expert Panel on NPWT (NPWT-EP); systematic review of evidence base	Traumatic wounds (soft tissue defects, open fractures, burns) and reconstructive procedures (flaps and grafts The guideline included studies evaluating NPWT in: • Soft-tissue traumatic wounds • Open fractures • Fasciotomy wounds • Partial-thickness burns • Skin graft procedures • Flap reconstruction • Donor-site management	Evidence-based recommendations for NPWT use in traumatic wounds; companion to Birke-Sorensen 2011 covering indications/contraindications NPWT versus conventional wound management across multiple indications	For open fractures: NPWT can be used when closure is not feasible or before delayed definitive closure; can be stopped once closure possible; use to obtain healing of fasciotomy incisions. For grafts: NPWT improves integration and is recommended. Standard pressure -125 mmHg for trauma wounds. Dressing change: 48-72 h. Infection management: NPWT can serve as adjuvant but cannot replace treatment of infection. Recommends NPWT as bridge therapy for complex traumatic wounds pending definitive reconstruction.

				Exclusion Criteria • Wounds containing untreated necrotic tissue. • Full-thickness burns with eschar. • Situations where adequate surgical debridement had not been performed. • Use of NPWT as a substitute for essential surgical debridement or definitive reconstruction.		
16	Elbana OH, et al RCT, 2025 (PMC12630174) International	Prospective Randomized Controlled Trial	65 patients; flap reconstruction procedures; 30-month study period	Patients undergoing flap reconstruction surgery. Three groups: HNPWT (75-125 mmHg, continuous), LNPWT (50-75 mmHg, intermittent 5 min on/2 min off), and conventional wound dressing	Direct comparison of high-pressure NPWT (75-125 mmHg continuous) vs low-pressure NPWT (50-75 mmHg intermittent) vs conventional wound dressing	HNPWT had highest incidence of flap ischaemia (41%). LNPWT showed superior safety and efficacy vs HNPWT: fewer ischaemic events, lower pain scores, faster wound healing, better aesthetic and functional outcomes. Both NPWT groups had significantly lower infection (p=0.015), dehiscence (p=0.029) and edema (p=0.003) vs CWD.

				(CWD). Dressing changed every 3 days; discontinued after 3rd dressing	for post-flap reconstruction wound management	Conclusion: Lower pressure (50-75 mmHg) in intermittent mode is safer and more effective for flap reconstruction than standard higher pressure. Challenges the universal application of -125 mmHg as optimal pressure - wound/tissue type matters.

Section 3: Results Summary (up to 500 words)

Study designs and overview: A total of 16 papers were reviewed, comprising: narrative/evidence-based reviews (n=5), international expert consensus statements (n=3), prospective RCTs (n=3), retrospective cohort studies (n=2), one best practice statement, one algorithm review, and one structured forum article. Study quality ranges from Level I (WOLLF RCT, n=460; Stannard RCT, n=62; Flap RCT, n=65) to Level IV (expert opinion/narrative review).

Suction Pressure: -125 mmHg is the most consistently recommended pressure for foam-based NPWT across all included reviews and guidelines (Robert 2017, Novak 2014, Desai 2012, Holt 2018, Lok 2024, Birke-Sorensen 2011, Krug 2011). This derives from Morykwas et al. 1997 animal studies(17). The Stannard 2009 prospective RCT applied -125 mmHg and demonstrated significantly reduced deep infection (5.4% vs 28%, p=0.024, RR 0.199). Animal model differentiation (Holt 2018): maximal wound contraction at -75 mmHg; maximal fluid extraction at -125 mmHg. Gauze-based NPWT: 75-100 mmHg (Gray 2008; Birke-Sorensen 2011 recommends -80 mmHg). Skin grafts: -75 mmHg continuous. High-density WhiteFoam: up to -175 mmHg. The 2025 flap RCT directly compared pressure levels and found lower pressure (50-75 mmHg intermittent) safer and more effective for flap wounds than higher pressure (75-125 mmHg continuous).

Continuous vs Intermittent Mode: Continuous suction is the preferred clinical standard (lower leak risk, better patient comfort). Intermittent (5 min on/2 min off) enhances granulation tissue formation and microcirculation in animal and in vitro studies (Robert 2017, Novak 2014, Holt 2018, Lok 2024, Birke-Sorensen 2011), but is less practical due to pain cycles and seal failures. Consensus: continuous for first 48 hours, with possible transition to intermittent thereafter. The 2025 flap RCT used intermittent mode for the lower-pressure arm and found superior outcomes vs continuous higher-pressure NPWT.

Duration and Dressing Change Interval: The most consistently recommended dressing change interval is 48-72 hours (Robert 2017, Gray 2008, Novak 2014, Lok 2024, Birke-Sorensen 2011, Krug 2011). Infected wounds: more frequent changes. The prospective RCT (Verma 2022) used 4-5 day intervals. Osterhoff 2014 (n=280) recorded median total NPWT duration of 6 days (9 days with open fractures). Open

fracture and older age independently predict prolonged duration. Prolonged NPWT associated with increased bacterial growth. Discontinue if no improvement after two consecutive changes or after 1 week (Robert 2017, French HAS).

Critical counterpoint — WOLLF Trial (Costa et al. 2018): The largest RCT to date (n=460, 24 UK centres, JAMA 2018) found no significant improvement in 12-month disability, deep infection rate, or quality of life with NPWT vs standard dressings for severe open lower limb fractures. The accompanying economic analysis found NPWT cost-ineffective (ICER £267,910/QALY) (18). This challenges the widespread adoption of NPWT in this setting and highlights the need for careful patient selection.

Section 4: Discussion (<1000 words)

The question of optimal NPWT suction pressure and duration has evolved considerably with the addition of the supplementary literature. The evidence base now includes three Level I RCTs directly relevant to this question (Stannard 2009, Verma 2022, Costa/WOLLF 2018) and two major international consensus documents (Birke-Sorensen 2011, Krug 2011), substantially strengthening the review.

The foundational recommendation of -125 mmHg remains the most consistently supported pressure across all review literature and the international consensus documents (Birke-Sorensen 2011, Krug 2011). The Stannard 2009 prospective RCT provides the strongest direct clinical evidence for this pressure, demonstrating a 5-fold reduction in deep infection rates at -125 mmHg (5.4% vs 28%, p=0.024). However, the Birke-Sorensen 2011 international consensus acknowledges that the evidence base for this specific value remains limited, with optimal pressure likely ranging from 75-125 mmHg depending on therapeutic objectives. Their recommendation that -80 mmHg is adequate for gauze-based systems reflects mechanistic evidence that approximately 85% of maximum wound contraction is achieved at -80 mmHg (Malmsjo et al., cited in reviewed literature), challenging the assumption that -125 mmHg is uniquely optimal.

The 2025 flap reconstruction RCT provides the first direct head-to-head comparison of different NPWT pressure levels in a human clinical trial. Its finding that low-pressure (50-75 mmHg) intermittent NPWT produces superior safety and efficacy compared to higher-pressure (75-125 mmHg) continuous NPWT for flap wounds represents an important paradigm shift. This suggests that the optimal pressure is fundamentally tissue-specific: flap tissue, with its delicate pedicle vasculature, may be compromised by the ischaemic effects of higher pressures, whereas open traumatic wounds with exposed bone and soft tissue may require higher pressures for adequate fluid evacuation. This reinforces the principle that -125 mmHg should not be applied universally but should be tailored to tissue type and clinical objective.

The WOLLF trial (Costa et al. 2018, JAMA) represents the most significant challenge to the existing NPWT evidence base. Its failure to demonstrate benefit of NPWT over standard dressings in 460 patients with severe open lower limb fractures, despite being sufficiently powered, fundamentally challenges the clinical effectiveness assumed in all preceding literature. Several factors may explain this discrepancy: (1) the WOLLF trial used NPWT as a single-application dressing after first debridement, whereas most supporting literature employed NPWT as a continuing wound management strategy; (2) the heterogeneous UK Major Trauma Network setting may differ from the single-centre Level I trauma settings of earlier trials; (3) advances in standard wound care since the foundational Stannard (2009) study may have narrowed the performance gap. The WOLLF trial does not definitively rule out NPWT benefit in all contexts but highlights that routine application to all open lower limb fractures is not supported by high-quality evidence.

The international consensus documents (Birke-Sorensen 2011, Krug 2011) address a critical gap by systematically evaluating treatment variables. Their recommendation that foam-based NPWT systems should use -125 mmHg while gauze-based systems should use lower pressures (-80 mmHg) provides a clinically actionable framework that balances the existing evidence. Gauze dressings are generally associated with less pain during dressing changes, whereas foam dressings promote more rapid granulation tissue formation. Similarly, pressure settings should be tailored to the clinical situation, with a therapeutic range of 50–150 mmHg recommended. Lower pressures may be preferable for painful or ischemic wounds, whereas higher pressures may be beneficial in wounds with substantial exudate.The Krug 2011 consensus further contextualises NPWT within the broader open fracture management algorithm, emphasising its role as a bridging therapy pending definitive closure rather than a standalone treatment. Importantly, expert panels consistently highlight that NPWT should never replace fundamental surgical principles. Thorough debridement, infection control, fracture stabilization, and timely definitive wound coverage remain the cornerstones of successful management. From a safety perspective, structured monitoring is essential throughout NPWT treatment. Clinicians should remain vigilant for complications such as bleeding, infection, seal failure, retained dressing material, and device-related problems. Appropriate patient selection and adherence to established treatment protocols are critical to maximizing therapeutic benefits while minimizing adverse events.

Key evidence limitations across all 16 papers include: heterogeneity of wound types and NPWT application protocols; reliance on animal data for pressure-level recommendations; variable definitions of treatment success; and the only direct pressure-comparison RCT (2025 flap study) being specific to flap reconstruction and not directly generalisable to open traumatic wounds. NPWT represents a cost-effective strategy in selected patient populations, particularly those with complex wounds requiring prolonged management.

A definitive multi-arm RCT comparing -75, -125, and -175 mmHg in standardised open fracture wounds remains the priority research need.

Section 5: Risk of Bias of Included Studies

Overall: MODERATE (upgraded from previous assessment with addition of Level I studies)

With the addition of three Level I RCTs and two international consensus documents, the overall evidence quality is upgraded to MODERATE. The Stannard 2009 RCT is limited by small sample size (n=62) and single-centre setting. The WOLLF trial (Costa 2018) is high quality (n=460, 24 centres, JAMA-published, independent funding) but addresses a pragmatic question that may not fully reflect optimised NPWT use. The 2025 flap RCT is the first to directly compare pressure levels but is limited to flap reconstruction and a relatively small sample (n=65). The two international consensus documents (Birke-Sorensen 2011, Krug 2011) are comprehensive but have potential industry bias (Smith & Nephew-sponsored symposium). Retrospective cohort studies (Osterhoff 2014, Rezzadeh 2015) have inherent selection bias. No study was specifically designed as a dose-finding RCT for NPWT pressure levels in open traumatic wounds — this remains the most critical gap.

Section 5: Response/Recommendation

For open injuries managed with NPWT, we recommend an initial suction pressure of -125 mmHg for foam-based systems, with pressure reduction to -75 mmHg for skin graft bolstering, haemostatic-risk wounds, compromised vascularity, flap reconstruction, or pain intolerance; gauze-based NPWT is effective at 75-100 mmHg. Continuous mode is preferred for the first 48 hours, with consideration for transition to intermittent mode (5 min on/2 min off) thereafter to enhance granulation tissue formation, if wound seal integrity and patient tolerance allow. Dressing changes should be performed every 48-72 hours under standard conditions, with increased frequency for infected wounds, and NPWT should be discontinued if no wound improvement is observed after two consecutive changes or one week of therapy. Clinicians should note that high-quality RCT evidence (WOLLF trial, JAMA 2018) does not support routine use of NPWT over standard dressings for all open lower limb fractures, and patient selection should be individualised.

Section 6: Level/Strength of Evidence:

MODERATE — Three Level I RCTs are now included (Stannard 2009 supporting NPWT at -125 mmHg; WOLLF 2018 challenging NPWT benefit; 2025 flap RCT supporting lower pressure for flap wounds). Two major international consensus documents (Birke-Sorensen 2011, Krug 2011) support the -125 mmHg standard with acknowledged evidence limitations. However, no RCT has directly compared NPWT pressure levels in open traumatic wounds, and the conflicting results between Stannard (2009) and Costa/WOLLF (2018) reduce overall evidence certainty. The specific recommendation for -125 mmHg standard pressure with 48-72 h dressing changes is supported by consistent expert consensus and two RCTs but challenged by the largest RCT in the field. Based on number of studies, risk of bias, study design, sample size, and key outcomes: the overall evidence level is LOW to MODERATE for specific pressure/duration parameters, and MODERATE for NPWT as a treatment modality in open injuries.

(Based on the number of studies, risk of bias, study design, sample size, and key outcomes.)

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