Photobiomodulation (PBM) for Bone Fractures: Evidence and Protocols

What is Photobiomodulation?

Photobiomodulation (PBM) involves the use of red and near-infrared light to stimulate biological healing processes at the cellular level. PBM enhances mitochondrial activity, promotes angiogenesis, increases collagen synthesis, and regulates inflammation—all essential factors in bone healing.

Bone fractures require effective vascularization, mineral deposition, and inflammation control to heal properly. PBM offers a non-invasive, drug-free adjunct therapy that accelerates callus formation, enhances bone remodeling, and supports functional recovery across a range of fracture types.

☑ Clinical Benefits for Bone Fractures

1. Accelerated Bone Healing
- A systematic review published in 2020 concluded that PBM significantly accelerates fracture healing in both animal and human models. [Live link](https://pubmed.ncbi.nlm.nih.gov/32403284/)
- Clinical data supports earlier radiographic evidence of healing and reduced time to union in patients treated with PBM after fracture. [Live link](https://pubmed.ncbi.nlm.nih.gov/23539493/)

2. Improved Callus Formation and Bone Density
- In vivo studies show increased expression of bone morphogenetic proteins (BMPs), alkaline phosphatase, and osteocalcin with PBM therapy. [Live link](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6612360/)
- PBM improves trabecular thickness and mineral density at the fracture site in controlled animal models. [Live link](https://pubmed.ncbi.nlm.nih.gov/27804085/)

3. Post-Surgical Orthopedic Recovery
- PBM following fracture fixation surgery reduces postoperative swelling, pain, and supports bone union. [Live link](https://pubmed.ncbi.nlm.nih.gov/31484393/)

🧪 Mechanistic Evidence

PBM enhances osteoblast proliferation and differentiation, stimulates vascular endothelial growth factor (VEGF) production, and promotes angiogenesis. It modulates inflammatory cytokines (↓ TNF-α, IL-1β) and improves mitochondrial efficiency, resulting in faster callus formation and bone regeneration. [Live link](https://pubmed.ncbi.nlm.nih.gov/31918191/)

🎯 Suggested Protocols: SPRB & GRPB

1. SPRB – Targeted treatment at fracture site
- Wavelength: 660 nm (red) 50% + 850 nm (near-infrared) 50%
- Application: Wrap the SPRB directly over or around the fracture site (e.g., wrist, forearm, ankle)
- Duration: 15 minutes per session and if a large or complex fracture 2 treatments at one session; repeat 3 × daily during acute healing phase approximately 2 -3 weeks depending on size and complexity of the fracture
- Frequency: 1 x day until clinical/radiographic union is observed

- Benefit: Focused stimulation at fracture area to enhance collagen matrix formation and mineralization

2. GRPB – Comprehensive application for large or deep bone structures
- Wavelengths: 660 nm (1/3) + 850 nm (2/3)
- Application: Wrap around limb or lay flat against femur, tibia, humerus, or pelvis in non-weightbearing position
- Duration: 15 minutes x 2 per session 3x per day
- Frequency: 3× daily depending on severity or post-op status and continued until final healing is confirmed with your healthcare provided
- Benefit: Enhanced deep tissue penetration, effective for systemic healing and extensive orthopedic applications

To support systemic recovery and circulation, consider additional GRPB application over the area above and below the fracture with the same usage protocols per device .

📌 Monitoring & Safety Tips

- Place the device directly on the skin and if not possible use very light, thin and white clothing to shine the light through and onto the fracture

- Ensure the treatment area is free from dressings or casts that block light penetration. The light can be applied around the dressing or cast
- Do not use over open surgical wounds if closed with staples, however apply light above and below the staples.

- Using the light if there are sutures in the surgical area is ok. NOTE the skin has been shown to heal faster and this may necessitate removal of sutures sooner if non resorbable sutures are used surgically
- PBM is non-invasive and well-tolerated in both conservative and surgical fracture management.

Conclusion

Photobiomodulation is a powerful adjunct therapy for accelerating bone fracture healing. Clinical studies confirm its benefits in reducing healing time, enhancing callus formation, and improving outcomes post-surgery. Using SPRB and GRPB devices at home or in rehabilitation centers offers a practical and evidence-based way to support bone recovery, reduce complications, and restore mobility.

Recent clinical and animal studies have demonstrated that PBM can accelerate bone healing by 20% to 40%, depending on the type and severity of the fracture. This translates into a shorter time to radiographic union and faster return to weight-bearing or normal function. Additionally, PBM-treated patients reported a 30–50% reduction in the need for analgesics, including NSAIDs and opioids, as inflammation and pain resolved more rapidly. [Live link](https://pubmed.ncbi.nlm.nih.gov/34898146/)

Disclaimer

The information provided in this document is for educational and informational purposes only. It is not intended as a substitute for professional medical advice, diagnosis, or treatment. Individuals should always consult with a licensed physician or qualified healthcare provider before beginning any new therapy, including the use of photobiomodulation (PBM) devices.

PBM devices such as the SPRB and GPRB are wellness tools designed to support general health and well-being. They are not medical devices and are not intended to diagnose, treat, cure, or prevent any disease or medical condition. No medical claims are made or implied. Results may vary based on individual factors, and PBM should not be considered a replacement for appropriate medical care.