



## TRAUMA/ORTHOPEDECS LITERATURE

Emerg Med Clin North Am. 2007 Feb;25(1):177-88.

### **Hyperbaric oxygen therapy in the treatment of open fractures and crush injuries.**

**Buettner MF, Wolkenhauer D.**

This article focuses on the use of hyperbaric oxygen therapy (HBOt) in the treatment of open fractures and crush injuries. Based on the clinical evidence and cost analysis, medical institutions that treat open fracture and crush injuries are justified in incorporating HBOt as a standard of care. Both Medicare and Undersea and Hyperbaric Medical Society guidelines list crush injuries as an approved indication for HBOt. Emergency physicians should familiarize themselves with this emerging treatment modality because of their role in the early management of these injuries.

Microsurgery. 2005;25(4):272-83.

### **Delayed microsurgical reconstruction of the extremities for complex soft-tissue injuries.**

**Riccio M, Paolo Pangrazi P, Campodonico A, Bertani A.**

The treatment of severe wounds of the extremities, characterized by large posttraumatic tissue loss, represents a clinical problem difficult to resolve, especially when the lesion is surrounded by large areas of ischemic dystrophic tissue which progressively aggravate and extend the initial lesion, with frequent exposure of bone and joint structures making the amputation of the limb an inevitable outcome. The authors present their experience based on combined treatments by medical support methods such as hyperbaric oxygen (HBO) and vacuum-assisted closure therapy (VAC) and microsurgical reconstruction of the limbs, within a precise therapeutic protocol. The use of this protocol in appropriate times and ways allowed us to successfully treat severe posttraumatic sequelae of the limbs, avoiding the delayed healing typical of these pathologies, both on the donor site of the flap and on the repaired area, and avoiding unsuitable microsurgical reconstruction of limbs, allowing satisfactory morpho-functional restoration and a reduction of the hospitalization period.

J Am Acad Orthop Surg. 2004 Nov-Dec;12(6):376-84.

### **Hyperbaric oxygen therapy in extremity trauma.**

**Greensmith JE.**

Hyperbaric oxygen therapy potentially can provide enhanced oxygen delivery to peripheral tissues affected by vascular disruption, cytogenic and vasogenic edema, and cellular hypoxia caused by extremity trauma. After appropriate resuscitation, macrovascular repair, and fracture fixation/stabilization, adjunctive hyperbaric oxygen therapy can enhance tissue oxygen content. In patients with crush injury or early compartment syndrome, hyperbaric oxygen therapy may reduce the penumbra of cells at risk for delayed necrosis and secondary ischemia. Animal experiments and human case series suggest the benefits of such therapy, and recent randomized, prospective studies on trauma patients have confirmed its efficacy in those with extremity trauma. However, more data are necessary to determine additional indications as well as optimal timing and dosing for hyperbaric oxygen therapy.



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Unfallchirurg. 2001 Feb;104(2):102-14.

### **Hyperbaric oxygen therapy in trauma surgery**

**Mutschler W, Muth CM.**

Hyperbaric oxygenation is achieved when a patient breathes 100 percent oxygen in an environment of elevated atmospheric pressure. Physiologically, this produces a directly proportional increase in the plasma volume fraction of transported oxygen which is readily available for cellular metabolism. A number of beneficial biochemical, cellular and physiologic effects result which account for the use of hyperbaric oxygen as an adjunctive therapy in the treatment of clostridial myonecrosis, crush injuries, compromised flaps, osteoradionecrosis and chronic problem wounds. Indications, modes of treatment, contraindications, side effects, costs and experimental and clinical results are presented. Overall, these data demonstrate that hyperbaric oxygen is no longer "a therapy in search of diseases". However, more randomized controlled clinical trials are necessary to demonstrate its efficacy.



## TRAUMA/ORTHOPEDECS LITERATURE

J Trauma. 1996 Aug;41(2):333-9.

### **Hyperbaric oxygen therapy in the management of crush injuries: a randomized double-blind placebo-controlled clinical trial.**

**Bouachour G, Cronier P, Gouello JP, Toulemonde JL, Talha A, Alquier P.**

Hyperbaric Oxygen (HBO) therapy is advocated for the treatment of severe trauma of the limbs in association with surgery because of its effects on peripheral oxygen transport, muscular ischemic necrosis, compartment syndrome, and infection prevention. However, no controlled human trial had been performed until now to specify the role of HBO in the management of crush injuries. Thirty-six patients with crush injuries were assigned in a blinded randomized fashion, within 24 hours after surgery, to treatment with HBO (session of 100% O<sub>2</sub> at 2.5 atmosphere absolute (ata) for 90 minutes, twice daily, over 6 days) or placebo (session of 21% O<sub>2</sub> at 1.1 ata for 90 minutes, twice daily, over 6 days). All the patients received the same standard therapies (anticoagulant, antibiotics, wound dressings).

Transcutaneous oxygen pressure (PtCO<sub>2</sub>) measurements were done before (patient breathing normal air) and during treatment (HBO or placebo) at the first, fourth, eighth, and twelfth sessions. The two groups (HBO group, n = 18; placebo group, n = 18) were similar in terms of age; risk factors; number, type or location of vascular injuries, neurologic injuries, or fractures; and type, location, or timing of surgical procedures. Complete healing was obtained for 17 patients in the HBO group vs. 10 patients in the placebo group (p < 0.01). New surgical procedures (such as skin flaps and grafts, vascular surgery, or even amputation) were performed on one patient in the HBO group vs. six patients in the placebo group (p < 0.05). Analysis of groups of patients matched for age and severity of injury showed that in the subgroup of patients older than 40 with grade III soft-tissue injury, wound healing was obtained for seven patients (87.5%) in the HBO group vs. three patients (30%) in the placebo group (p < 0.05). No significant differences were found in the length of hospital stay and number of wound dressings between groups. For the patients with complete healing, the PtCO<sub>2</sub> values of the traumatized limb, measured in normal air, rose significantly between the first and the twelfth sessions (p < 0.001). No significant change in PtCO<sub>2</sub> value was found for the patients whose healing failed. The Bilateral Perfusion Index (BPI = PtCO<sub>2</sub> of the injured limb/PtCO<sub>2</sub> of the uninjured limb) at the first session increased significantly from 1 ata air to 2.5 ata O<sub>2</sub> (p < 0.05). In patients with complete healing, the BPI was constantly greater than 0.9 to 2.5 ata O<sub>2</sub> during the following sessions, whereas the BPI in air progressively rose between the first and the twelfth sessions (p < 0.05), reaching normal values at the end of the treatment. In conclusion, this study shows the effectiveness of HBO in improving wound healing and reducing repetitive surgery. We believe that HBO is a useful adjunct in the management of severe (grade III) crush injuries of the limbs in patients more than 40 years old.