

Case Study – Use of Topical Oxygen for Management of a Pedal Amputation Site with Multiple Vascular Limitations

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Introduction and Purpose

One of the major determinants of wound healing is the level of perfusion to the wound to allow proliferation of growth factors for tissue growth and eventual closure. Detrimental factors from a patient's medical history can severely limit this, from well established issues like peripheral vascular disease to more recent concerns like COVID-19. Oxygen therapy is a treatment adjunct that aids wound healing by supplying oxygen to tissue similarly to perfusion for inducing wound healing, but hyperbaric oxygen therapy can be difficult to establish for a patient and may affect organ function due to oxygen toxicity. Topical oxygen has been proposed as an alternative that is more portable, simpler to use, and avoids undue oxidative stress on the organs by focusing oxygen delivery onto the wound of interest.

The purpose of this case study is to demonstrate one instance of a poorly healing surgical wound after a trans-metatarsal amputation, which was successfully closed using topical oxygen therapy that was started after months of unsuccessful closure. This difficulty healing stemmed from a medical history leading to limitations to perfusion.

Case Report

A 61-year-old female with a past medical history including insulin-dependent diabetes with peripheral neuropathy, peripheral arterial disease, hypertension, hyperlipidemia, coronary artery disease with surgical history of coronary artery bypass graft placement, COVID in 2020, and a former smoker. On top of these perfusion-limiting issues, she also has degenerative disc disease. The Stony Brook podiatry service first saw her in mid-September 2021 for a left dorsal foot with notable gangrenous changes over the forefoot and associated pain. A trans-metatarsal amputation with Achilles tendon lengthening was performed in mid-October 2021, following revascularization in early October as vascular studies revealed non-compressible calcific vessels with a >50% stenosis at the mid anterior tibial artery. She also had a recent coronary artery bypass graft placement in late August 2021 to address concerns of chest pain and difficulty breathing with exertion. About four months in total was spent in the hospital and outpatient setting for post-op management, with notable wound dehiscence and development of a fibrotic wound bed despite regular in-office debridement, dressings with Dakins solution, and vacuum-assisted closure. Topical oxygen via the TWO2 system was eventually offered and started alongside a continued regimen of outpatient debridement every two weeks with daily at-home dressings with hypochlorous acid. After 4 months of topical oxygen use, what started as a singular fibrogranular wound more than 10cm in length would gradually close, starting from the middle to form two smaller medial and lateral wounds that would also eventually close.



Conclusion

This is a retrospective analysis of a patient's post-operative healing progress that demonstrates the benefit of topical oxygen therapy as part of the healing course despite a multifactorial predisposition for poor perfusion that presented initial difficulty in healing the surgical site.

References

1. Hatibie, Mendy & Oley, Maximillian & Noersasongko, Albertus & Hatta, Mochammad & Philips, Gerard & Agustine, & Faruk, Muhammad & Kalangi, Jane & Rumampuk, Irene & Tulong, Marcella. (2021). Effects of Hyperbaric Oxygen Therapy on Vascular Endothelial Growth Factor Protein and mRNA in Crush Injury Patients: A Randomized Controlled Trial Study. *International Journal of Surgery Open*. 29. 33-39.
2. Kalliainen LK, Gordillo GM, Schlanger R, Sen CK. Topical oxygen as an adjunct to wound healing: a clinical case series. *Pathophysiology*. 2003 Jan;9(2):81-87. doi: 10.1016/s0928-4680(02)00079-2. PMID: 14567939.
3. Ceasovschi A, Sorodoc V, Shor A, Haliga RE, Roth L, Lionte C, Onofrei Aursulesei V, Sirbu O, Culis N, Shapieva A, Tahir Khokhar MAR, Statescu C, Sascau RA, Coman AE, Stoica A, Grigorescu ED, Banach M, Thomopoulos C, Sorodoc L. Distinct Features of Vascular Diseases in COVID-19. *J Inflamm Res*. 2023 Jul.
4. Cates NK, Kim PJ. Topical Oxygen Therapy for Wound Healing: A Critical Evaluation. *Surg Technol Int*. 2022 May 19;40:33-36.
5. Brouwer RJ, Laliou RC, Hoencamp R, van Hulst RA, Ubbink DT. A systematic review and meta-analysis of hyperbaric oxygen therapy for diabetic foot ulcers with arterial insufficiency. *J Vasc Surg*. 2020 Feb;71(2):682-692.e1.
6. Frykberg RG, Franks PJ, Edmonds M, Brantley JN, Téot L, Wild T, Garoufalos MG, Lee AM, Thompson JA, Reach G, Dove CR, Lachgar K, Grottemeyer D, Renton SC; TWO2 Study Group. A Multinational, Multicenter, Randomized, Double-Blinded, Placebo-Controlled Trial to Evaluate the Efficacy of Cyclical Topical Wound Oxygen (TWO2) Therapy in the Treatment of Chronic Diabetic Foot Ulcers: The TWO2 Study. *Diabetes Care*. 2020 Mar;43(3):616-624.