Investigation of germ patency of a PLA-based membrane for the treatment of burns

H. Haller, Leonding*, **E. Held-Föhn**, Denkendorf **

Polylactide-based membranes are an effective physical barrier for germs and reduce risk of infections

Introduction

Infections are severe complications in burns treatments. To avoid such infections, burn care dressings and skin substitutes should be impermeable to germs. **Polylactide-based membranes** (PLM), made of lactide, trimethylene carbonate and caprolactone are **used for the treatment of superficial (2a°) and deep dermal/partial thickness (2b°) burns and injuries and donor sites** as they **mimic the natural skin**.

While their permeability to oxygen and water vapor is similar to skin [1], they provide a physical barrier for microorganisms as well.

The infection rate derived from 11 studies published about the PLM treatment in burns was 2,9% on average [2-12].

Antiseptics (e.g. acetic acid) can be added to PLM to treat and reduce infections further [13].

Aims of the investigation

The investigation was intended to **evaluate the effectiveness of the physical barrier for microorganism** in an in-vitro model for PLA-based membranes for the treatment of burns.

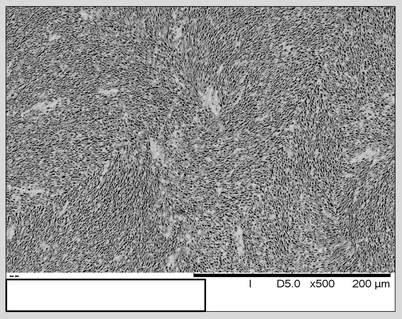
Material and Methods

Polylactide-based membranes with microporous structures were used to determine the germ patency.

The pore sizes vary between 2 and 50 µm and the initial porosity of the membrane is >80% [1].

The sterile PLM samples were aseptically transferred into sterile Petri dishes and **inoculated with 100 µl each of a bacterial suspension.**

SEM of Polylactide-based membrane (surface)



The **test strains:** *Staphylococcus aureus* (ATCC 6538) with approximately 730 colony forming units (cfu) and *Pseudomonas aeruginosa* (ATCC 10145) with approximately 350 CFU / sample were used.

The bacterial suspension was spread over the surface and dried.

PLMs were then **transferred to Tryptic Soy Agar (TSA) plates**.

The incubation was carried out in each case with 3 batches per test strain after 1 day and 3 days at 37°C.

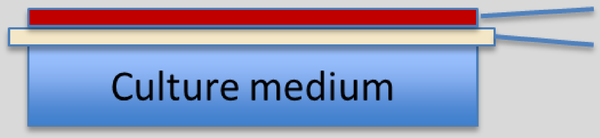
After incubation, the PLM **samples were visually examined for microbial growth under the samples** and photographically documented. A **control group** with inoculation of culture medium and covered with PLM was also tested.

Autors and Affiliations:

***H.L. Haller Unfallkrankenhaus Linz der AUVA (retired) , HL MedConsult, (potential CI) Austria Zehetlandweg 7 4060 Leonding

**E. Held-Föhn, ITV Denkendorf Produktservice GmbH, Körschtalstr. 26, 73770 Denkendorf, Germany

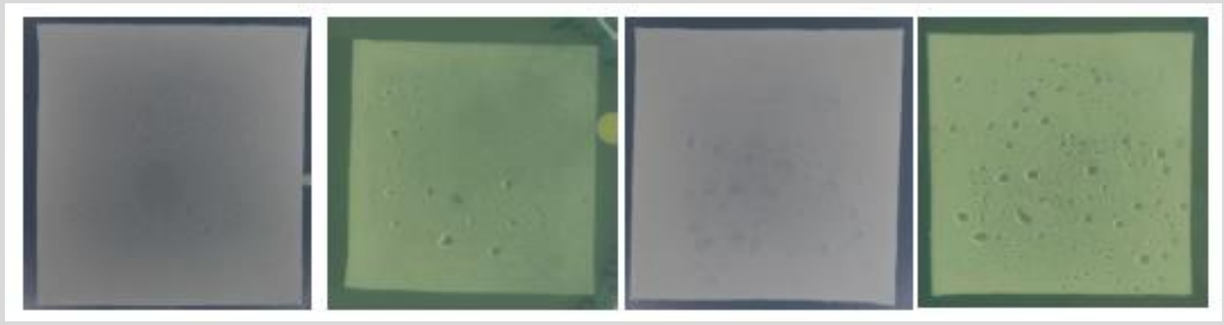
Test Method (schematic)



Test conditions: n = 18 (3 sheets/ germ and control, Temperature: 37°C, Measurement after 1 day, and 3 days for PLM and 1 day control group)

Results of PLM-based samples

In both bacterial strains tested, **no bacterial growth** was observed among the PLM-based samples after an incubation period of one day or after 3 days.



1 day, *S. aureus* | 3 days, *S. aureus* | 1 day, *P. auruginosa* | 3 days, *P. auruginosa*

Results of Control group

The germ count of the growth controls without PLA-based membranes showed an average of 476 CFU with *S. aureus* and 228 CFU with *P. aeruginosa.*

Bacterial growth after 1 day

Staph. aureus *P.aeruginosa*

Lessons Learned

Polylactide-based membranes (PLM) proved to be an effective physical barrier for microorganisms as germs do not pass the PLM.

Control group results to growth of bacteria and confirms, that test method works well.

Polylactide-based membranes protect wounds effectively and are consistent with the low infection rates documented in 11 clinical studies.

Literature:

[1] Uhlig C., Rapp M., Hartmann B., Hierlemann H., Planck H. Dittel K.K. Suparthel – An innovative, resorbable skin substitute for the treatment of burn victims, Burns 33 (2007) 221 - 229
[2] Blome-Eberwein S, Amani H, Lozano D, Boorse D, Pagella P. Firts Results From Application Of an Absorbable Synthetic Membrane to Superficial and Deep Second Degree Wounds. Journal of Burn Care & Research, Volume 35, Issue suppl_3, 1 May 2014
[3] Everett M, Massand S, Davis W, Burkey B, Glat PM. Use of a copolymer dressing on superficial and partial-thickness burns in a paediatric population. J Wound Care. 2015 Jul;24(7):S4-8.
[4] Glat P, Burkey B, Davis W. The Use of Suprathel in the Treatment of Pediatric Burns: Results of an Initial Pilot Investigation. Journal of Burn Care & Research, Volume 35, Issue suppl_3, 1 May 2014
[5] Highton L, Wallace C, Shah M. Use of Suprathel® for partial thickness burns in children. Burns. 2013 Feb;39(1):136-41
[6] Hundeshagen G, Collins VN, Wurzer P, Sherman W, Voigt CD, Cambiaso-Daniel J, Nunez Lopez O, Sheaffer J, Herndon DN, Finnerty CC, Branski LK. A Prospective, Randomized, Controlled Trial Comparing the Outpatient Treatment of Pediatric and Adult Partial-Thickness Burns with Suprathel or Mepilex Ag. J Burn Care Res. 2018 Feb 20;39(2):261-267.
[7] Keck M, Selig HF, Lumenta DB, Kamolz LP, Mittlböck M, Frey M. The use of Suprathel(®) in deep dermal burns: First results of a prospective study. Burns. 2012 May;38(3):388-95.
[8] Markl P, Prantl L, Schreml S, Babilas P, Landthaler M, Schwarze H. Management of split-thickness donor sites with synthetic wound dressings: results of a comparative clinical study. Ann Plast Surg. 2010 Nov;65(5):490-6.
[9] Merz KM, Sievers R, Reichert B. Suprathel® bei zweitgradig oberflächlichen Verbrennungen im Gesicht [Suprathel® for coverage of superficial dermal burns of the face]. GMS Verbrennungsmedizin 2011, Vol 4, ISSN 1869-1412
[10] Rashaan ZM, Krijnen P, Allema JH, Vloemans AF, Schipper IB, Breederveld RS. Usability and effectiveness of Suprathel® in partial thickness burns in children. Eur J Trauma Emerg Surg. 2017 Aug;43(4):549-556
[11] Schwarze H, Küntscher M, Uhlig C, Hierlemann H, Prantl L, Noack N, Hartmann B. Suprathel, a new skin substitute, in the management of donor sites of split-thickness skin grafts: results of a clinical study. Burns. 2007 Nov;33(7):850-4.
[12] Schwarze H, Küntscher M, Uhlig C, Hierlemann H, Prantl L, Ottomann C, Hartmann B. Suprathel, a new skin substitute, in the management of partial-thickness burn wounds: results of a clinical study. Ann Plast Surg. 2008 Feb;60(2):181-5
[13] Ryssel H., Gazyakan M.A., Germann G, Hellmich S., Riedel K., Reichenberger M.A., Radu C.A. Antiseptic therapy with a polylacticacid-acetic acid matrix in burns, Wound Rep Reg (2010), 18439 - 444