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Different growing of osteoblasts on 3D structures in comparison with industrial and individual materials

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Introduction

In reconstructive surgery of maxillofacial defects the application of tissue engineering cell carrier matrices of bone grafts is needed. There is still a variety of indications for special supporting stability materials e.g. for calvarium reconstruction, sinus floor elevation and tumor surgery. The materials differ in pore size, composition, permeability, durability and pore density. Industrial and individual methods exist of producing such materials. The individual technique of rapid prototyping allows a three dimensional growing of cells.

Material and Methods

Scaffolds produced by rapid prototyping (PLGA, Resomer RG 503® Boehringer Ingelheim, Germany (Fig 1)) and one industrial produced material (Tissue FoliE, Baxter, native equine collagen) were compared. Both materials were seeded with 1 x 105 cells/ml osteoblasts. The cells were cultivated of corticolamellar bone of the maxilla from ten different patients and twelve sheep. After one week incubation (37°C / 5% CO2 atmosphere) cell proliferation test (EZ4U, Biomedica Vienna) was performed. Furthermore cell growing was investigated by using scanning electron microscope.

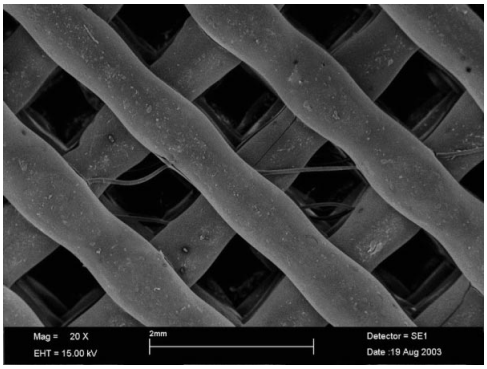
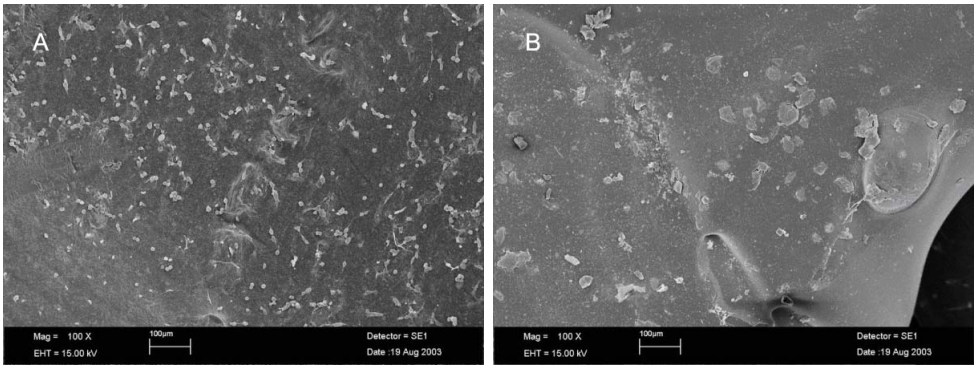


Fig.1: Individual PLGA scaffold produced by rapid prototyping



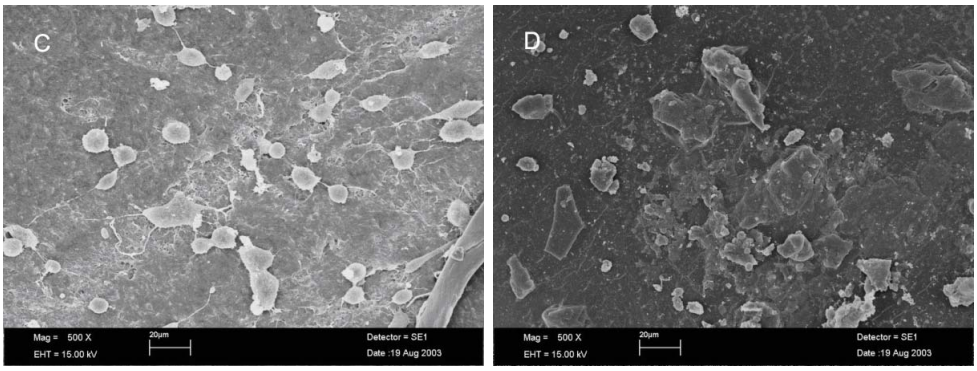


Fig.2: Scanning electron microscopy study of industrial and individual materials. On the left side (Fig A,C) are the collagen matrices and on the right side (Fig B,D) are the PLGA scaffolds produced by rapid prototyping. Only human osteoblasts are shown. They were cultivated and seeded with 1x105 osteoblasts/ml on each

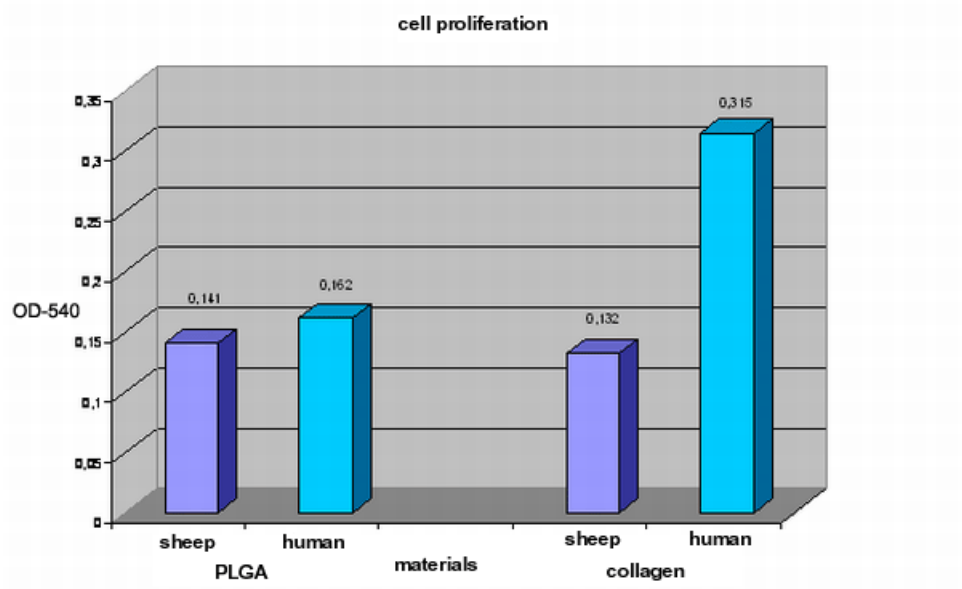


Fig 3: Cell proliferation analysis of human (n=10) and sheep (n=12) osteoblasts seeded on individual PLGA and industrial collagen material. Little difference in cell proliferation between the materials for sheep osteoblasts exist. The difference between human and sheep osteoblasts on PLGA was obvious. The optimal growing conditions were on the industrial material with human osteoblasts.

Results

Comparing these experiments human osteoblasts showed a higher cell proliferation than sheep osteoblasts on each material. Furthermore the growing of sheep osteoblasts was better on PLGA 3 D plotted structure. There was a significant higher cell proliferation of human osteoblasts on the collagen matrix than on PLGA.

Conclusions

This study showed that both materials are equal with regard to cell proliferation and cell cytotoxic effects. The industrial and the individual structures are suitable for clinical application. The advantage of rapid prototyping is the possibility of producing individual scaffolds which allows three dimensional growing condition.

Literature

- How to optimise seeding and culturing of human osteoblast-like cells on various biomaterials, Wiedmann-Al-Ahmad M, Gutwald R, Lauer G, Hübner U, Schmelzeisen R, Biomaterials 23(2002) 3319-3328
- Rapid prototyping of scaffolds derived from thermoreversible hydrogels and tailored for applications in tissue engineering, Landers R, Hübner U, Schmelzeisen R, Mülhaupt R, Biomaterials 23 (2002) 4437-4447

This Poster was submitted by Bettina Hohlweg-Majert

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Poster Faksimile:

Different growing of osteoblasts on 3D structures in comparison with industrial and individual materials

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Introduction

In reconstructive surgery of craniomaxillofacial defects the application of tissue engineered osteoblasts seeded on 3D-matrices to replace autologous bone grafts is needed. There is still a variety of indications for bone substitutes providing enough stability versus support to reconstruct e.g. calvarial defects or to elevate the maxillary sinus floor. The materials differ in pore size, composition, permeability, durability and pore density. Industrial and individual methods exist to produce such materials. The individual technique of rapid prototyping allows a three dimensional growth.

Materials and methods

Two types of matrices were analysed. One scaffold produced by rapid prototyping (PLGA, Resomer RG 503® Boehringer Ingelheim, Germany (**Fig 1**)) and one industrially produced material (Tissue FoliE, Baxter, native equine collagen) were compared. Both materials were seeded with 1 x 10^5 cells/ml osteoblasts. The cells were cultivated out of corticolamellar maxillary bone from ten different patients and twelve sheep. After one week incubation period (37°C / 5% CO_2 atmosphere) cell proliferation test (EZ4U, Biomedica Vienna) was performed. Furthermore cell growth was investigated by using scanning electron microscopy.

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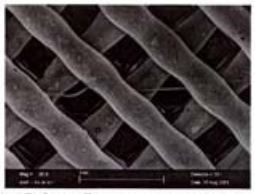

Fig 1
Individual PLGA scaffold produced by rapid prototyping

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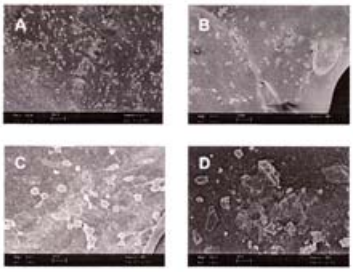

Fig 2:
Scanning electron microscopy study of industrial and individually plotted materials: on the left side (**Fig A,C**) are the collagen matrices and on the right side (**Fig B,D**) are the PLGA scaffolds produced by rapid prototyping. Only human osteoblasts are shown. They were cultivated and seeded with 1x10^5 osteoblasts/ml on each material.

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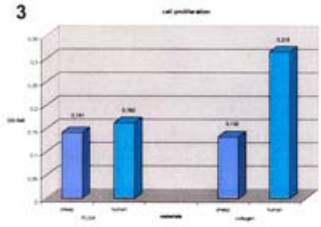

Fig 3:
Cell proliferation analysis of human (n=10) and sheep (n=12) osteoblasts seeded on individual PLGA and industrial collagen material. Little difference in cell proliferation between the materials for sheep osteoblasts exist. The difference between human and sheep osteoblasts on PLGA is obvious. Optimal growth conditions are given on the industrial material with human osteoblasts.

Results

This study reveals that human osteoblasts show a higher cell proliferation than sheep osteoblasts on each material. Furthermore the growth of sheep osteoblasts was better on plotted PLGA 3 D matrices. There was a significant higher cell proliferation of human osteoblasts on the collagen matrix compared to the PLGA scaffold.

Conclusion

This research shows that both matrix materials are basically equal with regard to cell proliferation and cell cytotoxic effects. The industrial and the individual structures are suitable for clinical application. The advantage of rapid prototyping is the possibility of producing micro- and makroporous individual scaffolds which allows three dimensional approaches for clinical application of tissue engineering in the future.

Literature:
How to optimise seeding and culturing of human osteoblast-like cells on various biomaterials, Wiedmann-Al-Ahmad M, Gutwald R, Lauer G, Hübner U, Schmelzeisen R, Biomaterials 23(2002) 3319-3328
Rapid prototyping of scaffolds derived from thermoreversible hydrogels and tailored for applications in tissue engineering, Landers R, Hübner U, Schmelzeisen R, Mülhaupt R, Biomaterials 23 (2002) 4437-4447