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A 3D printed biodegradable polylactide cage loaded with collagen I and growth factors (SDF-1 and BMP-7) for bone regeneration

BiomaTiCS

Ulrike Ritz

Preliminary works

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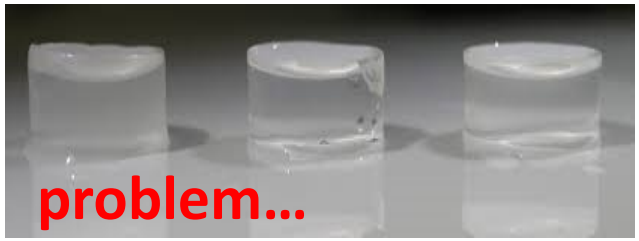
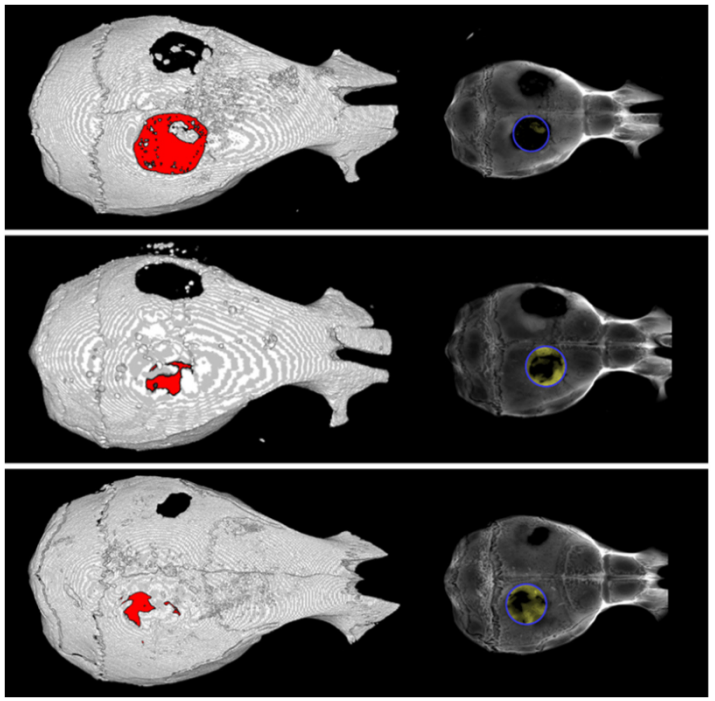
hydrogels / collagen gels loaded with primary cells or cytokines





3D- printing

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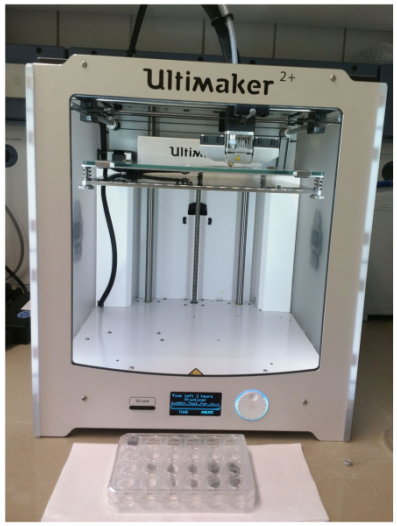
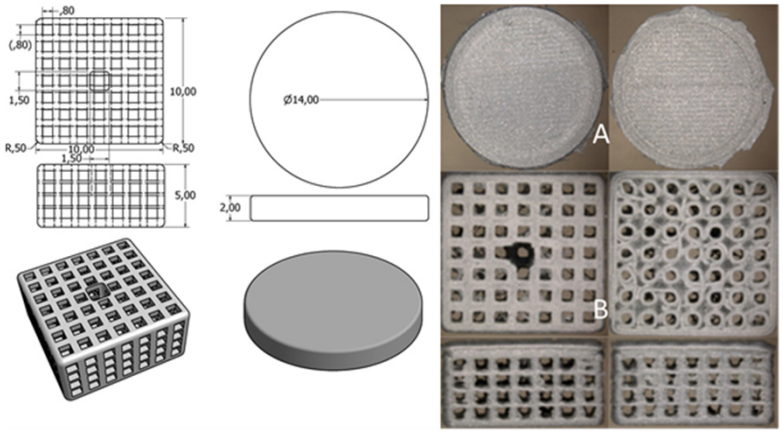
Polylactide



modifications with collagen and SDF-1 or BMP-7

In vitro
In vivo



- **no cytotoxic effects**

Biocompatibility

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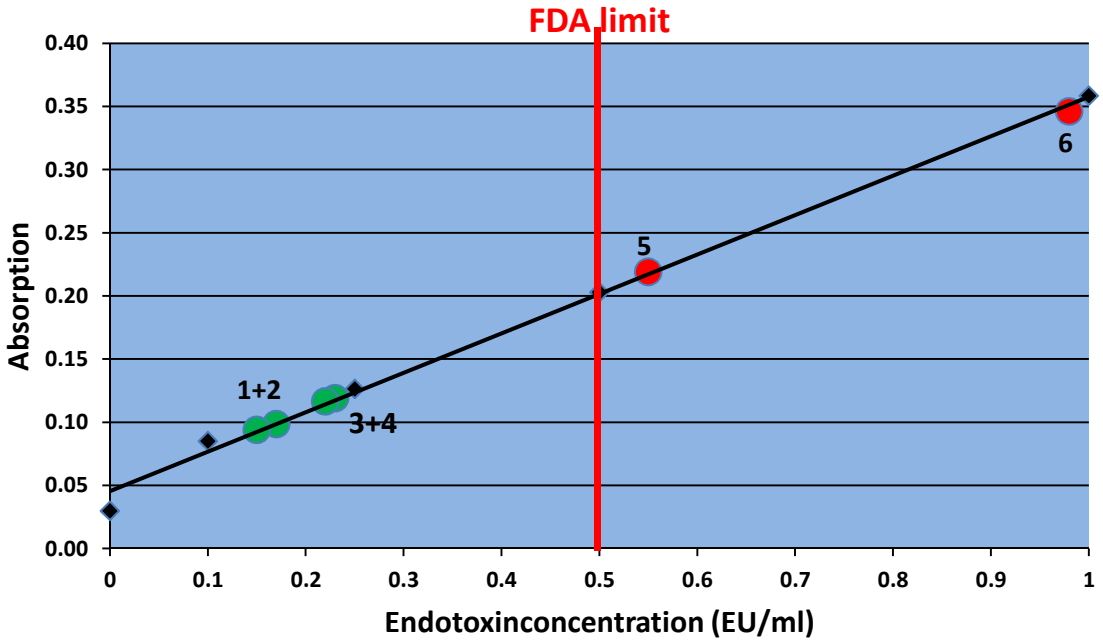
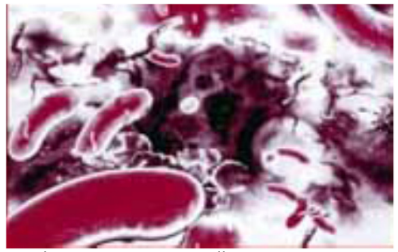
Testing for endotoxin contamination




Endotoxins, Kevin L. Williams

- 1+2 PLA after incubation in PBS (24h)
- 3+4 PLA after incubation in PBS (48h)
- 5 PLA after unpacking
- 6 PLA after unpacking and 7 days of storage

Biocompatibility

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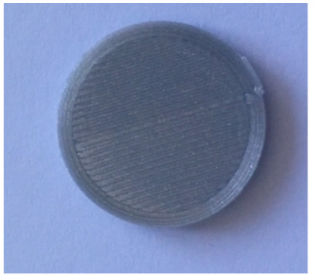

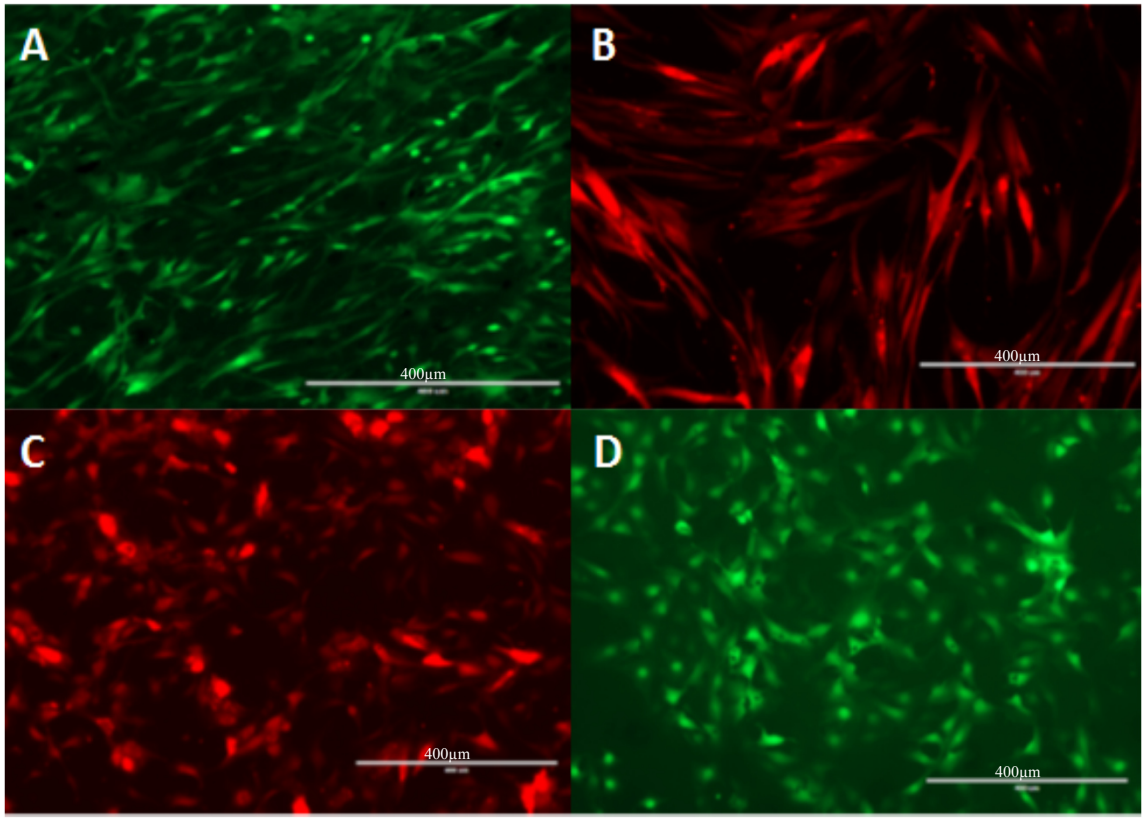

A: primary osteoblasts - hOB
B: dermal fibrobroblasts - NHDF
C: umbilical vein endothelial cells - HUVEC
D: osteosarkoma cells - SaOS-2

SDF-1 release

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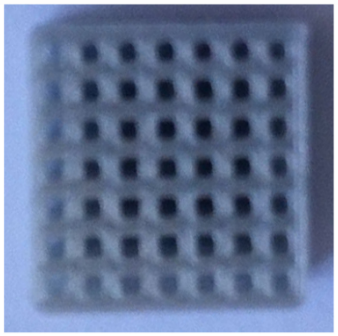

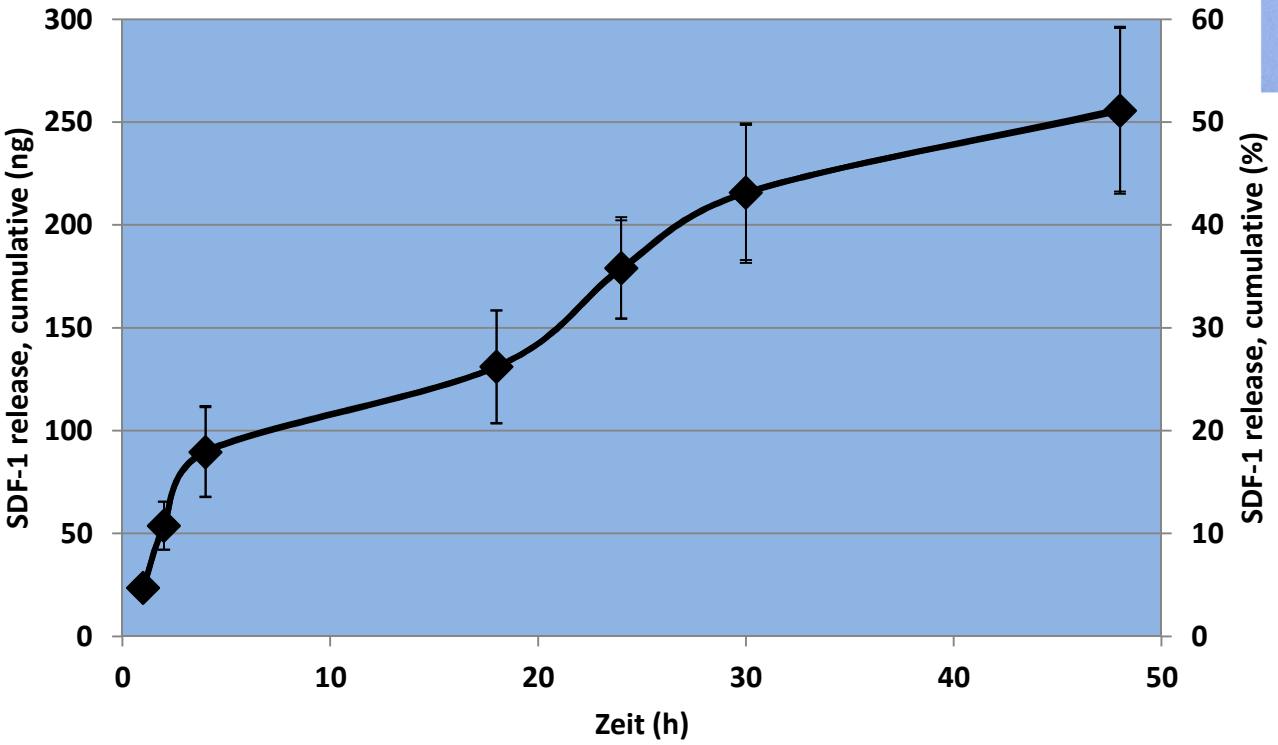

3-dimensional growth of endothelial cells

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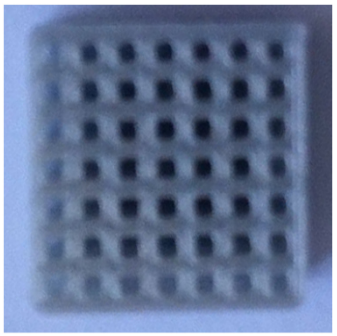
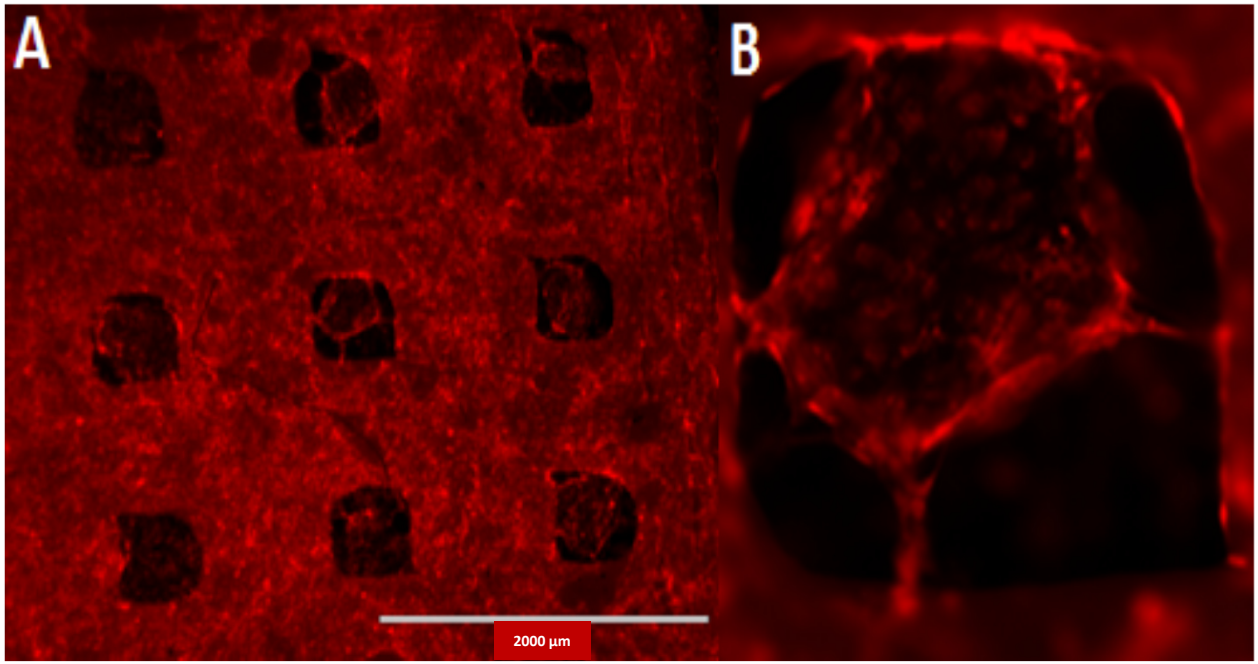
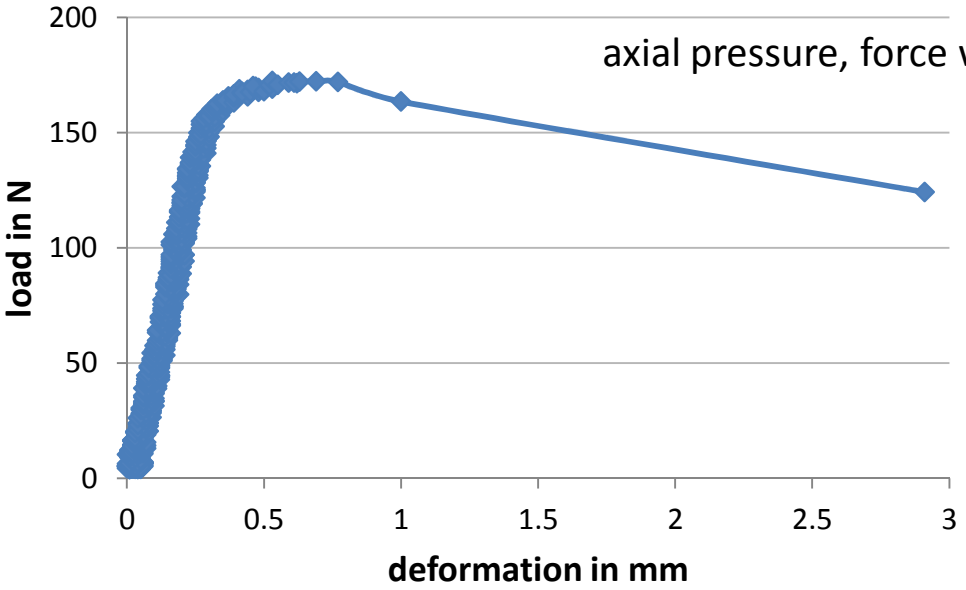




Biomechanical testing



axial pressure, force was continually raised with 0,03Hz

Maximum force til breakdown was 157,13N (4 measurements).
As 9,81 N represent 1 kg; the cages withstand a load from 16 kg.

In vivo

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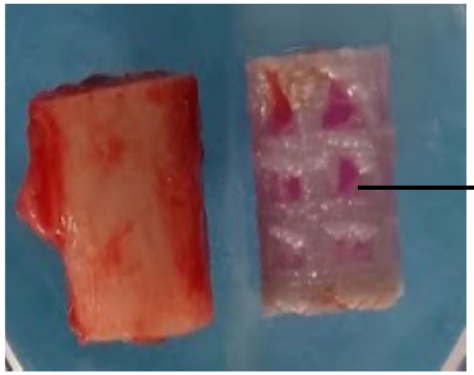
Critical size defect – rat femur

RiSystems



In vivo

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Group	Group size/ usable	Time of killing
Empty control - no PLA-cage	4/4	8 weeks
PLA-cage alone	8/7	8 weeks
PLA-cage + collagen	8/8	8 weeks
PLA-cage + collagen + BMP-7	8/8	8 weeks
PLA-cage + collagen + BMP-7	2/2	18 weeks
PLA-cage + collagen + SDF-1	8/8	8 weeks
PLA-cage + collagen + SDF-1	2/2	18 weeks

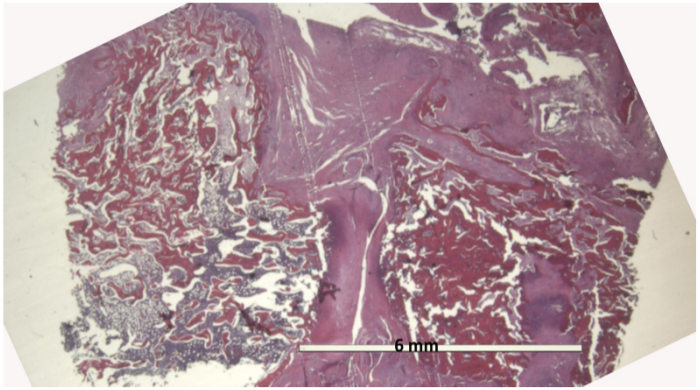
Summary

In vitro

- Biocompatible and adhere, grow and proliferate
- immobilization and release of growth factors
- endothelial cells grow into cages and form neo-vessels

Outlook

- **Quantification of bone formation**
- **HE-stainings**
- **Immunohistochemical stainings: bone and angiogenesis markers**



Team

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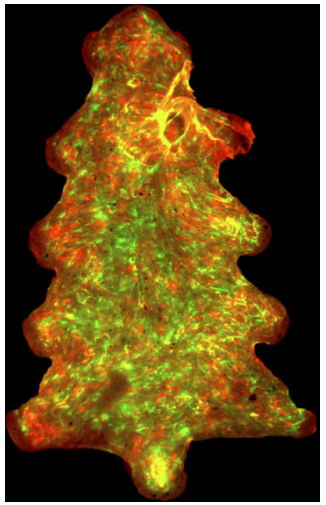

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