IN VITRO PERIODONTAL LIGAMENT MODEL TO ASSESS SYNTHETIC SELF ASSEMBLING PEPTIDES FOR REGENERATION

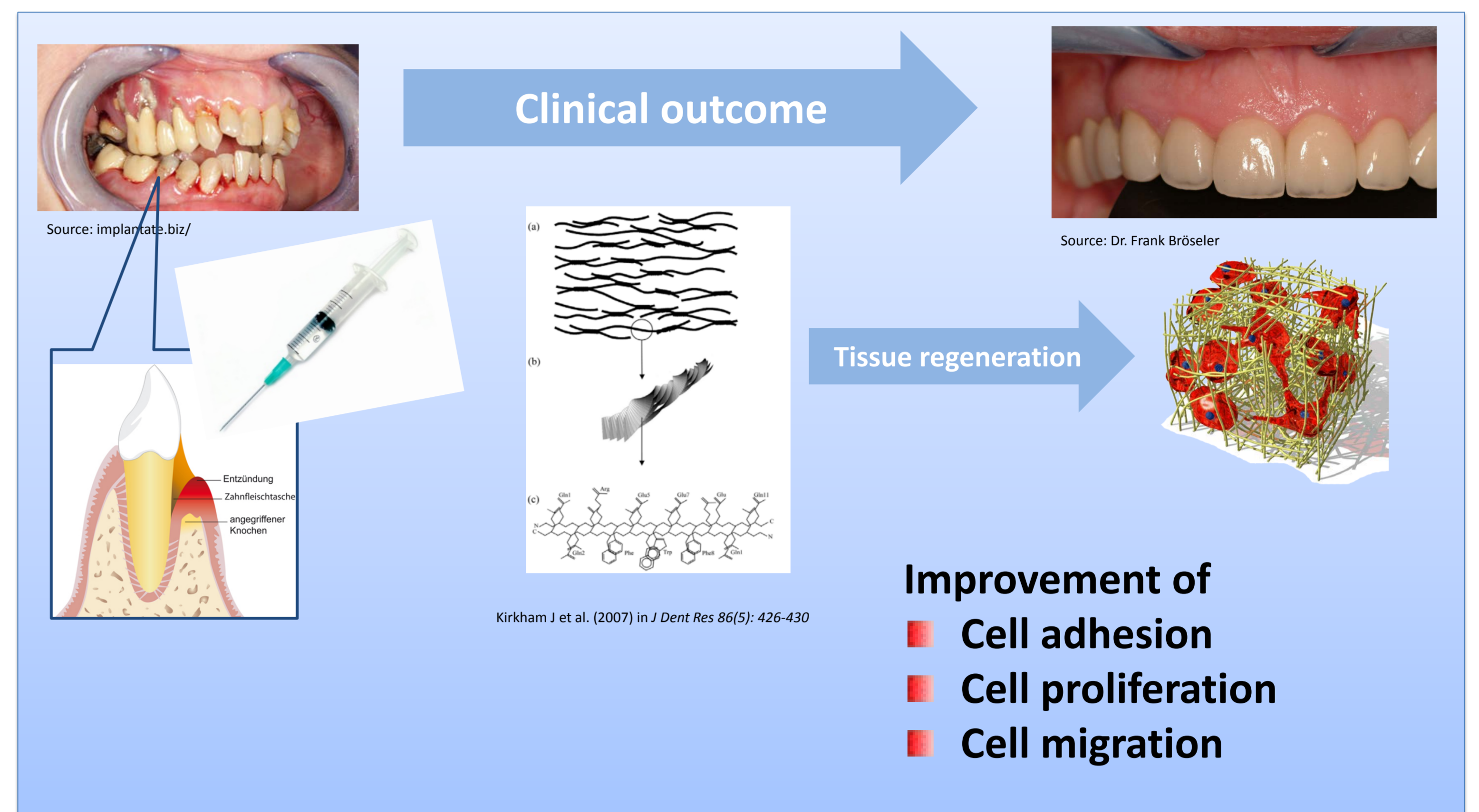Nina Meyer[1], Franziska Koch[2], Ronald Jung[3] and Stephanie Mathes[1]

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Objectives

The periodontal ligament represents a complex tissue structure between the tooth cementum and the alveolar bone. The matrix is build up by periodontal ligament fibroblasts (PDLF) that produce their ECM, which mainly consists of collagen. During periodontitis this structure is severely affected. In order to enable tissue regeneration a new matrix based on self-assembling peptides (SAPs) will be introduced into the defect site. In order to avoid unnecessary animal trials and to receive relevant biological information in an early phase of product development, a relevant human tissue model of the periodontal gap was developed.


Clinical outcome
Source: implantate.biz/
Source: Dr. Frank Bröseler
Tissue regeneration
Kirkham J et al. (2007) in *J Dent Res 86(5): 426-430*

Improvement of
- Cell adhesion
- Cell proliferation
- Cell migration

Methods

- **Matrix / surface interaction**: Evaluation of interaction of SAP P11-4 with dentin surface using fluorescent labeled peptide
- **Matrix /cell interaction**: Evaluation of cell adhesion and proliferation on SAP matrices by viability assays and evaluation of cell migration into SAP matrices by fluorescence microscopy
- **Matrix / tissue interaction:** Evaluation of migration in SAP gels on dentin surface
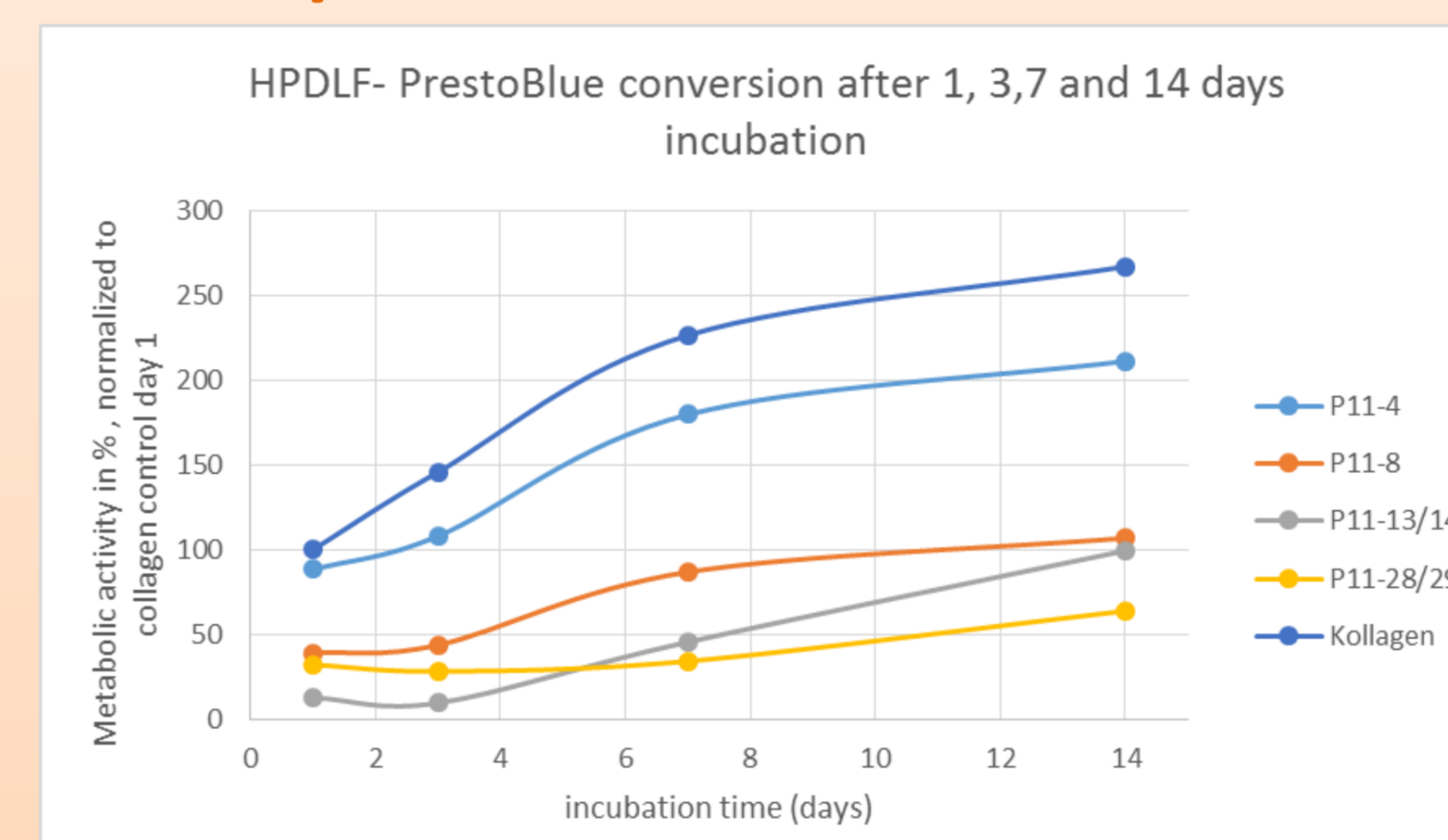
Results

Matrix / surface interaction

Direction of cutting
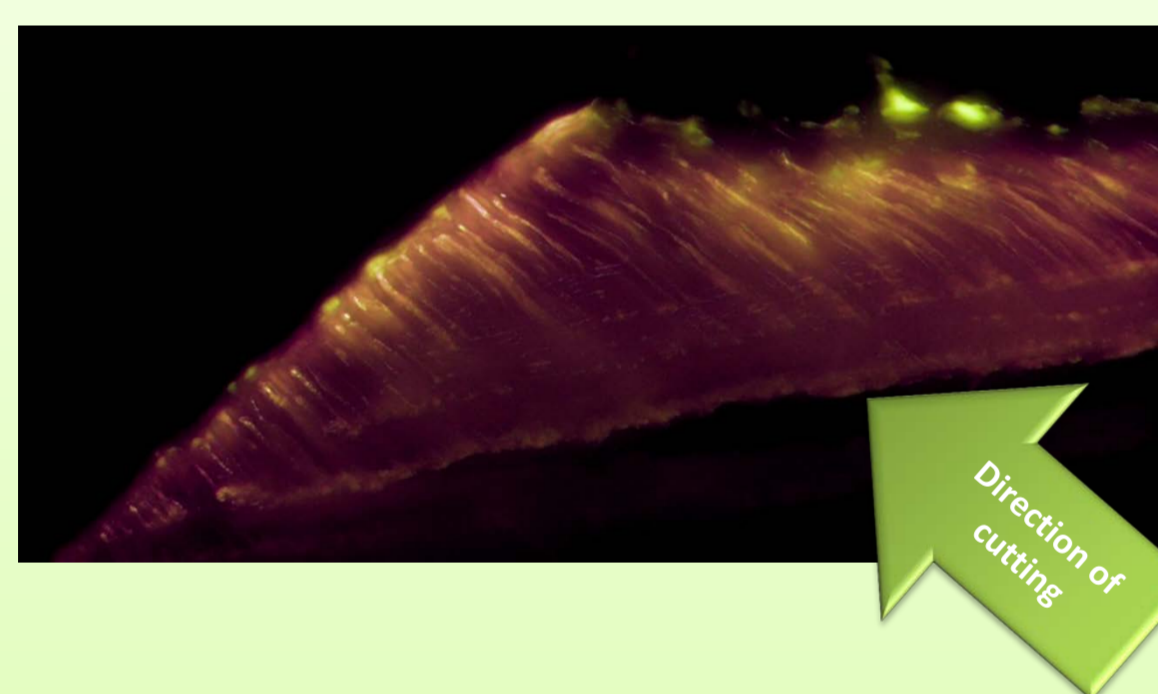
P11-4 labeled with fluorophore; interaction with dentin surface for 24h; samples were de-mineralized and cut using a cryotome

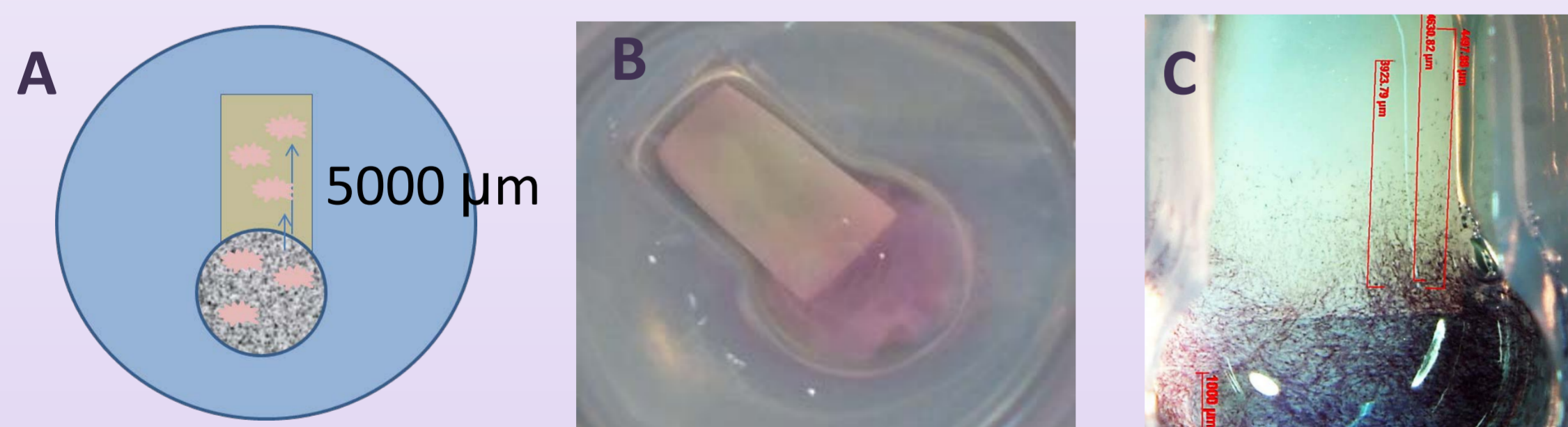**Strong interaction of peptide and dentin surface and inside dentin channels**
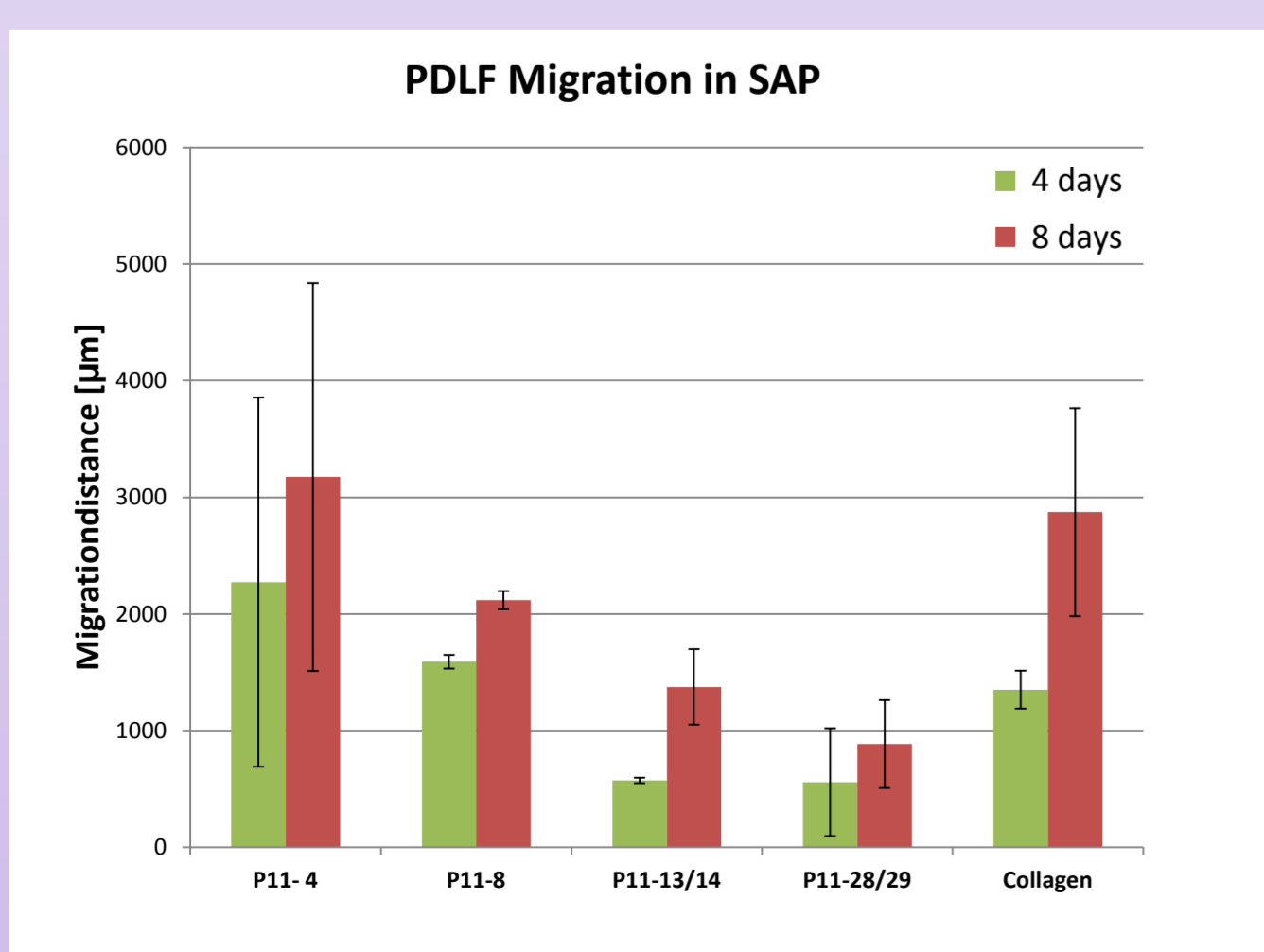
Matrix / tissue interaction
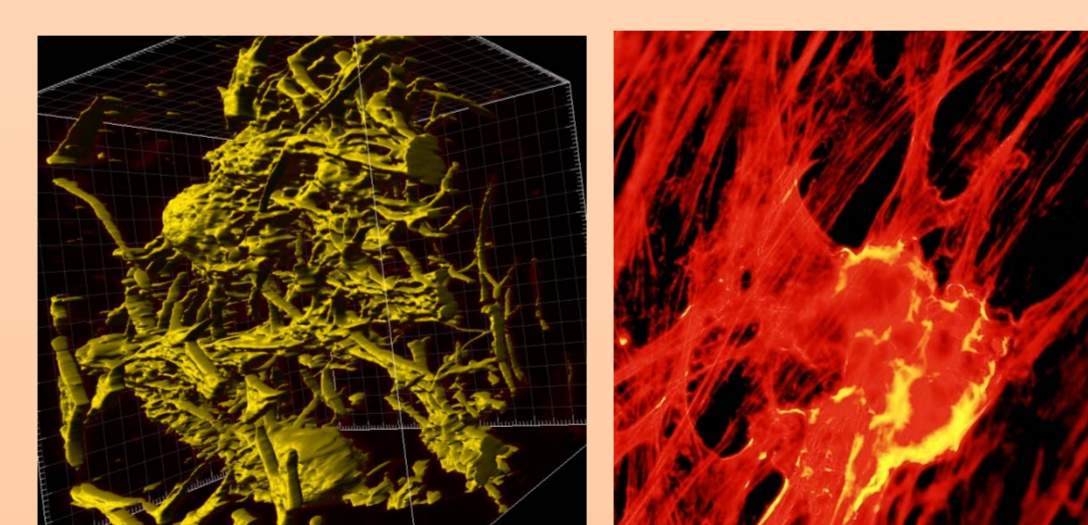

A 5000 µm
B
C

In vitro *model of the periodontal pocket of 5 mm. (A) Schematic drawing, (B) periodontal model with PDLF containing collagen hydrogel (pink) and dentin surface (yellow) surrounded by agarose. (C) Analysis of cell migration distance after MTT staining*


PDLF Migration in SAP

- 4 days
- 8 days

Distance of migration from donor compartment over 4 and 8 days on SAP covered dentin surfaces

Homogeneous migration of PDLF cells in periodontal model is most obvious for P11-8

Matrix / cell interaction

HPDLF- PrestoBlue conversion after 1, 3,7 and 14 days incubation

- P11-4
- P11-8
- P11-13/14
- P11-28/29
- Kollagen

Development of PDLF viability over 14 days on SAPs

Fluorescent labeled PDLFs inside a P11-4 hydrogel (left) and interaction of the cells with P11-8 (right)

Degradation of P11-peptides by action of PDLF

- PDLF [2000 Cells]
- Medium
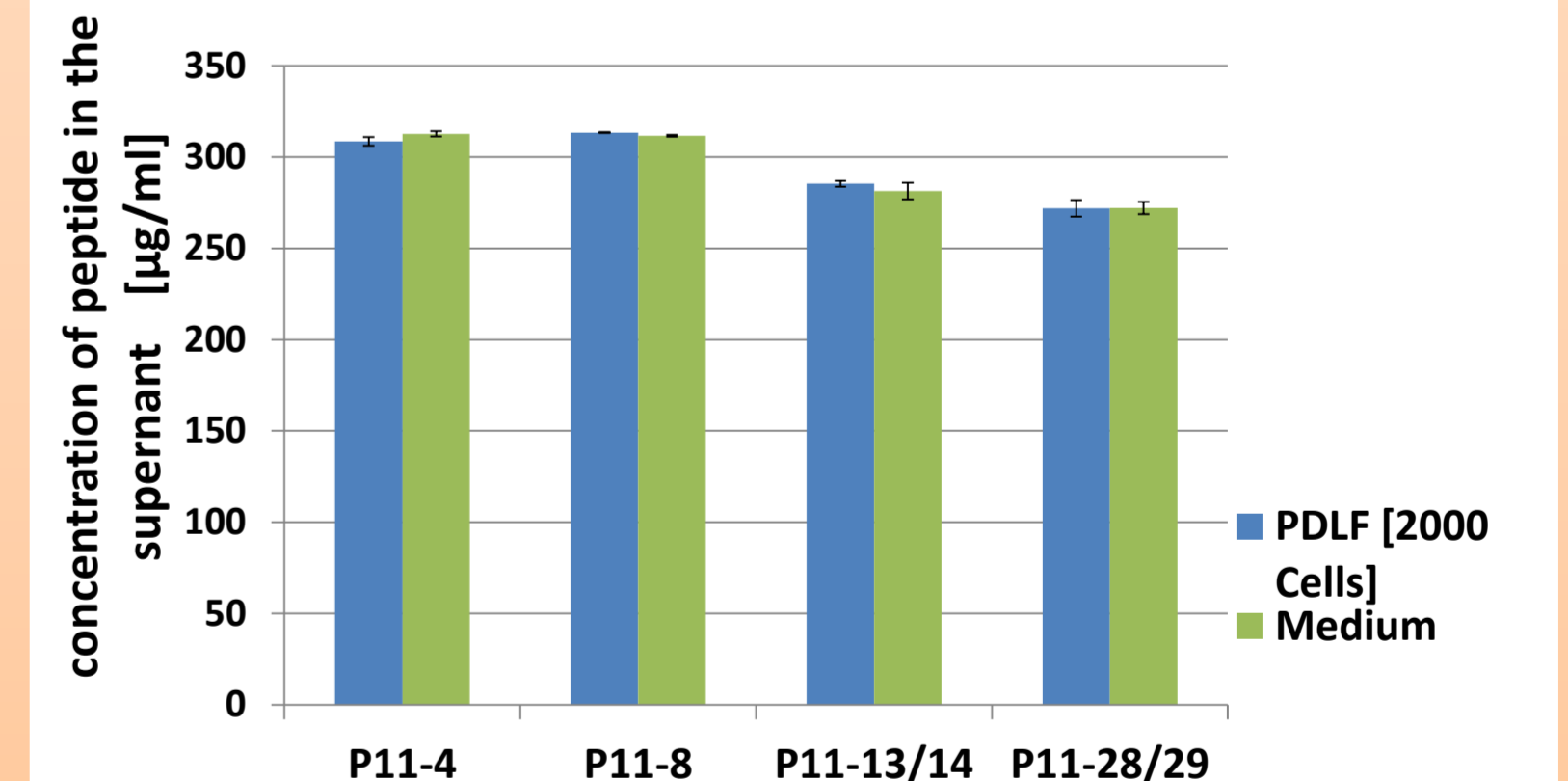
PDLF does not degradant the P11 Peptide after 24 h

PDLF proliferate best on P11-4, also spread inside the matrix and matrix will nevertheless be stable over

Conclusion

Periodontal treatment has emerged to one of the most important issues in dentistry. The established *in vitro* model of the periodontal ligament is feasible to assess important process steps of tissue regeneration. *In vitro* investigations made the positive effect of **P 11-4** and **P 11-8 SAPs** for periodontal tissue regeneration apparent. These peptides will subsequently be evaluated in an *in vivo* animal trial to assess the efficacy in an environment where microorganisms and immune cells are present.