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# First biological quantification of periodontal ligament from histology for orthodontic bone remodeling

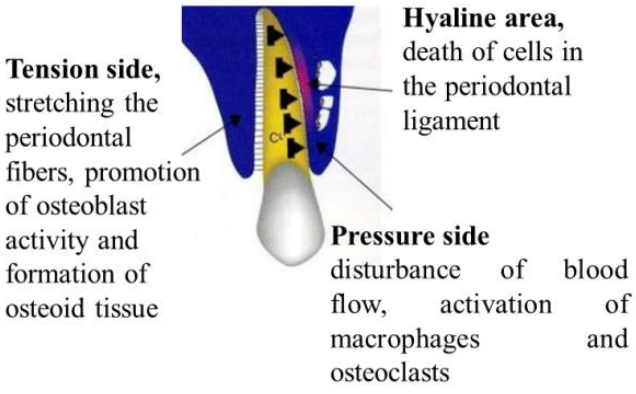
**D. Wagner [1][2] , H. El Hafci [3] , M. Bensidhoum [3] , Y. Rémond [1] , D. George [1]**

[1] Laboratoire Icube, Université de Strasbourg, CNRS UMR 7357, Strasbourg
[2] Faculté de Chirurgie Dentaire, 8 rue Sainte Elisabeth, 67000 Strasbourg
[3] Laboratoire B2OA (Bioingénierie et Bio-imagerie oastéo-articulaire), CNRS UMR 7052, Paris

## CONTEXT

In orthodontics, appliances exert loads to the crown of the tooth resulting in tooth movement (Ammar, 2011; Field, 2009). The PDL connecting the tooth and the alveolar bone is a connective biological soft tissue where the biological and mechanical responses in the PDL under orthodontic loads trigger bone modelling and remodelling (Natali, 2007; Dustra, 2016).

Trying to predict bone remodeling, a detailed understanding of the histology and mechanical properties of the PDL can provide deeper insights into the biomechanical mechanism of tooth movement.




## OBJECTIVES AND METHODOLOGY

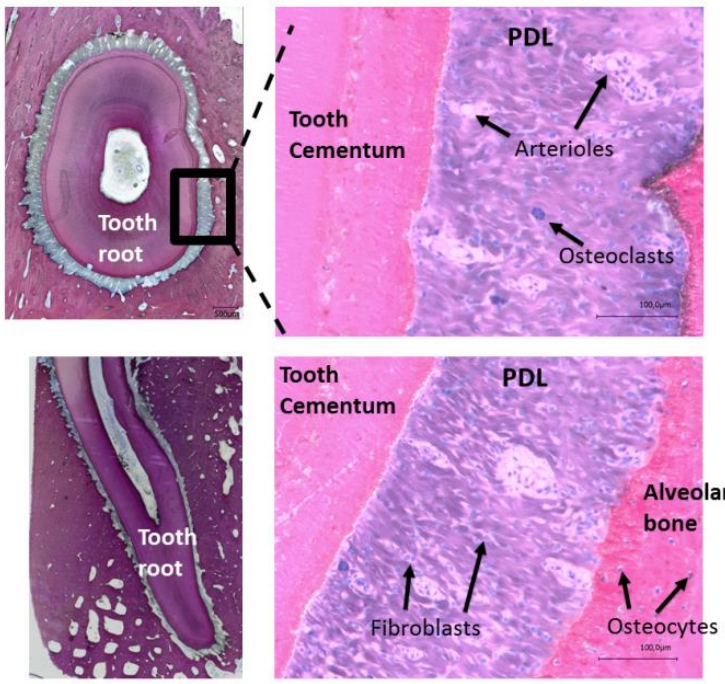
The aims of this study are to :

- Histologically quantify the cellular and vascular elements present into the PDL using porcine samples.
- Integrate these density distributions into a theoretical numerical model to predict bone remodelling as function of time
- Compare and validate the numerical model results with patient data and reconstructions

## PRELIMINARY RESULTS

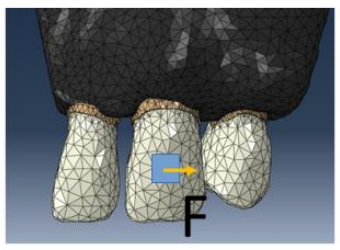
From a coronal section of a dental root, we need to quantify the vascularization and cell types densities to integrate into the numerical model. An example is presented here where :

- We identified between 30 and 50 arterioles which corresponds to an occupation of the blood vessels between 10-30% of the volume of the PDL.
- Other cellular populations are present as fibroblasts in the PDL, osteocytes, osteoblasts and osteoclasts in bone and cementocytes in the cementum.




## INTEGRATION

The experimentally measured cell densities and vascularization will help in the integration and validation of the predictive theoretical numerical model for bone remodelling of specific patients malformations.




## DISCUSSION AND PERSPECTIVES

A preliminary quantification of the biological parameters (vascularization and cell populations) was done on PDL and surrounding biolgical materials on Pig's teeth. These data would serve to implement a predictive numerical model of bone remodelling during orthodontic tooth movement. This issue has priority in orthodontics to be able to anticipate the biological reactions and thus limit the undesirable side effects.

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