
Study of the Adhesive Properties of Porcine Mandibular Periosteum

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Abstract

The periosteum is a complex connective tissue that plays a fundamental role in bone regeneration, mechanical stability, and response to mechanical stress. Our study focuses on the adhesive properties of the porcine mandibular periosteum, with the objective of better understanding its mechanical interactions with the underlying bone. This knowledge is essential for optimizing clinical applications such as mandibular distraction, a surgical technique used to correct mandibular deformities, particularly in children.

Peeling tests were performed on porcine mandibles, collected from specimens of horizontal and ascending branches. These tests allowed us to measure the forces required to detach the periosteum and quantify the adhesion energy. The results show that the horizontal branches exhibit significantly higher adhesion ($695 \pm 434 \text{ J/m}^2$) compared to the ascending branches ($324 \pm 133 \text{ J/m}^2$). This difference is attributed to an inhomogeneity in the density of Sharpey's fibers and muscle insertions between the branches of the mandible.

Our approach is based on a cohesive zone model to describe the adhesion mechanisms. This model incorporates the contribution of mechanical stresses and the visco-hyperelastic properties of the periosteum. The results reveal adhesion energy similar to that of certain industrial adhesives.

Clinically, this work opens up new perspectives for the development of more effective bone grafts and the improvement of mandibular distraction treatments. By more accurately modeling the interactions between the periosteum and bone, it may be possible to optimize surgical protocols and minimize the risks of complications, such as graft detachment or non-integration.

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