

SKIN-TO-BONE INTERACTION: MECHANICAL CHARACTERIZATION BY PEELING TESTS ON PIG SCALPS

Yves Vallet (1), Adrien Baldit (1), Charline Bertholdt (2,3), Rachid Rahouadj (1), Olivier Morel (2,3), Cédric Laurent (1)

1. CNRS UMR 7239 LEM3 - Université de Lorraine, Nancy, France ; 2. Université de Lorraine, CHRU-NANCY, Pôle de la femme, F-54000 Nancy, France ; 3. IADI INSERM U1254, Rue du Morvan, 54500, Vandoeuvre-lès-Nancy, France

Introduction

Fasciae are collagenic tissues permitting a large but finite sliding between organs, but also between skins and its underlying elements [1], [2]. Testing such materials remains a challenge due to high softness and hasty dehydration. Although the peeling test is currently used in the industry, it has seldomly been used to assess the adhesion strength between two living tissue until recently [3]. The objective of this study is to introduce the peeling test as a way to quantify the skin-to-bone interactions.

Materials and Methods

To this aim, peeling tests have been performed on porcine scalps (see Fig.1). The samples peeled were thin bands composed of three distinct layers excised from the scalp region of pig's head: skin; collagenic tissues; and skull. The experimental setup was mounted on a Zwick / Roell tensile machine (load cell capacity of 500 N). The skull band was fixed at the bottom on a translatable tank while the skin was pulled upward by the machine cross head, hence measuring the needed force to separate both parts. To assess the reproducibility of such setup, two experimental campaigns were performed, varying the width and length of the specimen's skin to skull interface.

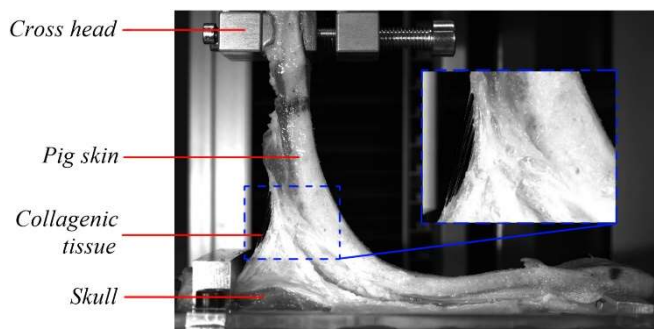


Figure 1: Experimental image - Scalp's skin being peeled from skull

Results

The separation of skin and bone induced progressive tear at the skin interface or within the collagenic tissues (as seen on Figure 1). To compare the results from both campaigns, the measured peeling force have been normalized by the specimen width and the cross head displacement needed to complete the peeling have been normalized by the skin to bone interface length.

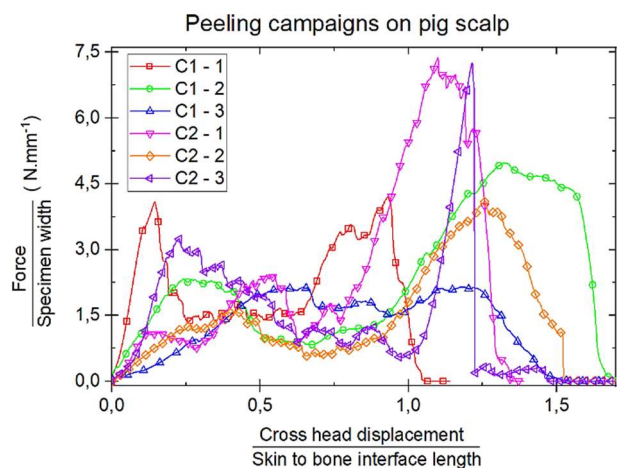


Figure 2: Experimental results from the two different peeling campaigns. C1: campaign 1; C2: campaign 2

The experimental data exhibited three different zones: a transient state where the first collagenic tissues aligned; a force plateau, and a last transient state used to measure the tensile strength of the skin. The plateau force was estimated to $1.22 \pm 0.37 \text{ N} \cdot \text{mm}^{-1}$.

Discussion and conclusion

The extreme softness of the collagenic tissues inducing large sliding between skin and bone and occasional peeling within the collagenic layer resulted in a large observed variability of the obtained data. However, a clear tendency (i.e. plateau) have been observed. This will be exploited to fuel numerical models and would notably be useful to model the interaction between the scalp and skull. To the best of our knowledge, this study is the first attempt to quantify the skin-to-bone interaction using peeling test.

References

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