Biomechanics of osteoderms in a lizard skull – a preliminary finite element study

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Osteoderms (ODs) are bone-like-rich organs found in the skin of many reptiles. The underlying mechanisms of their formation is not well-known. However, it is likely that biomechanical forces may contribute to the formation of osteoderms.

The aim of this study was to develop a finite element model of a reptile skull (with osteoderms) and to investigate: (1) the pattern of stress distribution across the skull with and without the osteoderms; (2) the effect of bone-osteoderm interface properties and (3) the effect of changes in the mechanical properties of osteoderms.

A series of finite element models of an Ocellated lizard (*Timon lepidus*) skull were developed. Bone and osteoderms were modelled with isotropic material properties. The skull was loaded in a simplified loading condition i.e. it was constrained at the occipital condyle and loaded in three biting positions. As quadrate movement (streptostyly) during biting in *Timon* is still a matter of debate, simulations were performed with a mobile and a fixed quadrate.

Removing the ODs led to an increase in the level of stress across the skull roof. Further models with a movable quadrate showed a higher level of stress in the nasal region and a lower level of stress in the parietal region (parietal region). Modelling the gradual fusion of the osteoderms to the bone revealed a gradual reduction of the stress across the skull roof and a gradual increase of the stress within the osteoderms. A similar result was obtained when a fused interface between the bone-osteoderms was assumed and the mechanical properties of osteoderms were gradually increased (i.e. they became more bone like).

These preliminary results suggest that the formation of osteoderms, and their gradual fusion to the underlying bone might be the result of a local adaption to release the mechanical stress on the underlying bone.