

NUMERICAL INVESTIGATION OF BONE HEALING AROUND IMMEDIATELY LOADED DENTAL IMPLANTS USING SIKA DEER ANTLERS AS IMPLANT BED

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Keywords: Sika deer, implants, immediate loading, osseointegration

Summary: Objective: The aim of this study was to analyse the bone healing of antler tissue around dental implants in submerged and unsubmerged conditions and to compare the reaction of the antler tissue with human bone healing process.

Method: Two implants per antler were inserted into four sika deer antlers with a distance of 2.5 cm. One implant was loaded immediately via a self-developed loading device¹; the other was submerged and unloaded as a control implant. The immediately loaded implants and surrounding tissue were harvested after 3, 4, 5 and 6 weeks. The unloaded implants were collected after the shedding of antlers. Specimens were scanned in a μ CT scanner (Skyscan 1174, Skyscan, Belgium) and bone mineral density was analysed. Finally, finite element models were generated for loaded and unloaded specimens. A vertical force of 10 N was applied on the implant. The mean values of maximum displacements, stresses and strains were recorded and compared.

Results: During the healing time, the density of antler tissue around the implant increased significantly. The bone mineral density of antler tissue around immediately loaded implants was much higher than that around unloaded implants after full osseointegration. The highest values of implant's displacement (6.2 μ m) were observed in the 3-week immediately loaded model. The 6-week osseointegrated model showed the lowest values of maximum displacement of the implant (0.3 μ m). Stresses in the bone were significantly decreased and concentrated in small area while the healing time was increasing. As the healing time increased, strains in the antler tissue around the implants were reduced. The 3-week immediately loading model showed the highest values of maximum strains (9,878 μ strain) in the antler tissue.

Conclusions: Our findings showed that antler tissue has similar biomechanical properties as human bone and can be used as a novel model for studying bone remodelling around dental implants.

References

[1]Rahimi A, Klein R, Keilig L, Abboud M, Wahl G, Bourauel C. Development and design of a novel loading device for the investigation of bone adaptation around immediately loaded dental implants using the reindeer antler as implant bed. J Biomech 2009;42:2415-2418.