

Bone Collagen Fibers Orientation in the Loaded Osseointegrated XiVE® Dental Implants in Human

Piattelli A.¹, Traini T.¹, Degidi M.¹, Neugebauer J.², Caputi S.¹

¹ Dept. of Oral Medicine and Pathology, Dental School, University of Chieti, Italy

² Dept. Cranio-maxillo-facial and Plastic Surgery, University to Cologne, Germany



Purpose

Immediate loading quite often shows an higher risk for implants, if the preconditions are not clear and micro-movements disturb the course of osseointegration. The clinical experience shows a high success rate, if the appropriate protocol is used. This study investigates the birefringence in the human peri-implant bone after loading.

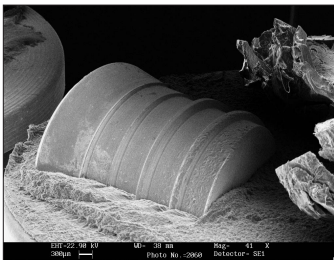
Material and Method

Ten osseointegrated XiVE® dental implants, retrieved from five patients were used in the present study. The implants, immediately loaded after surgical procedures, were left in function for 6 months before retrieving. Undecalcified cut sections were prepared by using the Precise automated system 1 (Assing, Roma, Italy). One central section

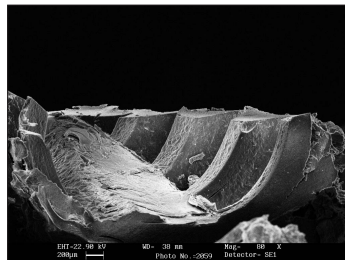
from each sample was ground to final thickness of 40 µm. Birefringence was measured as an indicator of transverse collagen fibers orientation using circularly polarized light (CPL). The measurements were performed on digitized images stored in format .tif with NxM = 768 x 1024 grid of pixels for a 24 bit, after converting in gray scale

at 8 bit. A semi-quantitative digital densitometry of the black and white areas related to longitudinally or transverse collagen fibers was made by a software image analysis. The area of analysis was standardized for all implants in 9.707 mm² measured at 100x and restricted to the first two threads under cortical bone.

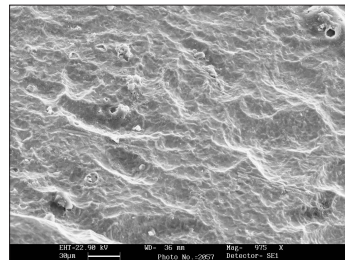
Human Retrieval of XiVE® Implants



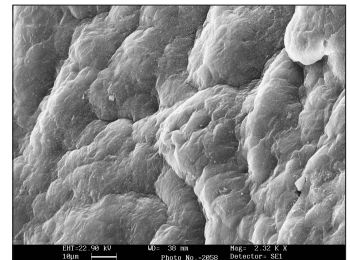
Human retrieval of XiVE® implant with preparation for SEM analysis.



Bone block removed from XiVE® implant for SEM evaluation of collagen structure.

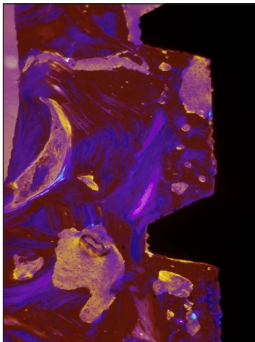


Implant surface at higher magnification (x 975) with residual bone particles on rough surface.



Bony counter part of retrieved implant at high magnification (x 2320). Notice the corresponding bone formation according the implant topography.

CPL at + 90°



CPL image of human section after 6 months loading.

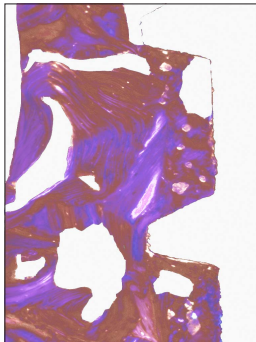


Image after removal of connective tissue, implant body and marrow spaces.



Separation of longitudinal and transversal fibers.

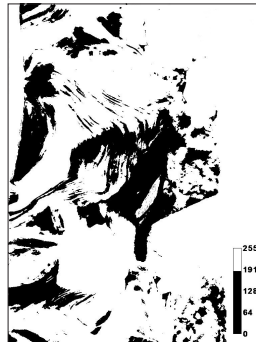
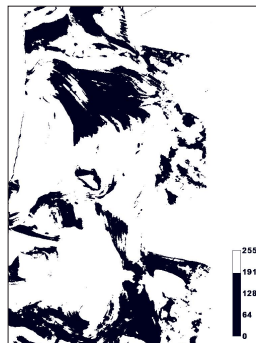
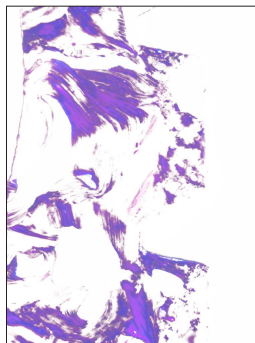
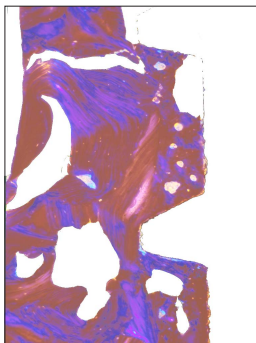
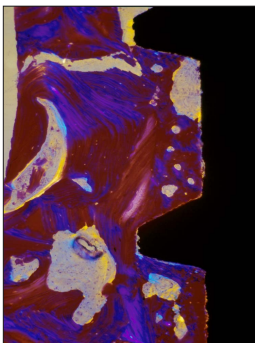


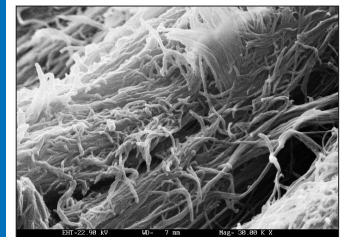
Image for calculation of one collagen fibre orientation.

CPL at - 90°



Results

A 33% (3.208 ± 0.435 mm²) of the examined area was composed of transverse collagen fibers while only a 20.1% (1.957 ± 0.253 mm²) was composed of longitudinally collagen fibers. The difference was statistically significant (P < .05)



Collagen fibre orientation in transversal orientation. Macrostructure of thread is visible. (x 30.000).

Conclusion

The collagen fibers were more transversally oriented under the horizontally portion of the threads where the compression loads act.