

SCANNING ELECTRON MICROSCOPY OF LTI
CARBON DENTAL IMPLANT-TISSUE INTERFACE

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Functional retention of a dental implant requires that the interface between tissue and implant is capable of transmitting service loads without causing adverse changes in the tissue structures adjacent to the device. Animal studies have shown that LTI carbon blade type dental implants are capable of establishing a functional retention for periods in excess of two years. The objective of this investigation was to study the microstructure of the interface between LTI carbon dental implants and tissue.

Twelve LTI carbon blade type dental implants and surrounding tissues were removed together with surrounding tissues from the mandibles of 6 female baboons after an implant duration of 24 months. One half of the implants were fitted with three unit restorations and the other half were left unrestored and free standing. No adverse changes were observed clinically or radiographically in ten of twelve sites. The tissue blocks containing the implants were sectioned to provide specimens from each implant for histological, microradiographic and scanning electron microscopic (SEM) analyses. Histological evaluations were performed using decalcified and undecalcified sectioning techniques. The undecalcified sections containing the carbon implants were produced using polymethylmethacrylate embedding, diamond sawing and abrasive grinding and polishing techniques. The undecalcified procedure allowed for the preparation of microradiographs of the implant-mandibular bone sections.

An SEM analysis of the LTI carbon implant surface prior to implantation revealed a microporous surface layer was present on the otherwise dense carbon material. Examination of the undecalcified histological sections revealed that bone had formed so that it interdigitated with the microporous surface of the implants, Figure 1. Examination of the microradiographs revealed evidence that a mechanical bond had been formed by the interdigitation of bone with the microporous carbon surface. Figure 2 shows a microradiograph of an undecalcified section of a specimen in which the implant was mechanically dislodged from the bone during the sectioning procedure. The arrow in figure 2 points to a microradiographically detectable layer of bone left adherent to the carbon surface, indicating that a sufficiently strong bond had formed so that delamination of the bone in contact with the carbon had occurred. SEM examina-

tion of the corresponding surfaces of tissue and implant after mechanical separation revealed a distinctly different morphological appearance for the areas of bone contact as compared to areas of soft tissue contact. Soft tissue was always found to adhere to the carbon surface. The areas corresponding to direct bone-carbon interfacing showed two distinctly different characteristics. One in which the bone and carbon material separated at the interface with no bone adherent to the carbon and no carbon adherent to the bone. This type of behavior is shown in figure 3. The second type of bone-carbon interface behavior resulted in a delamination of the bone tissue leaving a layer of bone adherent to the carbon as shown in figure 4. The delamination of bone observed with the SEM appears to be the same as that observed microradiographically as shown in figure 2.

It was concluded that a load transmitting interfacial bond between the microporous LTI carbon surface and bone had been formed and may have been a contributing factor to the successful performance of the dental implants.

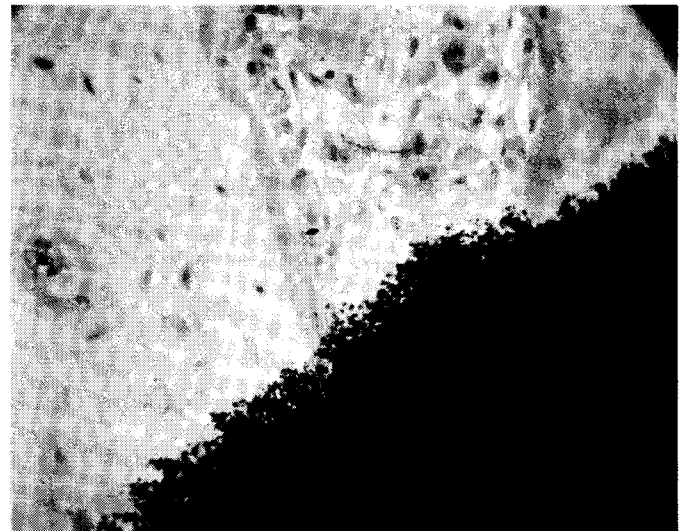


Figure 1 Photomicrograph showing bone growth into the microporous LTI carbon surface, 180X.

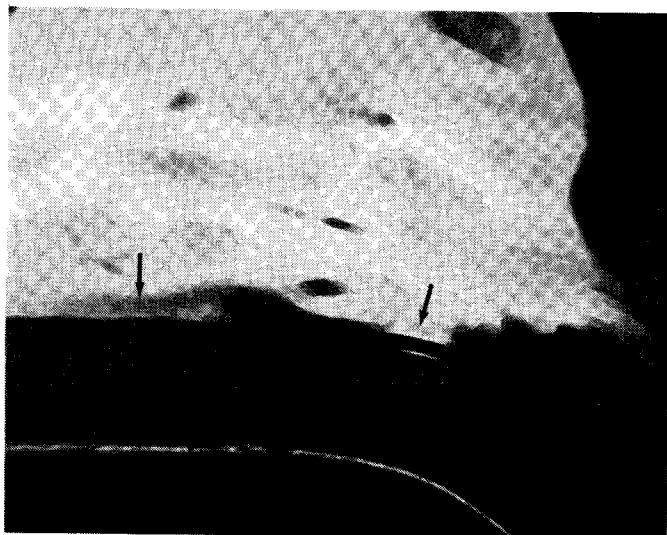


Figure 2 Photomicrograph of microradiograph showing bone adherent to carbon (arrows) after mechanical separation of bone from implant, 75X.



Figure 3b

Figure 3 Scanning electron micrograph of a) LTI carbon surface, and b) corresponding tissue surface. Left hand portion of figures show adherent soft tissue and right hand portion shows clean separation of bone from carbon, 3750X.

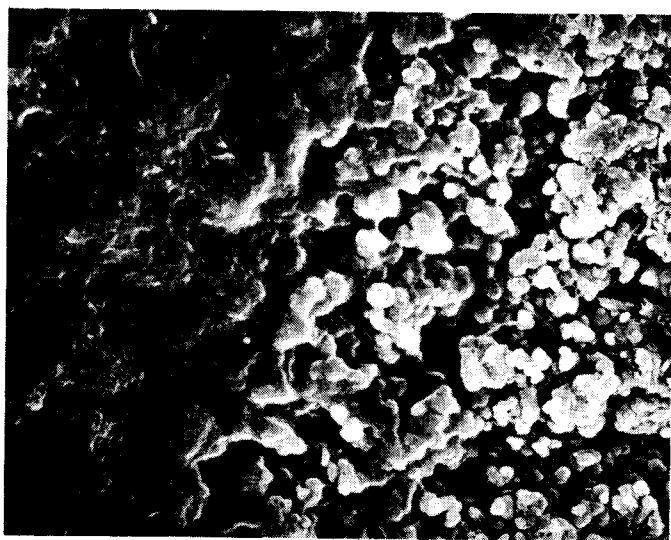


Figure 3a

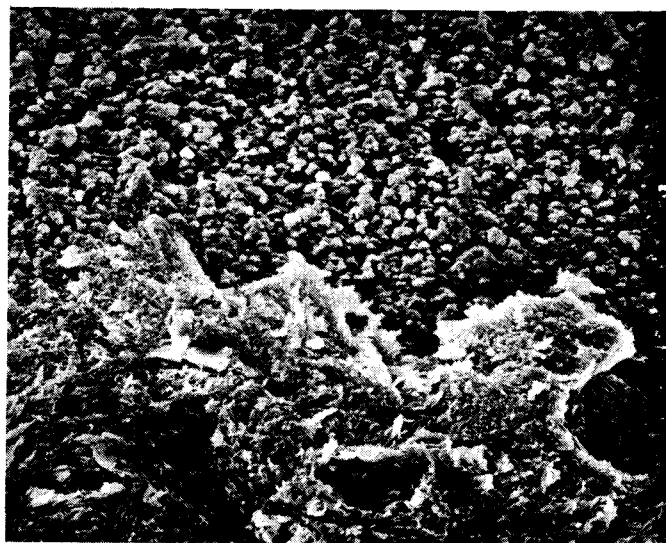


Figure 4 Scanning electron micrograph of carbon surface showing a portion of adherent bone tissue, 1500X.