Cementum Formation Around a Titanium Implant: A Case Report

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Animal studies have shown that a periodontal ligament may be produced around a titanium implant when it is in contact with fractured and retained roots. Formation of cementum and attachment connective tissue around titanium implants confirms that cementum progenitor cells are located in the periodontal ligament, since cementum and periodontal ligament are present at the implant-root interface, whereas the remainder of the implant, which is not in contact with the root, shows osseointegration. The aim was to evaluate histologically the characteristics of the tissue present between a titanium implant and a retained root, which were subsequently extracted as a result of peri-implantitis. The histologic examination revealed a continuous layer of cementum and numerous cementocytes on the implant surface. No blood vessel or collagen fibers were detected in the periodontal space. In contrast to experimental studies carried out on animals, the lack of connective tissue fibers and the presence of hypercementosis in this specimen could have been caused by the inflammatory process. Furthermore, the extrusive movement of the root might explain the presence of cementum hypertrophy. Further studies are required to establish whether the neoformation of cementum and collagen fibers on an implant in the presence of root residues occurs only in animal models or whether it may also occur in humans. (INT J ORAL MAXILLOFAC IMPLANTS 2002;17:729–732)

Key words: *connective tissue cells, dental cementum, endosseous dental implantation*

Experimental studies have shown that only the cells of the periodontal ligament (PDL) are able to form new root cementum.[1–3] These results were later confirmed by clinical studies in humans using the guided tissue regeneration technique, wherein the formation of a new periodontal attachment with neoformation of cementum and connective fibers was observed.[4–6] After the loss of natural teeth, cells of the PDL are also lost, so that they are unable to participate in the healing process around endosseous implants. Buser and associates[7] and Warrer and colleagues[8] have shown experimentally that it is possible to produce a PDL around implants when they are placed in contact with root residue in monkey mandibles, confirming the fact that the progenitor cells of root cementum are found in the PDL and not in the alveolar bone.[9,10] These experimental studies detected cementum and attachment connective fibers only at the implant-root interface, while the portion of the implant that was not in contact with the root showed only osseointegration.

The aim of this study was to investigate the characteristics of the tissue present between an implant, which was extracted because of peri-implantitis, and a root to which it adhered.

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Fig 1 Preoperative radiograph.

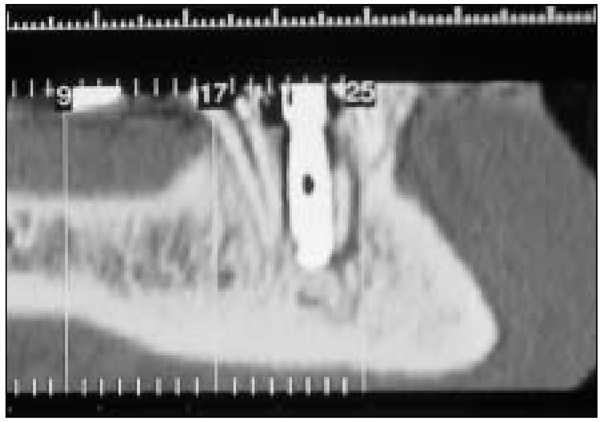

Fig 2 Preoperative computed tomographic scan.

Fig 3 Intraoperative view of implant and root (×10).

Fig 4 Implant and root after extraction.

PATIENT REPORT

The patient was a 40-year-old man who had lost the mandibular right canine because of trauma. After several months, the lost tooth was replaced with an implant positioned in contact with root residue not detected by radiologic examination. One year later, the patient suffered pain and mobility at the implant site and was sent to the Department of Periodontology, University of Turin, for treatment. Examination revealed that the implant had degree I mobility with a probing depth of about 8 mm around the entire circumference (Figs 1 and 2). Radiologic investigation revealed the presence of a tooth fragment very close to the implant. Local-regional anesthesia was administered and a trapezoidal mucoperiosteal flap was prepared. The flap was folded back and extensive bone loss was revealed. The implant was extracted, and root residue was found strongly adhering to the implant (Figs 3 and 4) .

After extraction, the implant and adhering tissues were fixed in Karnovsky fixative for 24 hours, postfixed in 2% osmic acid, dehydrated with a series of alcohol solutions up to absolute alcohol, embedded in Epon Araldite Resin (Sigma, Milan, Italy). The sample was sectioned, mounted, and observed under a phase-contrast microscope (Zeiss FOMI III, Thornwood, NY) with the DIC system.[11]

Fig 5 Section through implant and root (×12; DIC).

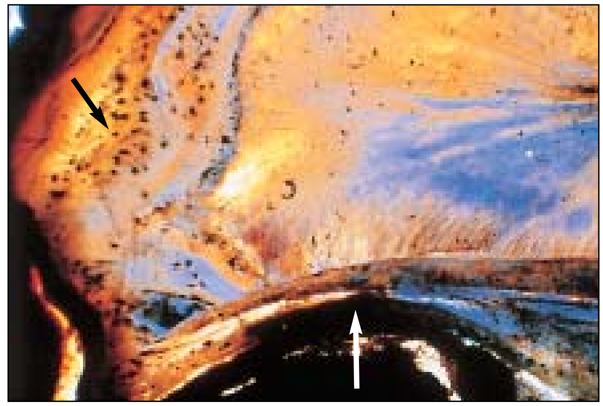

Fig 6 Root cementum in the apical zone. Numerous cementocytes are visible *(black arrow)* adhering to the implant surface *(white arrow)*. There is a clear demarcation line between dentin and neo-cementum apposition on the implant surface (×32; DIC).

Fig 7 Continuous cementum along the implant surface and porous plasma spray layer coating the implant (*arrow;* ×32; DIC).

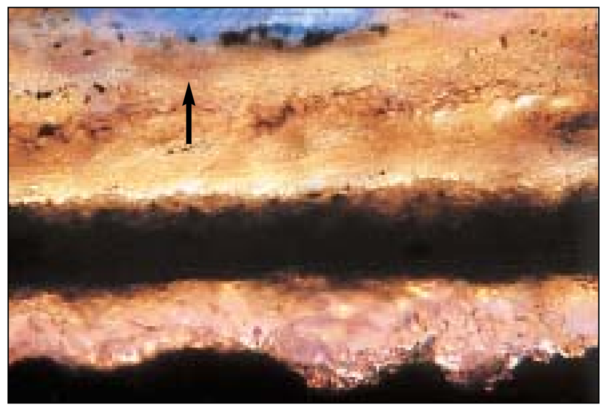

Fig 8 Enlargement of area shown in Fig 6. Clear demarcation between dentin and layer of neo-cementum (*arrow;* ×160; DIC).

RESULTS

Microscopic examination revealed a continuous layer of cementum adhering to the implant and innumerable cementocytes, with a clear demarcation between dentin and cementum apposition on the implant surface (Figs 5 and 6). It was possible to distinguish the porous layer of the plasma spray coating on the implant surface (Fig 7). At a higher magnification, the layer of neo-cementum could be seen more clearly, together with the dentinal tubules, cementocytes, and cementum adhering to the implant surface (Figs 8 and 9). The periodontal space between the root and the implant was present in the form of a rudimentary space with a continuous layer of cementum strongly adhering to the surface of implant, with no blood vessels or collagen fibers.

Fig 9 Cellular cementum and cementocytes (*arrow;* ×160; DIC).

DISCUSSION

It has been shown that a PDL, represented by cementum and connective tissue fibers, may form around implants when these tissues are placed in close contact with retained roots.[7,8] The ability to form a connective attachment around a titanium implant has also been documented in an experimental study on dogs[12] in which a culture of ligament cells was placed on the surface of the implant before placement.

In the clinical case under consideration, a marked presence of root cementum covering the implant surface was seen, but with no connective tissue fibers and no blood vessels in the periodontal space. A previous study[13] has shown that the similar cementum attachment protein (CAP) is capable of recreating putative cementoblastic population on root slices in vitro and therefore might play an important role in cementogenesis during periodontal homeostasis and wound healing. The hard tissue near the implant, seen in the present report, presents with a cementum-like structure, but only CAP, alkaline phosphatase (AP), osteopontin (OP), and bone sialoprotein (BSP) identification in specimens may offer the best evidence that the tissue examined is in fact cementum. This was not possible here, because the present study was only histologic and CAP, AP, OP, and BSP were not identified. The retained root, representing a source of periodontal cells, evidently played no part in the healing process around the implant, which could have been capable of forming a connective attachment. It is probable that the excessive cementum production in this case was a response to the inflammatory stimulus.

Clinical and radiologic evidence of peri-implantitis may explain the phenomena of apposition and resorption leading to an anomalous formation of cementum. The cementum performs its function through continual apposition, especially in the apical zone of the root. This deposition can be accentuated during inflammation of the periodontium and in teeth without antagonist. Root movement in the coronal direction could have been a further stimulus to compensatory cementum hypertrophy. These observations suggest that further studies should be carried out to establish whether the neoformation of cementum and connective tissue fibers around an implant is possible only in animal models or whether, in the presence of a retained root, it may also occur in humans, although in the case presented only cementum was observed and no connective fibers were seen.

The deliberate use of roots as a source of periodontal cells, though, must be ruled out. The retained root may be contaminated by bacteria originating from the ligament and/or root canal, with subsequent formation of periapical lesions and cementum resorption, especially in the apical part of the root, thus compromising osseointegration of the implant. Future studies should verify whether the formation of PDL, capable of providing an implant with mobility similar to the mobility of a natural tooth, is favored by a culture of periodontal cells or by growth factors placed in the implant bed or surface.

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