Histologic Evaluation of a Retrieved Endosseous Implant: A Case Report

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An implant that had penetrated the nasal cavity of a 53-year-old woman was removed after 10 months. The implant had a resorbable blast media surface and an external connection. Histomorphometric evaluation showed that the mean bone-implant contact ratio was 88.08%, and excellent osseointegration was observed. The mean bone fill between threads was 78.46%. (Int J Periodontics Restorative Dent 2013;33:e32–e36. doi: 10.11607/prd.1015)

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Osseointegration was initially defined as direct contact between living bone and an implant as seen under light microscopic examination. This was subsequently changed to a structural and functional connection between living bone and the implant surface.[1,2] More recently, Albrektsson and Zarb[3] defined it as the absence of specific symptoms clinically with the implant firmly held within the bone structure and maintained under normal loading conditions, such as masticatory function.

Histomorphometrically, the bone-implant contact (BIC) ratio and bone density have been applied to represent the level of bone formation between the implant threads and thus evaluate the level of osseointegration. The greater the volume of bone formation in the vicinity of the implant, the higher the BIC ratio and the better the implant withstands loading. The reported BIC ratio of implants after initial loading is 25% for type 4 bone quality (D4) and 80% for type 1 bone quality.[4] Recently, the osseointegration period of a rough surface was reported to be shorter than that of a smooth surface.

Fig 1 *The implant placed in the maxillary left canine area had penetrated the nasal fossa.*

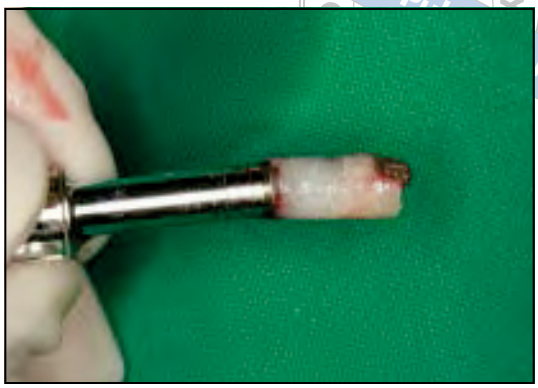


Fig 2 *Appearance after removing the implant using a trephine bur.*

Augmenting the surface roughness using various methods may enhance the resistance to shear force and maximize the initial fixation and osteoconduction effect.[5,6]

Since histologic evaluations of implant osseointegration have been conducted primarily in animals, less is known of the actual osseointegration reaction in humans. The occasional case reports and histologic evaluations of implants removed from humans as a result of prosthesis failure and poor placement are a great help. In this case report, the authors evaluate an implant placed in the maxillary anterior area that was removed together with the adjacent bone to examine the osseointegration reaction by assessing the BIC ratio, bone density, and histologic findings.

Case report

A 53-year-old woman was referred to the Boston Hub Dental Clinic, Seoul, Korea, because she developed persistent discomfort near the nasal cavity after implant treatment performed at another dental clinic. The cause was found to be perforation of the nasal floor by an implant placed in the maxillary left canine area (Fig 1). The placement angle and depth were determined to be inappropriate for fabrication and maintenance of a maxillary prosthesis. This implant had been placed immediately after tooth extraction and subjected to early loading 6 weeks after placement by connecting provisional acrylic resin teeth enforced with wires to adjacent implants.

Ten months after implant placement, no movement of the implant or inflammation of the periodontal tissues was detected. The implant (SinusQuick EB, Neobiotech) was seen to have perforated the nasal cavity using panoramic radiographs and computed tomography scans. The surgical record of the referring dental clinic indicated that the implant was 11.5 mm in length and 4.0 mm in diameter. A provisional tooth was prepared using an osseointegrated posterior implant. Under local anesthesia, a full-thickness flap was elevated, and the implant was removed together with the adjacent bone using a trephine bur 4.5 mm in diameter. No BIC had developed at the implant apex (Figs 2 and 3). The removed sample was fixed immediately in 10% formalin solution and sent for histologic evaluation. At the time of implant removal, an additional implant was placed in an adjacent area.

Histologic findings

The implant specimen was fixed in 10% neutral-buffered formalin, dehydrated in a graded series of alcohols, and embedded in methyl methacrylate. The samples were cut parallel to the longitudinal axis of the implant in the mesiodistal plane using an Exakt cutting and grinding system (Exakt). The sections were ground to a thickness of 20 μm and stained using hematoxylin-eosin.

The following parameters were measured using image-analyzing software (Analysis LS starter version 2.8, Olympus): BIC (the length of the bone surface border in direct contact with the implant divided by the complete implant periphery) and interthread bone density (the area of bone inside the threads

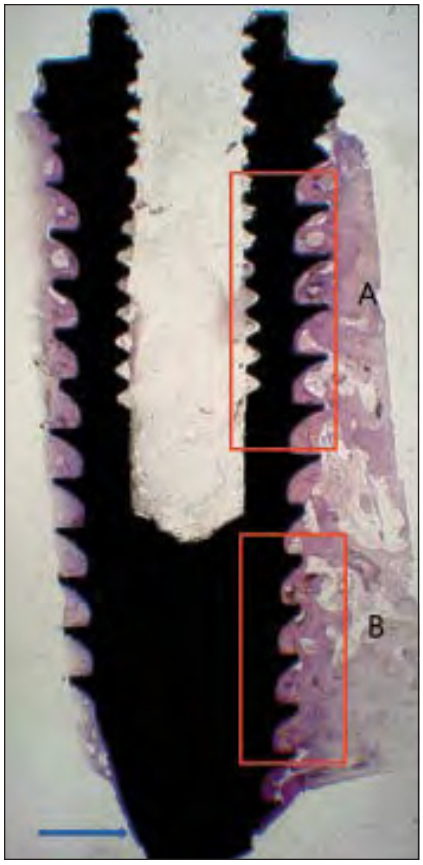
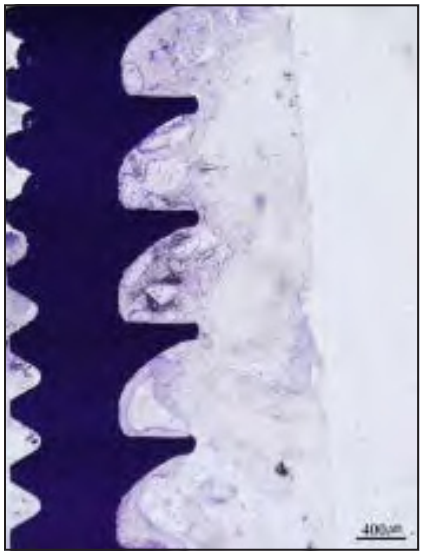


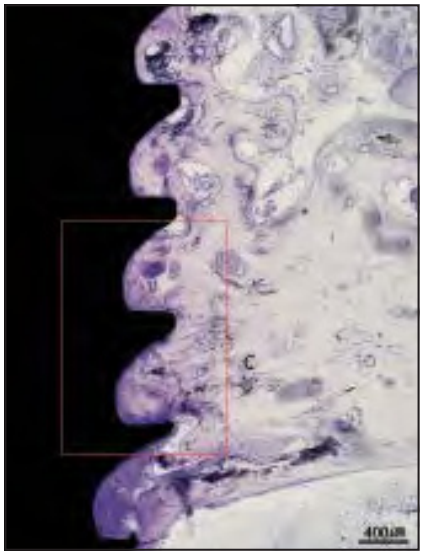
Fig 3 *Histologic view of the implant (original magnification ×1.25). No BIC developed at the implant apex* (arrow).

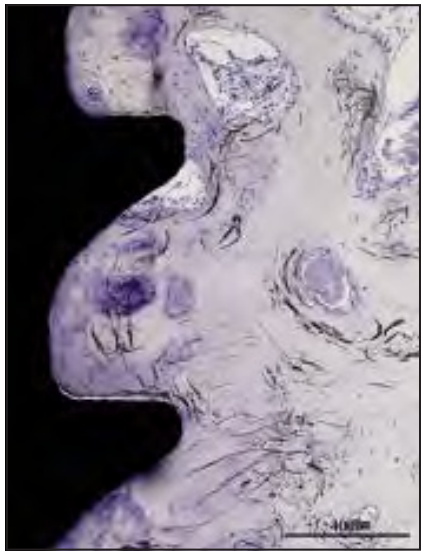
Fig 4 *Higher magnification of box A in Fig 3.*

Fig 5 *Higher magnification of box B in Fig 3.*

Fig 6 *Higher magnification of box in Fig 5.*







divided by the complete area inside the threads).

The implant showed osseointegration with the adjacent bone tissue (Figs 4 and 5). The BIC pattern appeared to produce broad-based direct contact. Well-organized lamellar bone containing osteocytes was observed along the implant surface (Fig 6). The mean BIC was 88.08%, and the mean interthread bone density was 78.46%.

Discussion

Implant surface texture and design are important factors for initial osseointegration. The microscale rough topography of a porous implant can favorably affect angiogenesis, cellular migration, activity, and function, resulting in greater BIC and mechanical interlocking.[7,8]

Landi et al[9] reported a histologic analysis of a failing three-part dental implant. The coronal section of the implant consisted of a long, smooth collar, and the central and apical parts were threaded and lightly tapered. Bone loss was visible in the most coronal area. The alveolar bone loss stopped at the level of the fourth thread. Sakakura et al[10] performed a histomorphometric evaluation of a threaded, sandblasted, acid-etched implant retrieved from the mandible of a 68-year-old man because of fracture of the abutment screw after functioning for 40 months. This showed 75.40% BIC and 89.30% bone fill within the limits of the implant threads.

Sennerby et al[11] examined the structure of the bone-titanium interface of seven retrieved oral implants placed in humans and removed after 1 to 16 years. The implant threads were well filled (79% to 95%) with dense lamellar bone. A large proportion of the implant surface (56% to 85%) achieved direct contact with mineralized bone. Suzuki et al[12] performed a clinical and histologic evaluation of immediately loaded posterior implants in nonhuman primates. After 90 days, the samples were evaluated histologically. The control group showed 50.34% to 64.13% BIC versus 43.23% to 75.72% (mean, 62.40%) for immediately loaded implants. Grassi et al[13] evaluated the histologic human bone integration on machined and sandblasted, acid-etched, titanium surfaces in type IV bone. Implants were placed, and samples were collected after a 2-month healing period. The mean BICs were 20.66% ± 14.54% and 40.08% ± 9.89% for the machined and sandblasted, acid-etched surfaces, respectively. The bone density in the thread area was 26.33% ± 19.92% and 54.84% ± 22.77% for the respective surfaces. Lazzara et al[14] performed a human histologic analysis of Osseotite (Biomet 3i) and machined surface implants. After a 6-month healing period, samples were collected and evaluated histomorphometrically. The mean BIC for the Osseotite surface was 72.96% ± 25.13%, and that for the machined surface was 33.98% ± 31.04%. Brunel et al[15] observed a 60% to 70% BIC for titanium plasma-sprayed implants removed from the maxilla after 14 months. After 9 months, Degidi et al[16] reported 60% BIC for a porous anodized implant subjected to immediate loading.

Jung et al[17,18] evaluated the relationship between implants that had penetrated the maxillary sinus cavity and sinus complications. There were no clinical signs of sinusitis in any patient. However, computed tomography showed postoperative sinus mucous thickening around 14 of 23 implants. Although sinus membrane perforation is not related directly to the occurrence of sinus complications, it has been reported that dust or bacterial accumulation around the implant apex, with excessive exposure, may cause delayed sinusitis. However, few studies have examined the histology of implants that have penetrated the nasal cavity or its complications. In this case, no osseointegration was seen in the apex region of histologic specimens of an implant that was removed 10 months after penetrating the nasal cavity.

The SinusQuick external-connection implant system with a resorbable blast media surface has a rounded form for sufficient soft tissue sealing in small 0.5-mm spaces and microgrooves to augment the fixation force of the maxilla while minimizing bone loss. The implant body is tapered-straight-tapered; the thread has a deep, thin, inverted triangular shape to maximize the bone volume between threads, with easy self-tapping abilities and excellent resistance to vertical occlusal forces and lateral pressure. In this case, the mean BIC ratio was 88.08%. Excellent osseointegration was achieved, and the mean bone fill between threads was 78.46%. In the case reported by Sakakura et al,[10] the sandblasted, large-grit, acid-etched implant removed after 40 months had a 75.40% BIC ratio and 89.30% bone density. Remarkably, despite the short 10-month healing period, the implant in this study showed excellent osseointegration in comparison with the 79% to 95% bone density between threads reported by Sennerby et al[11] for seven implants removed after 1 to 16 years.

Conclusions

A resorbable blast media surface implant removed 10 months after nasal cavity penetration was observed histologically. No BIC developed at the implant apex. Histomorphometric evaluation showed that the mean BIC ratio was 88.08%, with excellent osseointegration. The mean bone fill between threads was 78.46%.

Acknowledgment

The authors reported no conflicts of interest related to this study.

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