Peri-implant Bone Loss: Management of a Patient

Katherine C. M. Leung, BDS, MDS, FRACDS[1]/T. W. Chow, BDS, MSc, PhD, DRDRCS, FDSRCS[2]/
Peter Y. P. Wat, BDS, LDSRCS[3]/Margaret B. Comfort, BDS, MSc, FDSRCS[4]

This clinical report presents the prosthodontic management of early peri-implant bone loss in a partially edentulous patient. Two narrow Brånemark implants (3.3 mm in diameter) were placed to retain a mandibular implant prosthesis in the area of the mandibular left second premolar and first molar. Two weeks after the prosthesis was put into function, the distal implant exhibited soft tissue reactions. Radiographically, bone corresponding to 4 threads and 7 threads was lost at the mesial and distal sites, respectively. After occlusal load reduction was made to the existing prosthesis, bone was observed to have regenerated sufficiently to restore the defect radiographically, though not to the original level. The bone remained at a similar level at 36 months after treatment. (INT J ORAL MAXILLOFAC IMPLANTS 2001;16:273–277)

Key words: *complications, dental implants, fixed partial prosthesis, narrow-platform dental implants, occlusal overload, partial edentulism, peri-implant bone loss*

Osseointegrated implants have been used successfully in the treatment of edentulous patients, with predictable long-term results.[1,2] Studies have indicated that comparable results can be obtained in treating partially edentulous patients, both in short-term[3–6] and long-term perspectives.[7–9] The high success rate depends on careful patient selection and treatment planning.

However, complications are not uncommon. Various categories of complications have been described by a number of investigators.[1,10,11] Soft tissue reactions were reported to be associated with 2% of the implants in one survey[12] and 21% of the treated arches in another.[13] In a retrospective study by Lekholm and coworkers, 107 of 285 implants showed various amounts of bone loss; 8 implants had lost up to the fifth thread by the first annual checkup.[14] The authors suggested that the different degrees of bone resorption must have occurred during the first year in function, rather than as a result of progressive remodeling. This was substantiated by a classic study, which emphasized that most failures occurred within the first year of implant placement.[1]

In the following clinical situation, early peri-implant bone loss was suspected to be the result of overloading. The prosthesis was modified to reduce occlusal loading, and bone regeneration was observed radiographically.

PATIENT REPORT

A healthy 31-year-old male attended the university hospital and requested replacement of the missing teeth in his left mandible. The teeth (mandibular left second premolar and first molar) had been extracted 12 years previously because of nonrestorable caries. The edentulous ridge had been graded as 3 and B, respectively, at both sites.[15] The widest part of the ridge measured 4 mm. Standard-sized implants of 3.75-mm diameter were therefore not applicable. A periapical radiograph of the site showed no existing bone pathology (Fig 1).

Two 10-mm Brånemark System implants (Mk II, 3.3-mm, Nobel Biocare, Göteborg, Sweden) were placed in the area of the second premolar and first molar. The surgical procedure was carried out according to standard Brånemark System protocols.[1] The surgery was uneventful.

[1]Assistant Professor, Oral Rehabilitation, Faculty of Dentistry, University of Hong Kong, China.
[2]Associate Professor, Oral Rehabilitation, Faculty of Dentistry, University of Hong Kong, China.
[3]Honorary Clinical Assistant Professor, Oral Rehabilitation, Faculty of Dentistry, University of Hong Kong, China.
[4]Associate Professor, Oral and Maxillofacial Surgery, Faculty of Dentistry, University of Hong Kong, China.

Reprint requests: Dr Katherine C. M. Leung, 4/F, Prince Philip Dental Hospital, 34 Hospital Road, Hong Kong, China. Fax: +852 2858 6114. E-mail: kcmleung@hkucc.hku.hk

Fig 1 Pretreatment radiograph demonstrating no pre-existing bone pathology.

Fig 2a At the time of abutment connection, the bone level was above the first thread of both implants.

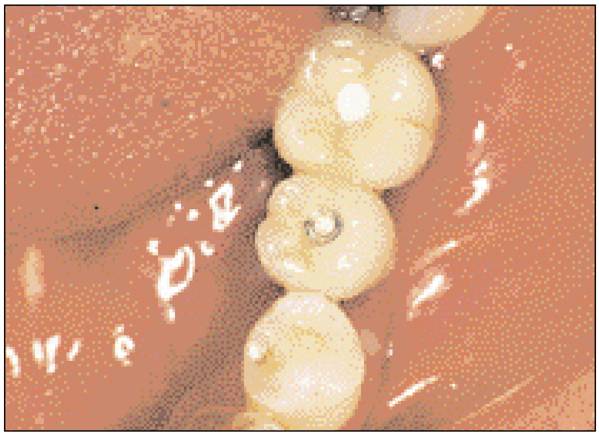

Fig 2b Occlusal view of the implant prosthesis.

After a 10-month undisturbed healing period for osseointegration to occur, the implants were exposed, and MirusCone abutments (Nobel Biocare) were fitted on both implants with a torque of 20 Ncm. A periapical radiograph was taken to verify the seating of the abutments to the implants (Fig 2a). It also revealed that the bone level was above the first thread at the mesial and distal aspects of both implants. No radiolucency was observed around the implants. A 2-unit porcelain-fused-to-metal restoration was fabricated. Passivity of fit was checked clinically and the prosthesis was screwed into place (with a torque of 10 Ncm) following standard prosthodontic procedures[16] (Fig 2b).

At the first follow-up appointment, 2 weeks after prosthesis connection, it was noticed that the gingiva peripheral to the mandibular molar replacement appeared severely inflamed and granulomatous (Fig 3a). Bleeding on probing was detected, and the probing depth was 6 mm at all sites around the involved implant. In spite of this, plaque accumulation was minimal. The gold screws were tight and the prosthesis was not mobile. Radiographic examination revealed a crater-like radiolucency at the coronal portion of this implant (Fig 3b). The radiolucency involved 4 threads and 7 threads at the mesial and distal sites, respectively (Fig 3b). The implant replacing the mandibular premolar was relatively unaffected.

The prosthesis was temporarily removed and healing screws were placed. A course of clindamycin was prescribed (150 mg daily for 1 week). The patient was also instructed to rinse daily with chlorhexidine.

When soft tissue healing was achieved, the original prosthesis was re-inserted after the occlusal table was adjusted to a smaller buccolingual dimension. Additionally, the occlusion was adjusted so that there were only light contacts of opposing teeth with the prosthesis (Fig 4a). The gingival condition

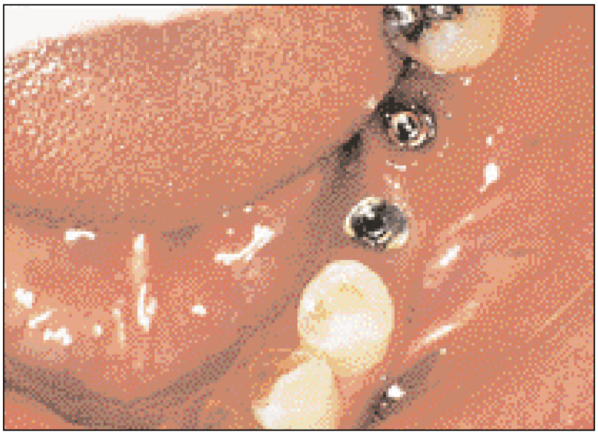

Fig 3a After removal of the prosthesis, the gingiva surrounding the first molar implant appeared red and swollen.

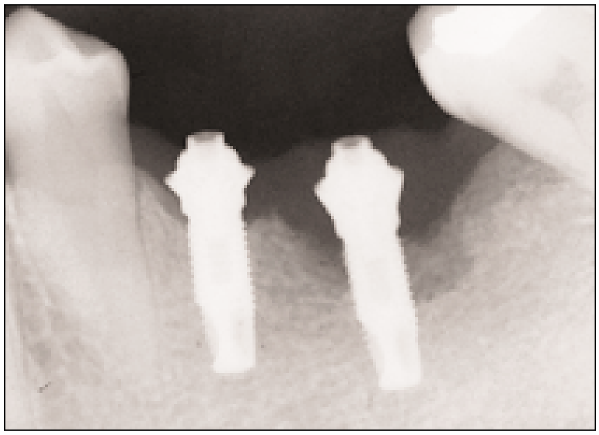

Fig 3b Two weeks after implant prosthesis placement, crater-like bone loss was evident at the first molar implant.

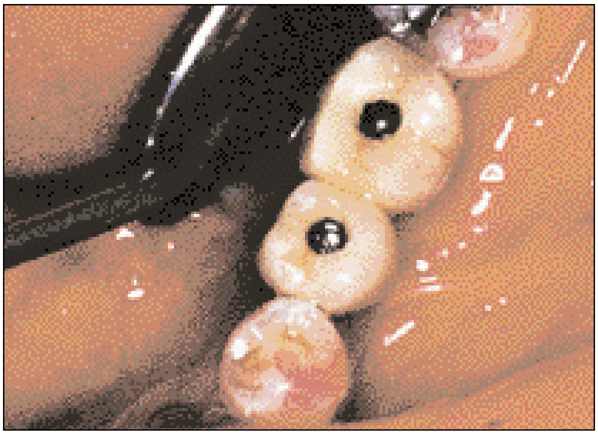

Fig 4a The modified implant prosthesis was replaced, with the lingual aspect reduced and the occlusion adjusted.

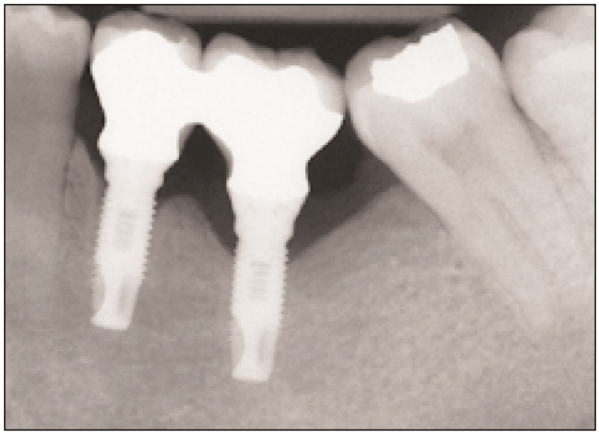

Fig 4b Radiograph taken at 12 months after modification of the implant restoration. Radiolucency at the previous defect sites was not seen.

was maintained at a satisfactory level on subsequent review appointments. A periapical radiograph, taken 1 year after re-insertion of the implant prosthesis, showed that bone had refilled the defects (Fig 4b). However, 2 threads were lost at the distal site and 1 at the mesial. The bone remained at the same level at the 4-year annual checkup (Fig 5).

DISCUSSION

Bone loss at the coronal portion of the implant is one of the first signs of peri-implantitis. This phenomenon could be caused by microdamage in the bone that exceeded its repair potential, leading to replacement of the bone-implant interface with a soft tissue layer.[17] Crater-like peri-implant bone loss is believed to happen during the period when fracture is occurring and is a reaction to percolation of inflammatory infiltrate from repeated micro-openings of initial

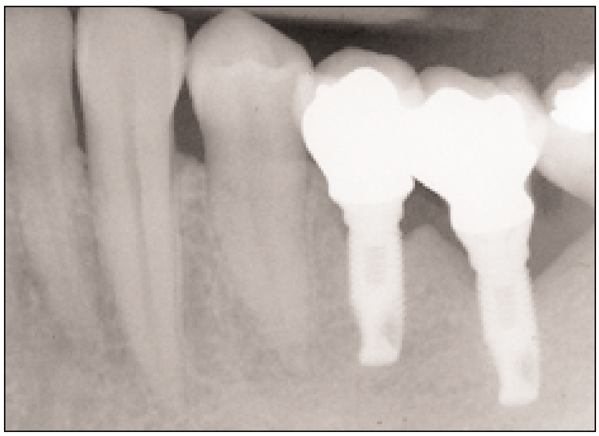

Fig 5 Radiograph obtained after 48 months, following re-seating of the modified restoration.

fatigue cracks.[18] It may continue to the stage where osseointegration is lost or the implant fractures. As a consequence, such an implant would be indicated for removal.

The cause of peri-implant bone loss can be multifactorial. Bacterial infection and biomechanical overloading have been suggested to be the 2 major etiologic factors associated with resorption of crestal peri-implant bone tissue,[1,7,18–20] although proof of the direct cause of peri-implant breakdown by micro-organisms is not available. In an animal study, implants with excessive occlusal load and weekly cleaning were demonstrated to lose osseointegration, but no implants with heavy plaque accumulation alone lost osseointegration.[21] The author concluded that overloading is regarded as more critical than plaque accumulation, and that occlusal overload can be the main factor in loss of integration in a previously osseointegrated implant. This view has been supported by many investigators.[1,7,19,20]

Management of peri-implant bone loss depends on the etiology of the problem. It is important that the problem be diagnosed accurately and therapy instituted promptly. Failure to do so may permit the destructive process to progress to an irreversible stage. In many situations, prosthodontic and surgical treatment are involved. Occlusal equilibration has been recommended to arrest the progression of peri-implant tissue breakdown, and bone regeneration around implants can be accomplished by surgical techniques involving mechanical and chemical debridement, systemic application of antibiotics, and regenerative techniques using resorbable membranes.[22] Additionally, some surgeons fill the defects with allografts or alloplasts. These maneuvers are employed to stop the destructive process from progressing, while allowing bone regeneration and re-osseointegration to follow. However, there seem to be no reports in the literature describing bone regeneration following occlusal load reduction.

The posterior regions of partially edentulous arches have inherent anatomic and biomechanical differences in prosthetic loading conditions. This region of the jaw is characterized by less favorable bone quality and smaller bone volume than the anterior region. Implants placed in the premolar or molar regions are generally shorter than those placed in the canine and incisor positions, because of the presence of the inferior dental nerve. The occlusal load is constantly high.[8] The less favorable distribution of partially edentulous ridge restorations does not permit cross-arch stabilization.[12] Furthermore, the in-line placement of the implants leads to a susceptibility to implant bending. This increased bending load exerted on the implants has been identified as the main reason for overload.[23] In the present patient situation, the risk of overloading was increased by the fact that narrow-diameter implants were used. Small-diameter implants inherently have lower mechanical strength than large-diameter implants. Because of a smaller implant diameter, the mechanical strength and surface area of narrow-platform implants are both reduced by 20 to 25%.[24] This implies that the present implants were probably subjected to a higher load per unit surface area.

After loading was reduced, a periapical radiograph showed increased radiopacity at the defect site. It was assumed that bone was regenerated in the defect. This regenerated bone appeared homogenous to the surrounding bone.

CONCLUSION

A correct diagnosis to the pathologic etiology is essential in the management of complications in implant therapy. The possibility of overloading should always be considered and prompt prosthodontic treatment provided, as in the present patient, to stop the progress of peri-implant tissue breakdown and allow bone regeneration to take place.

REFERENCES

1. Adell R, Lekholm U, Rockler B, Brånemark P-I. A 15-year study of osseointegrated implants in the treatment of the edentulous jaw. Int J Oral Surg 1981;10:387–416.
2. Albrektsson T. A multicenter report on osseointegrated oral implants. J Prosthet Dent 1988;60:75–84.
3. Jemt T, Lekholm U, Adell R. Osseointegrated implants in the treatment of partially edentulous patients: A preliminary study on 876 consecutively placed fixtures. Int J Oral Maxillofac Implants 1989;4:211–217.
4. Van Steenberghe D, Lekholm U, Bolender C, Folmer T, Henry P, Herrmann I, et al. The applicability of osseointegrated oral implants in the rehabilitation of partial edentulism: A prospective multicenter study on 558 fixtures. Int J Oral Maxillofac Implants 1990;5:272–281.
5. Naert I, Quirynen M, van Steenberghe D, Darius P. A six-year prosthodontic study of 509 consecutively inserted implants for the treatment of partial edentulism. J Prosthet Dent 1992;67:236–245.
6. Henry PJ, Tolman DE, Bolender C. The applicability of osseointegrated implants in the treatment of partially edentulous patients: Three-year results of a prospective multicenter study. Quintessence Int 1993;24:123–129.
7. Quirynen M, Naert I, van Steenberghe D. Fixture design and overload influence marginal bone loss and fixture success in the Brånemark system. Clin Oral Implants Res 1992; 3:104–111.
8. Jemt T, Lekholm U. Oral implant treatment in posterior partially edentulous jaws: A 5-year follow-up report. Int J Oral Maxillofac Implants 1993;8:635–640.

9. Nevins M, Langer B. The successful application of osseointegrated implants to the posterior jaw: A long-term retrospective study. Int J Oral Maxillofac Implants 1993;8:428–432.
10. Worthington P, Bolender CL, Taylor TD. The Swedish system of osseointegrated implants: Problems and complications encountered during a 4-year trial period. Int J Oral Maxillofac Implants 1987;2:77–84.
11. Friberg B, Jemt T, Lekholm U. Early failures in 4,641 consecutively placed Brånemark dental implants: A study from stage 1 surgery to the connection of completed prostheses. Int J Oral Maxillofac Implants 1991;6:142–146.
12. Jemt T, Lindén B, Lekholm U. Failures and complications in 127 consecutively placed fixed partial prostheses supported by Brånemark implants: From prosthetic treatment to first annual checkup. Int J Oral Maxillofac Implants 1992;7:40–44.
13. Tolman DE, Laney WR. Tissue-integrated prosthesis complications. Int J Oral Maxillofac Implants 1992;7:477–484.
14. Lekholm U, Sennerby L, Roos J, Becker W. Soft tissue and marginal bone conditions at osseointegrated implants that have exposed threads: A 5-year retrospective study. Int J Oral Maxillofac Implants 1996;11:599–604.
15. Lekholm U, Zarb GA. Patient selection and preparation. In: Brånemark P-I, Zarb GA, Albrektsson T (eds). Tissue-Integrated Prostheses: Osseointegration in Clinical Dentistry. Chicago: Quintessence, 1985:199–209.
16. Zarb GA, Jansson T. Prosthodontic procedures. In: Brånemark P-I, Zarb GA, Albrektsson T (eds). Tissue-Integrated Prostheses: Osseointegration in Clinical Dentistry. Chicago: Quintessence, 1985:241–282.
17. Frost HM. Wolff's law and bone's structural adaptations to mechanical usage: An overview for clinicians. Angle Orthod 1994;64:175–188.
18. Rangert B, Krogh PHJ, Langer B, Van Roekel N. Bending overload and implant fracture: A retrospective clinical analysis. Int J Oral Maxillofac Implants 1995;10:326–334.
19. Lindquist LW, Rockler B, Carlsson GE. Bone resorption around fixtures in edentulous patients treated with mandibular fixed tissue-integrated prostheses. J Prosthet Dent 1988;59:59–63.
20. Ahlqvist J, Borg K, Gunne J, Nilson H, Olsson M, Astrand P. Osseointegrated implants in edentulous jaws: A 2-year longitudinal study. Int J Oral Maxillofac Implants 1990;5:155–163.
21. Isidor F. Loss of osseointegration caused by occlusal load of oral implants: A clinical and radiographic study in monkeys. Clin Oral Implants Res 1996;7:143–152.
22. Jovanovic SA. The management of peri-implant breakdown around functioning osseointegrated dental implants. J Periodontol 1993;64:1176–1183.
23. Rangert BR, Sullivan RM, Jemt TM. Load factor control for implants in the posterior partially edentulous segment. Int J Oral Maxillofac Implants 1997;12:360–370.
24. Rangert B. Biomechanical considerations when choosing a platform: Treatment planning is essential for long-term predictable prognoses. Global Forum 1996;10(4):3–5.