

Twelve-Year Clinical and Radiological Results of Maxillary and Mandibular Implant-Retained Bar Overdentures Carried out on Oxidized (TiUnite) Replace Select Implants: A Clinical Case

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INTRODUCTION

The original Branemark protocol for successful implant osseointegration required a healing period of 3–6 months during which the implants were submerged for protection from premature loading.¹ As a result, the use of provisional implants during the osseointegration period, as a means of stabilization of a full-arch interim fixed restoration, has gained popularity in implant prosthodontic treatment.² Recently, implant reconstructive dentistry has strongly evolved into 1-stage surgery,^{3,4} such as immediate postextraction, implant placement,⁵ and immediate (occlusal/nonocclusal) loading.^{6,7} Nowadays, the cumulative implant survival rate after 10-year-in-function ranges between 96.52% and 98.05% for implants placed in healed and postextractive sites, respectively.⁸ One of the main contributions to the successful, long-term, clinical outcomes has been the development of an oxidized implant surface that may improve bone-to-implant contact in virgin healed bone,^{7,8} as well as regenerated bone.⁹ On the other hand, the treatment of periodontally susceptible patients is still controversial. Patients with periodontitis often experience early tooth loss that requires implant therapy.¹⁰ Nevertheless, smoking and a history of

periodontitis have been associated with a higher prevalence of peri-implantitis.¹¹

Since their introduction in the early 1970s, fixed partial dentures and implant-supported milled bar overdentures have developed into reliable treatment options in cases of partial as well as total edentulism in both the mandible and the maxilla.^{12,13} A high success rate for implant-retained overdentures has been reported, even if some late implant failures have been observed.^{14,15} Biomechanical evaluation suggests that implant overload is a major contributor to cortical bone loss.¹⁶ A favorable prognosis requires proper bar design and selection of the attachment system, based not only on retention or cost, but also on biomechanics since the attachment is the most fragile link between prosthesis and implant.¹⁷

This case report describes long-term results of a patient with a history of trauma from a motorcycle accident, chronic periodontal disease, recurrent decay, American Society of Anesthesiology (ASA) III clinical condition, insulin-dependent diabetes, and previous implants that had not been restored. The patient was treated in both jaws with multiple extractions of all remaining teeth, immediate implant placement, and implant-retained bar overdentures. Immediate provisional implants (IPIs) were placed between submerged implants to provide support and esthetics for a provisional restoration during healing. A multifactorial approach as well as a clinician-patient relationship was needed in order to ensure optimal treatment planning and a long-term successful result.

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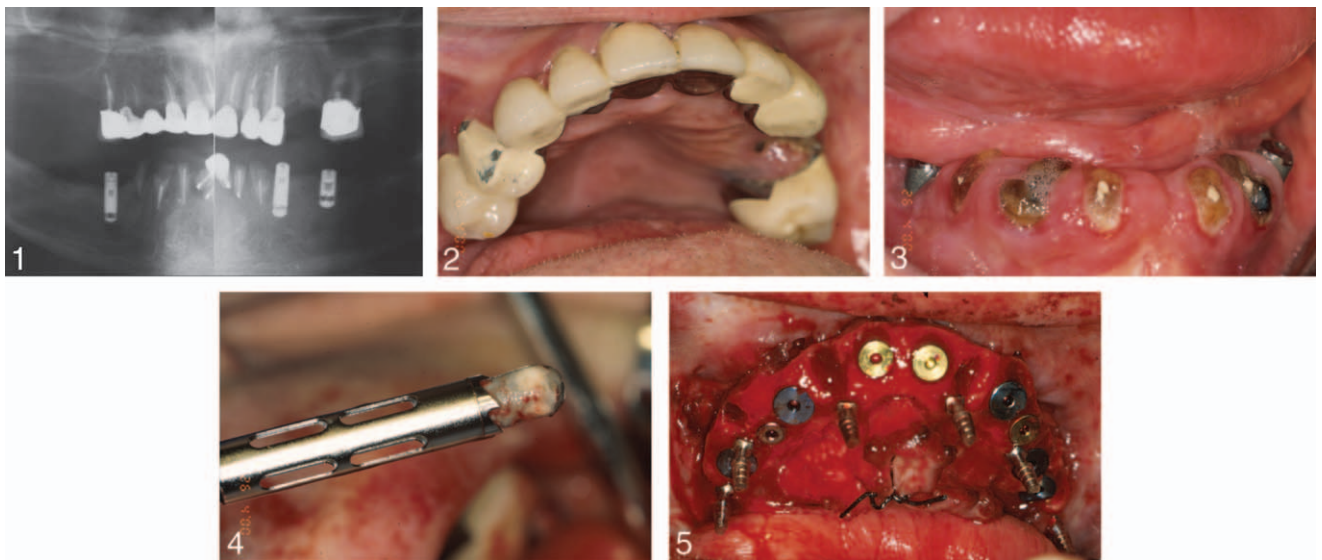
CASE REPORT

A 51-year-old man with a history of trauma from a previous motorcycle accident presented to our private clinic center in 2000, requiring an overall dental treatment. The patient had a history of herpes and hepatitis and had well-controlled insulin-dependent diabetes mellitus. Comprehensive clinical, radiographic, and study-cast evaluation revealed that 3 previously placed implants in the mandible were never restored causing fractured crowns on all remaining teeth with a bilateral distal-free-end situation. In the maxilla, the remaining dentition showed recurrent decay under the remaining crowns and progressive bone loss due to chronic periodontal disease (Figures 1 through 3). Various treatment options were discussed with the patient, including maxillary and mandibular conventional removable complete dentures, conventional overdenture supported by 2/4 implants, as well as implant-retained bar overdenture. The patient's chief concern was to replace his existing teeth with an implant-supported restoration without conventional removable complete dentures. After detailed consultation, the extraction of all remaining dentition, including the 3 nonrestored implants, and immediate implant placement with the use of platelet-rich plasma was suggested. The patient understood and agreed to the treatment plan and was informed about the higher risk of implant failure due to his periodontal disease and diabetes. The standard outcome in these cases is about 93% at 10-year follow-up, but owing to the preexisting diabetes and the patient's oral hygiene level, the success rate was decreased to 80%–85% at 5 years and 70%–75% at 10 years. Outcomes would be dependent on the patient's daily routine, home care, and his professional recall visits. The patient decided to proceed with rehabilitation of both arches with fixed/removable complete dentures, aware of cost and associated advantages and disadvantages. As a result of the patient's medical history and the extensive bone augmentation required, the option of immediate loading on the implant was ruled out in order to limit the risk of complications. Thus, the IPI solution was selected to support osseointegration and an interim fixed restoration for the healing process.

Esthetics, phonetics, and occlusal vertical dimension were evaluated prior to development of the definitive treatment plan. The patient underwent

antibiotic therapy 2 days prior to surgery, a single dose of antibiotic (2 g of amoxicillin and clavulanic acid) was administered per os 1 hour before surgery, and 10 days (1 g amoxicillin and clavulanic acid twice a day) after surgery. The patient received general nasotracheal anesthesia supplement with 2% Carbocaine (mepivacaine hydrochloride, Cook-Waite, Cambridge, Ontario, Canada). Treatment proceeded with atraumatic extraction of the remaining teeth and the removal of the 3 previously placed mandibular implants (Figure 4). According to protocol and manufacturer's recommendation, a flap approach was performed on the implant sites. Each drill was used under copious irrigation and with the in and out movement of the tip of the drill to avoid overheating while reaching the desired depth. Nine Replace Select Implants (Nobel Biocare USA, LLC, Yorba Linda, Calif) were placed in the maxilla (Figure 5) and 8 in the mandible (Figure 6). Respectively, 6 IPIs were placed in the maxilla, while 5 IPIs were placed in the mandible (Figures 5 and 6). Augmentation bone grafting with human demineralized bone matrix (DynaGraft-D, Keystone Dental, Burlington, Mass) and platelet-rich plasma (Harvest Technologies, Boston, Mass) was performed to promote natural bone formation around the implants and other osseous defects (Figure 7). The cover screws were positioned on all implants and prefabricated, 1-piece, cemented-retained interim restorations were relined on the IPIs of the maxilla and mandible. The restorations were completed, polished, and temporarily cemented (TempBond eugenol-containing, Kerr Corporation, Orange, Calif) on the IPIs (Figures 8 and 9). All centric contacts were assessed and adjusted until light occlusal contact was obtained. The patient was prescribed a soft diet for 18 weeks with analgesic prescriptions to control postoperative pain. Accordingly, both jaws were treated with the same procedure. At the 1-week recall, the patient reported no postoperative swelling, minimal discomfort, and increased satisfaction with the surgical, esthetic, and functional outcome.

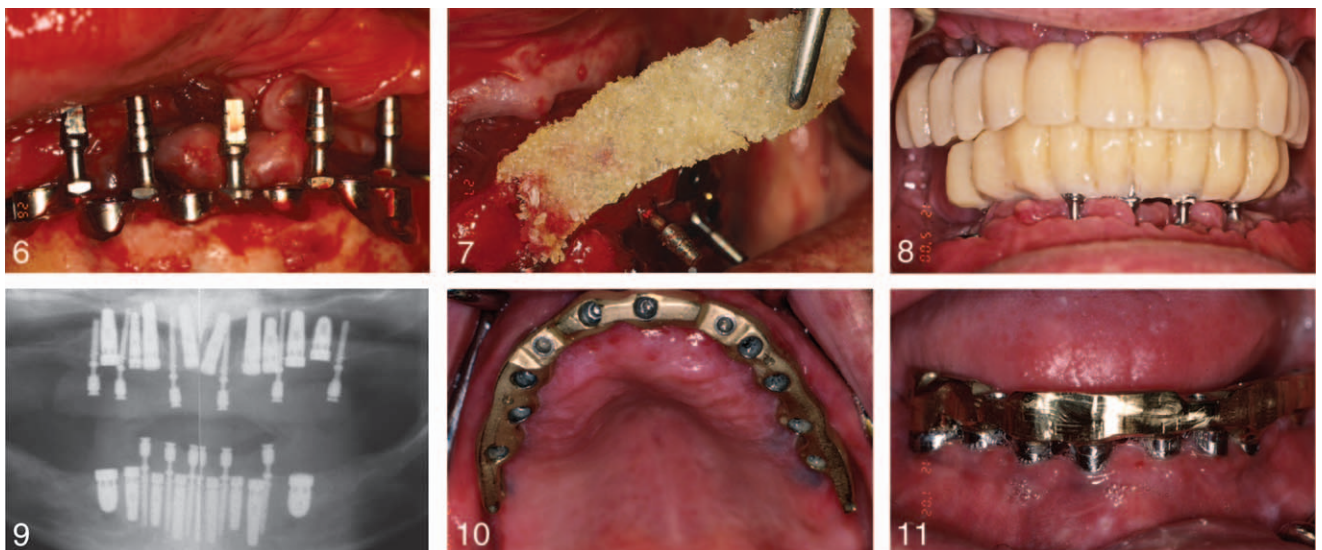
Following 5 months of submerged healing, the IPIs and the interim prostheses were removed and a second surgery was performed to expose all implants and connection of the healing and temporary abutments. The same interim prostheses were relined and temporarily cemented on the maxillary and mandibular implants. The same dentures also functioned as guides to transfer precise esthetics, phonetics, and occlusal vertical dimension. Impres-



FIGURES 1–5. **FIGURE 1.** Preoperative panoramic radiograph. **FIGURE 2.** Preoperative photograph of the maxilla showing the terminal nonrestorable dentition with all fractured crowns. **FIGURE 3.** Preoperative photograph of the mandible showing the terminal nonrestorable dentition with all fractured crowns. **FIGURE 4.** Previously placed implant removed using trephine technique. **FIGURE 5.** TiUnite Nobel Replace Select and immediate provisional implants placed in the maxilla after all teeth were extracted.

sion copings were connected to the implants, and radiographs were made to verify seating of the impression copings. Open tray impressions were taken in both jaws, using a polyether material with a custom open tray (Impregum, 3M ESPE, St Paul, Minn). In both jaws, a fixed-removable, implant-retained bar overdenture on cast gold bars was delivered to restore the function as well as the

esthetics (Figures 10 through 12). A precision good alloy suprastructure over prostheses (removable) was the primary choice, with no palatal coverage in the maxilla. Minimal occlusal adjustments were needed to achieve cross-arch centric relation contacts. A panoramic radiograph was taken to confirm seating of the definitive prosthesis (Figure 13). The occlusal scheme was verified and modified to assure lingual-



FIGURES 6–11. **FIGURE 6.** TiUnite Nobel Replace Select and immediate provisional implants placed in the mandible after implant removal. **FIGURE 7.** Platelet-rich plasma combined with human allograft to composite graft during insertion. **FIGURE 8.** Maxillary and mandibular temporary restorations in place. **FIGURE 9.** Postoperative panoramic radiograph. **FIGURE 10.** Maxillary retained bar. **FIGURE 11.** Mandibular retained bar.

ized balanced articulation. Postoperative instructions were given to the patient, including proper hygiene procedures and the importance of accurate hygienic care. Home oral health care instructions included use of floss threader, interproximal brushes, and an oral irrigator. The patient was recalled for a professional cleaning treatment by a dental hygienist on a routine basis. Each visit included evaluation of the patient's oral hygiene, implants and prostheses stability, and occlusion and periodontal status. The restorations have been in place for 12 years with no complication noted at recall appointments. At the last follow-up, 12-years after implant placement, both maxillary and mandibular prostheses were stable and periapical radiographs verified successful marginal bone levels compared to postinsertion baseline periapical radiographs (Figures 14 and 15a and b).

DISCUSSION

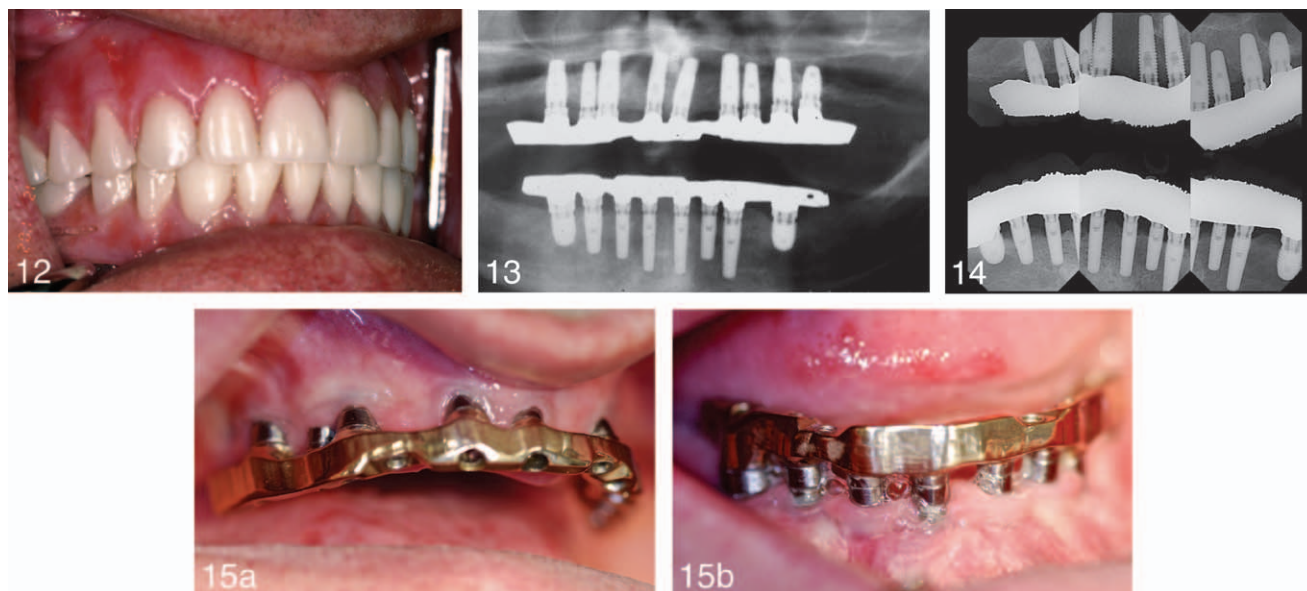
During the last decade, there has been a paradigm shift in periodontics from the philosophy of saving teeth at all cost to an opposite one of extracting compromised teeth and replacing them with dental implants for a better and more predictable long-term outcome.¹⁸ Rehabilitation with dental implants has been demonstrated to be a significant tool to improve the quality of life of edentulous patients.¹⁹ Eating comfort is the main concern for the patient and shows the highest improvement; postoperative complications are limited and patients consider immediate loading important.

Concerns have been raised about the use of surface-modified implants that may result in peri-implant infection and marked marginal bone loss over time.²⁰ Moreover, patients with a history of periodontitis present with a statistically significant higher number of sites that require additional treatment.¹⁰ Thus, patients with a history of periodontitis should be notified that they are at a higher risk for peri-implant disease. Therefore, the approach for multiple preventive dental extractions and implant placement, based on the assumption the implants perform better than teeth, should be followed with caution. Compared to periodontally healthy patients, implant therapy in patients susceptible to periodontitis is often complicated by severe bone loss and low bone quality.¹¹ On the other hand, positive results in terms of bone maintenance in the long-term perspective are to

be expected using immediate loaded implants with a TiUnite oxidized surface (Nobel Biocare) in both postextraction and healed sites when adequate levels of oral hygiene are kept.^{8,12} This underscores the value of the supporting periodontal therapy in enhancing long-term outcomes of implant therapy, particularly in subjects affected by periodontitis. Albrektsson and Wennerberg²¹ described in the TiUnite oxidized surface (Nobel Biocare) an increased TiO₂ layer, roughness, and an enlarged surface area, resulting in a faster integration of the implant in the surrounding bone. Furthermore, the oxidized surface (TiUnite) showed a high primary implant stability that tended to remain initially stable, and thereafter increased, due to the developing biologic stability, making these implants suitable to 1- as well as 2-stage procedures.^{22,23}

The literature reported that the implant overdenture prosthesis provides predictable results, enhanced stability, function, and a high-degree of satisfaction compared to conventional removable dentures.²⁴ Furthermore, biological (eg, nonosseointegration, peri-implantitis, mucositis with or without inflammatory hyperplasia) and biomechanical complications (eg, bar fracture, fracture, or detachment of the clip anchorage fracture of the prosthesis or its parts) can occur. The few studies that mentioned aspects of prosthetic aftercare provided to implant-retained maxillary overdentures reported complications with the attachment components,²⁵⁻²⁸ fractures of the acrylic resin or teeth,^{2,26} and adjustments to the overdenture.²⁸ When a bar design is used, to ensure proper stress distribution to bone around implants, bar height and length of distal cantilever must be considered.^{29,30} Cantilevered bar-retained prostheses with distal bar extensions up to 12 mm do not negatively influence the amount of mesial and distal marginal bone around implants.³⁰

Patient well-being is always the goal of rehabilitation of edentulism. The present case report describes high levels of patient satisfaction after a 12-year follow-up. The surgical and prosthetic aftercare needed for maintenance was minor and the overall aftercare treatment time was dedicated to routine inspections and oral hygiene care. According to a 10-year follow-up study of surgical and prosthetic care and aftercare, these prostheses are effective, predictable, and a reliable treatment option, requiring minimal aftercare other than adjustments of the attachments.²⁴ Minor remodel-



FIGURES 12–15. **FIGURE 12.** Definitive restorations in place. **FIGURE 13.** Panoramic radiograph at prosthesis delivery. **FIGURE 14.** Radiographs after 12 years in function. **FIGURE 15.** (a) Clinical photograph after 12 years in function (maxilla). (b) Clinical photograph after 12 years in function (mandible).

ing in the hard tissue was assessed after the 12-year follow-up. Major deviations from this pattern were, indeed, assessed in only 1 maxillary implant. The adoption of a systematic hygienic protocol is mandatory in order to control plaque accumulation and reduce the incidence of mucositis and peri-implantitis. Nevertheless, as a result of continuing evolution of bioactive surgical and prosthetic surfaces, the predictability and success of implant treatment have increased. Implant-retained maxillary overdenture on a bar suprastructure supported by 6–8 implants was a proper concept.¹⁹ Therefore, a reduction of the number of supporting implants resulted in the same clinical outcome of more implants and would be desirable in the future.

Furthermore, nonsubmerged implants are as predictable as submerged ones.²³ The literature review shows that immediate loading of implant-retained mandibular overdentures does not jeopardize the survival rate when designed with at least 4 implants,³¹ avoiding the use of IPIs. On the other hand, insufficient data exist to support immediate loading for the implant-retained maxillary overdentures.³² Finally, implant-retained overdentures with computer-aided design and manufacturing (CAD/CAM) bars presented levels of fit precision within limits, are considered to be clinically acceptable and superior to earlier published results on cast frameworks, and could be considered the gold-standard procedure.

CONCLUSION

In conclusion, an implant-retained maxillary bar overdenture, opposed by an implant-retained mandibular bar overdenture, can be considered an effective, predictable, and reliable treatment option for success in the long-term treatment of edentulism in periodontally compromised patients. Positive results in terms of bone maintenance in the long-term perspective are to be expected using implants with a TiUnite porous anodized surface in combination with adequate levels of oral hygiene.

ABBREVIATION

IPI: immediate provisional implants

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NOTES

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REFERENCES

1. Adell R, Lekholm U, Rockler B, Brånemark PI. A 15-year study of osseointegrated implants in the treatment of the edentulous jaw. *Int J Oral Surg.* 1981;10:387–416.
2. Babbush CA. Provisional implants: surgical and prosthetic aspects. *Implant Dent.* 2001;10:113–120.
3. Becker W, Becker BE, Israelson H, et al. One-step surgical placement of Branemark implants: a prospective multicenter clinical study. *Int J Oral Maxillofac Implants.* 1997;12:454–462.
4. Becktor JP, Isaksson S, Billstrom C. A prospective multicenter study using two different surgical approaches in the mandible with turned Branemark implants: conventional loading using fixed prostheses. *Clin Implant Dent Relat Res.* 2007;9:179–185.
5. Polizzi G, Grunder U, Goené R, et al. Immediate and delayed implant placement into extraction sockets: a 5-year report. *Clin Implant Dent Relat Res.* 2000;2:93–99.
6. Ericsson I, Nilson H, Lindh T, Nilner K, Randow K. Immediate functional loading of Brånemark single tooth implants. An 18 months' clinical pilot follow-up study. *Clin Oral Implants Res.* 2000; 11:26–33.
7. Hall JA, Payne AG, Purton DG, Torr B, Duncan WJ, De Silva RK. Immediately restored, single-tapered implants in the anterior maxilla: prosthodontic and aesthetic outcomes after 1 year. *Clin Implant Dent Relat Res.* 2007;9:34–45.
8. Degidi M, Nardi D, Piattelli A. 10-Year follow-up of immediately loaded implants with TiUnite porous anodized surface. *Clin Implant Dent Relat Res.* 2012;14:828–838.
9. Gurgel BC, Gonçalves PF, Pimentel SP, et al. An oxidized implant surface may improve bone-to-implant contact in pristine bone and bone defects treated with guided bone regeneration: an experimental study in dogs. *J Periodontol.* 2008;79:1225–1231.
10. Rocuzzo M, Bonino F, Aglietta M, Dalmasso P. Ten-year results of a three arms prospective cohort study on implants in periodontally compromised patients. Part 2: clinical results. *Clin Oral Implants Res.* 2012;23:389–395.
11. Mombelli A, Müller N, Cionca N. The epidemiology of peri-implantitis. *Clin Oral Implants Res.* 2012;23:67–76.
12. Babbush CA. ITI endosteal hollow cylinder implant systems. *Dent Clin North Am.* 1986;30:133–149.
13. Adell R, Lekholm U, Gröndahl K, Brånemark PI, Lindström J, Jacobsson M. Reconstruction of severely resorbed edentulous maxillae using osseointegrated fixtures in immediate autogenous bone graft. *Int J Oral Maxillofac Implants.* 1990;5:233–246.
14. Straioto FG, de Azevedo AM, do Prado CJ, das Neves FD, Neto AJ. Rehabilitation of maxillary edentulism with implant-supported milled-bar prostheses. *Implant Dent.* 2006;15:366–371.
15. Fortin Y, Sullivan RM, Rangert BR. The Marius implant bridge: surgical and prosthetic rehabilitation for the completely edentulous upper jaw with moderate to severe resorption: a 5-year retrospective clinical study. *Clin Implant Dent Relat Res.* 2002;4:69–77.
16. Esposito M, Hirsch JM, Lekholm U, Thomsen P. Biological factors contributing to failures of osseointegrated oral implants (II) etiopathogenesis. *Eur J Oral Sci.* 1998;106:721–764.
17. Watson CJ, Tinsley D, Sharma S. Implant complications and failures: the complete overdenture. *Dent Update.* 2001;28:234–238, 240.
18. Zitzmann NU, Krastl G, Hecker H, Walter C, Waltimo T, Weiger R. Strategic considerations in treatment planning: deciding when to treat, extract, or replace a questionable tooth. *J Prosth Dent.* 2010;104:80–91.
19. Agliardi EL, Pozzi A, Stappert CF, Benzi R, Romeo D, Gherlone E. Immediate fixed rehabilitation of the edentulous maxilla: a prospective clinical and radiological study after 3 years of loading. *Clin Implant Dent Relat Res.* doi: 10.1111/j.1708-8202.2012.00482.x.
20. Albouy J, Abrahamsson I, Persson L, Berglundh T. Spontaneous progression of peri-implantitis at different types of implants. An experimental study in dogs. I: clinical and radiographic observations. *Clin Oral Implants Res.* 2008;19:997–1002.
21. Albrektsson T, Wenneberg A. Part 1—review focusing on topographic and chemical properties of different surfaces and in vivo responses to them. *Int J Prosthodont.* 2004;17:536–543.
22. Tallarico M, Vaccarella A, Marzi GC, Alviani A, Campana V. A prospective case-control clinical trial comparing 1- and 2-stage Nobel Biocare TiUnite implants: resonance frequency analysis assessed by Osstell Mentor during integration. *Quintessence Int.* 2011;42:635–644.
23. Tallarico M, Vaccarella A, Marzi GC. Clinical and radiological outcomes of 1- versus 2-stage implant placement: 1-year results of a randomised clinical trial. *Eur J Oral Implantol.* 2011;4:13–20.
24. Visser A, Raghoobar GM, Meijer HJA, Vissink A. Implant-retained maxillary overdentures on milled bar suprastructures: a 10-year follow-up of surgical and prosthetic care and aftercare. *Int J Prosthodont.* 2009;22:181–192.
25. Kiener P, Oetterli M, Mericske E, Mericske-Stern R. Effectiveness of maxillary overdentures supported by implants: maintenance and prosthetic complications. *Int J Prosthodont.* 2001; 14:133–140.
26. Jemt T, Book K, Lindén B, Urde G. Failures and complications in 92 consecutively inserted overdentures supported by Brånemark implants in severely resorbed edentulous maxillae: a study from prosthetic treatment to first annual check-up. *Int J Oral Maxillofac Implants.* 1992;7:162–167.
27. Widbom C, Söderfeldt B, Kronström M. A retrospective evaluation of treatments with implant-supported maxillary overdentures. *Clin Implant Dent Relat Res.* 2005;7:166–172.
28. Jemt T. Implant treatment in resorbed edentulous upper jaws. A three-year follow-up study on 70 patients. *Clin Oral Implants Res.* 1993;4:187–194.
29. Rismanchian M, Dakhilalian M, Bajoghli F, Ghasemi E, Sadr-Eshkevari P. Implant-retained mandibular bar-supported overlay dentures: a finite element stress analysis of four different bar heights. *J Oral Implantol.* 2012;38:133–139.
30. Semper W, Heberer S, Nelson K. Retrospective analysis of bar-retained dentures with cantilever extension: marginal bone level changes around dental implants over time. *Int J Oral Maxillofac Implants.* 2010;25:385–393.
31. Chiapasco M. Early and immediate restoration and loading of implants in completely edentulous patients. *Int J Oral Maxillofac Implants.* 2004;19(suppl):76–91.
32. Weber HP, Morton D, Gallucci GO, Rocuzzo M, Cordaro L, Grutter L. Consensus statements and recommended clinical procedures regarding loading protocols. *Int J Oral Maxillofac Implants.* 2009;24(suppl):180–183.