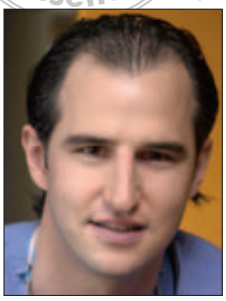
Stefan Fickl, Wolfgang Bolz, Hannes Wachtel, Tobias Thalmair, Otto Zuhr, Markus B. Hürzeler

Decision-making in periodontics: a case report



Stefan Fickl*
Wolfgang Bolz
Tobias Thalmair
Otto Zuhr

All from:
Institute for Periodontics and Implantology (IPI), Munich, Germany

*and: Department of Periodontology and Implant Dentistry, New York University College of Dentistry
345 East 24th Street
New York, 10010, NY, USA

Hannes Wachtel
Clinic and Polyclinic for Dentistry, Stomatology and Orthodontics, Department of Restorative Dentistry, Campus Benjamin Franklin, Charite-Universitätsmedizin Berlin, Germany
and
Institute for Periodontics and Implantology (IPI), Munich, Germany

Markus B. Hürzeler
Polyclinic for Restorative Dentistry and Periodontics, Albert-Ludwigs University, Freiburg im Breisgau, Germany
and
Clinical Assistant Professor, University of Texas, Dental Branch, Houston, Texas, USA
and
Institute for Periodontics and Implantology (IPI), Munich, Germany

Correspondence to:
Dr Stefan Fickl
Institute for Periodontics and Implantology (IPI)
Rosenkavalierplatz 18,
81925 Munich, Germany
Email: fickl@ipi-muc.de

KEY WORDS *decision-making, implants, periodontal therapy, risk assessment*

Long-term periodontal stability is one of the major issues of periodontal therapy. Besides a successful active therapy and a meticulous periodontal maintenance phase, the initial risk assessment for each single tooth is of utmost importance. However, the literature contains only limited guidelines and recommendations concerning periodontal risk assessment. In particular, when teeth are to be used as abutments for a new prosthetic reconstruction, long-term periodontal stability should be expected. This clinical report discusses the clinical considerations concerning periodontal risk assessment, and factors that aid in the decision-making process.

■ Introduction

The foundation of any successful periodontal therapy must be the correct prognostic assessment of the teeth. However, the decision-making that leads to prognostic assessment of each individual tooth is dependent on many variables and factors. Modified in accordance with the test series by McGuire and Nunn[1-4], a three-tiered classification of teeth from a periodontal viewpoint was created, which provided a rough guide for classification (Fig 1). In these studies, a high percentage of teeth that were initially given a good prognosis were able to be retained for a period of 5 to 8 years[1-4]. However, teeth with a questionable prognosis had a clearly inferior survival rate over the study period[1-4]. In addition, differentiation was made between multi-rooted teeth and single-rooted teeth in the prognostic assessment. Long-term studies have shown that molars (especially furcated molars) have the worst survival rates[5-7].

In this context, an important deciding factor is whether or not a tooth is to be used as an abutment tooth for a new prosthetic reconstruction. A tooth with a questionable prognosis must not be used in a new reconstruction, as the complete reconstruction is lost if this abutment tooth is removed.

The case presented provides examples of the factors on which clinical decision-making is dependent. The clinical decisions made in this case are scientifically and critically scrutinised.

■ Master data

The treatment of the patient (born 14.04.1968) began on 24.05.2005 and ended on 27.02.2007. Since then, supporting periodontal treatment has been carried out.

Prognosis and risk evaluation
Certain
- < 25% attachment loss
- good oral hygiene
- good aftercare guaranteed

Questionable: (one or more of the following parameters applies)
- > 50% attachment loss
- unfavourable root morphology
- grade II furcation and difficulty with cleaning, or grade III furcation
- endodontic problems
- tooth mobility class 2 to 3

Hopeless:
- more than 80% attachment loss

Fig 1 Prognostic assessment of teeth, modified in accordance with McGuire and Nunn[1-4].

■ Anamnesis

■ General

At the start of treatment, the patient was 37 years old, exhibited good general health and took no regular medication. A penicillin allergy and increased sensitivity to adrenaline were determined. The family anamnesis was ordinary and it was determined that the patient was exposed to a large degree of professional stress.

■ Dental

On the referral of her general dentist, the patient presented for treatment due to a periodontal complaint in October 2005. She stated that teeth had already been extracted a year previously because of increased loosening. Due to an extensive carious lesion, an adhesive filling with a self-hardening composite material (Clearfil Core®, Kuraray, Tokyo, Japan) was carried out on tooth 46 before the start of the periodontal treatment.

■ Findings

■ Extraoral

The extraoral findings were normal.

■ Intraoral

Inspection of the oral mucous membranes, the lips, the mouth base and the tongue showed no pathological changes. The saliva was inconspicuous in its quantity and consistency. Teeth 27, 28, 38, 37 and 48 were missing. Teeth 16, 15, 13, 24, 25, 26 and 45 did not react to a CO_2 cold test. Tooth 17 exhibited a gold onlay and insufficient metal-ceramic crowns could be diagnosed on teeth 16, 15, 13, 45 and 47. Teeth 24, 25 and 26 had been restored with metal-ceramic crowns. Resin composite fillings could be detected on teeth 12, 11, 23, 36 and 35. Teeth 16, 25 and 47 exhibited access cavities sealed with resin composite. The findings showed an average level of oral hygiene with dental calculus, plaque and bleeding on probing. The gingiva exhibited evidence of marginal inflammation.

The probing depths were between 3 mm and 12 mm. Degree II furcation involvement in accordance with the classification of Hamp and colleagues[8] could be measured on tooth 16 and 17 (buccal, mesial and distal). Degree I furcation involvement was exhibited by teeth 36 and 47 (buccal). There was no pathological tooth mobility. The probing attachment level (PAL) was between 4 mm and 13 mm. Figs 2 to 7 show the clinical findings at the time of initial assessment and Fig 8 shows the periodontal findings.

■ Functional

The patient had no tenderness upon pressure, and no other complaints of the jaw joints or masticatory muscles.

■ Radiographic

The patient brought a recent orthopantogram to the initial examination (Fig 9). In addition, on 07.12.2005

Fig 2 Anterior view of initial situation of the maxilla.

Fig 3 Anterior view of initial situation of the mandible.

Fig 4 Occlusal view of the maxilla.

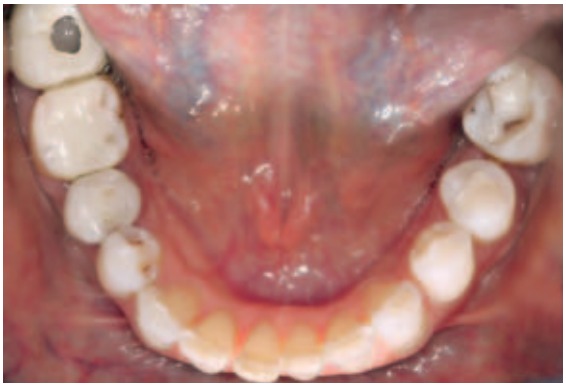


Fig 5 Occlusal view of the mandible.

Fig 6 Right lateral view.

Fig 7 Left lateral view.

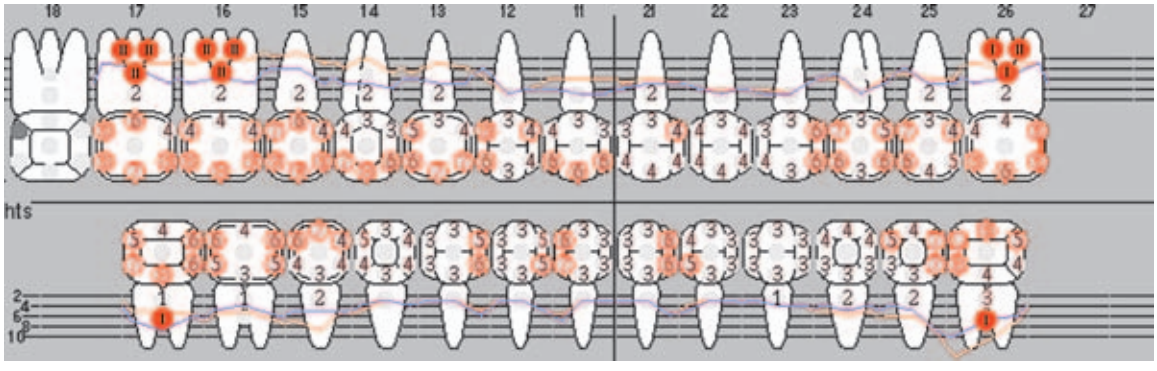


Fig 8 Periodontal status of initial situation.

Fig 9 Orthopantogram of initial situation.

Fig 10 Radiograph of region 17 to 15.

Fig 11 Radiograph of region 26 to 25.

Fig 12 Radiograph of region 47 to 45.

Fig 13 Radiograph of region 36.

single-tooth radiographs were taken (Figs 10 to 13). The gold reconstructions showed up as metal-dense shadows on the radiographs. Teeth 16, 15, 13, 24, 25, 26 and 45 exhibited previous root canal treatment and root canal filling. Apical light zones on teeth 16 and 15 were determined. Generalised bone reduction with vertical components could be seen on teeth 15, 16, 17 and 36. The bone reduction was between 2 mm and 12 mm and was measured as the distance between the cementoenamel junction or restoration margin and the limbus alveolaris. In region 18, a rudimentary wisdom tooth could be diagnosed.

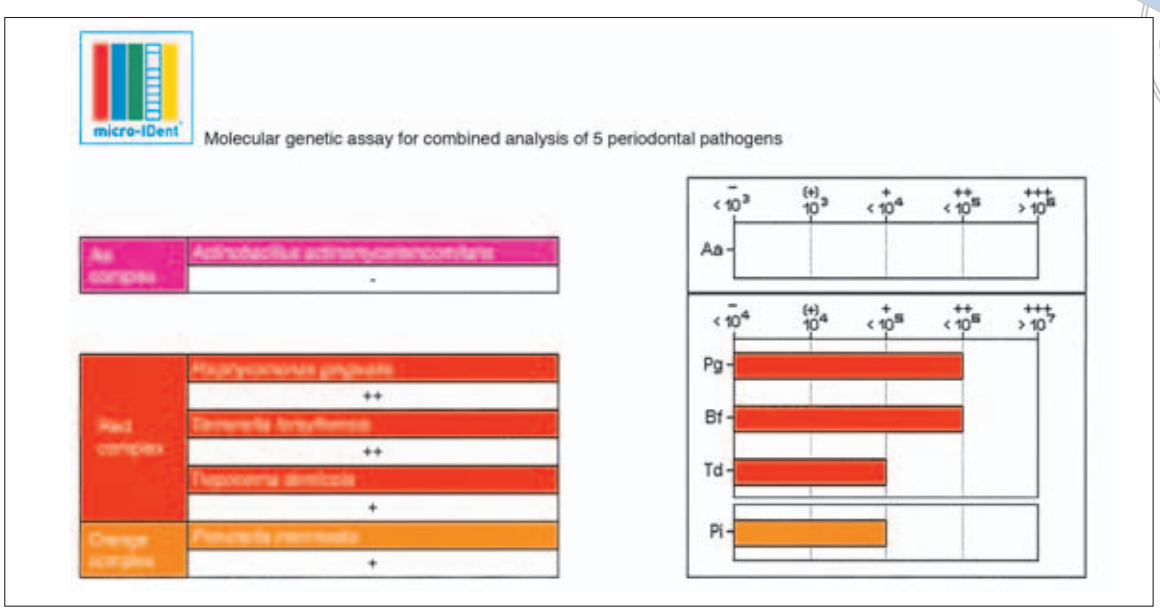


Fig 14 Microbiological assessment.

Microbiological findings

Due to the suspicion of a serious form of periodontitis, a further diagnostic test was carried out (Fig 14). Microbiological examination of the subgingival plaque flora was performed using the micro-IDent® test (Hain Lifescience, Nehren, Germany). For this, the removal of subgingival bacteria samples took place at the deepest sites of each quadrant[9]. The evaluation showed an elevated number of periodontopathogenic bacteria. The microbial concentration of *Porphyromonas gingivalis*, *Tannerella forsythensis* and *Treponema denticola* were greatly increased (< 10^6 cells/ml). In addition, it was also possible to detect *Actinobacillus actinomycetemcomitans* (< 10^3 cells/ml).

Diagnosis

The diagnosis was of severe generalised chronic periodontitis (in accordance with the classification of the American Academy of Periodontology[10]).

Aetiology of the periodontal disease in question

The insufficient oral hygiene in combination with extensive prosthetic reconstruction and the increased levels of professional stress must be listed as the risk factors in this case. In addition, owing to the age of the patient and the advanced periodontal disease, it could be assumed that the patient had increased sensitivity to periodontopathogenic bacteria, and consequently altered immunocompetence.

Prognosis

The prognostic assessment of the teeth (Fig 15) was carried out with the aid of the risk assessment by McGuire and Nunn as well as individual considerations[1-4].

The prognosis for teeth for 18 to 15 was assessed as hopeless. The following considerations were decisive; as well as the extensive periodontal bone loss and the apical pathology, the prosthetic reconstruction on tooth 16 was assessed as insufficient. These factors led to the cost of reconstructing this tooth being assessed as too high with a prognosis that remained questionable nonetheless. Due to the furcation involvement and bone loss through to the apex, tooth 17 could not be used as the bridge anchor. A prosthetic reconstruction was also necessary. As well as the increased probing depths and extensive bone loss, tooth 15 also exhibited root pin construction with insufficient residual tooth structure. Revision of the root canal filling and new prosthetic construction would also have been necessary.

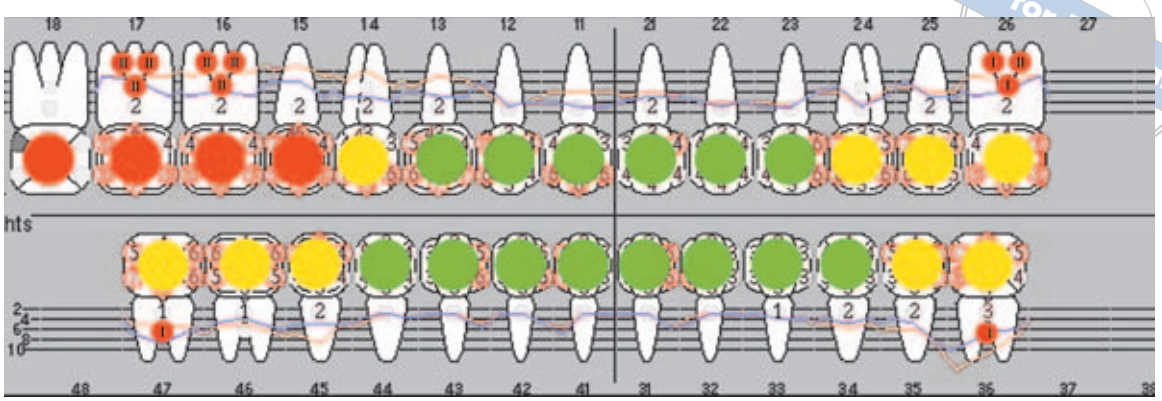


Fig 15 Prognostic assessment of teeth. ● secure; ● doubtful; ● hopeless.

Despite all the treatments, the prognosis of these two teeth (17 and 15) would have remained questionable in the long term. Implant construction of tooth 16 would have been required as it was not possible to make a bridge construction on the basis of abutment teeth, and this also added to the poor prognosis. Particularly after augmentative measures, three interlocked implants in the posterior tooth area are usually favoured with regard to the long-term stability. These points led to the decision to extract teeth 18 to 15 and to replace them with a purely implant-supported reconstruction.

Teeth 24 to 26 were assessed as questionable because of the increased probing depths. In addition, the advanced furcation involvement on tooth 26 made this prognosis worse. However, tooth 26 did not receive a hopeless prognosis, particularly because no prosthetic reconstruction or endodontic revision had to be carried out. Owing to the fact that almost no expenditure had to be invested in this tooth, it could be retained (even long term) despite the questionable prognosis, as it could be re-observed in the recall and, if necessary, action could be taken. Teeth 35 to 36 and 45 to 47 were assessed as questionable because of the increased probing depths and existing furcation involvement.

■ Treatment plan:

- Anti-infectious treatment
- Re-evaluation
- Extraction of teeth 18 to 15
- Implant insertion in regions 17 to 15
- Periodontal surgical measures 35 to 36
- Re-evaluation II
- Implant exposure
- Definitive prosthetic treatment
- Supporting periodontal treatment.

■ Course of treatment

■ Anti-infectious treatment

The anti-infectious treatment was carried out from 27.06.2005 to 28.08.2005. An initial session to inform the patient took place, along with oral hygiene instruction and motivation and supragingival plaque and tartar removal. An ultrasound toothbrush (Philips Sonicare®, Philips, Hamburg, Germany) was recommended and the correct cleaning technique was demonstrated to the patient. In addition, the patient was shown how to use interdental brushes in the sizes selected for each interdental space. One week after this initial session, a subgingival curettage of all pathologically deepened pockets was carried out under local anaesthetic in two subsequent sessions (full-mouth disinfection in accordance with Quirynen et al[11]). In addition, all deepened pockets were rinsed with 0.2% chlorhexidine solution (Chlorhexamed® Strength 0.2%, GlaxoSmithKline, Bühl, Germany) during these sessions. The patient was instructed to clean her teeth with a chlorhexidine toothpaste (Gum® Paroex® chlorhexidine gel toothpaste 0.12%, Butler, Kriftel, Germany).

Owing to the results of the microbiological examination, a supporting, systematic intake in accordance with van Winkelhoff et al[12] of 3 x 500 mg amoxicillin and 3 x 400 mg metronidazole was taken daily over a period of 7 days.

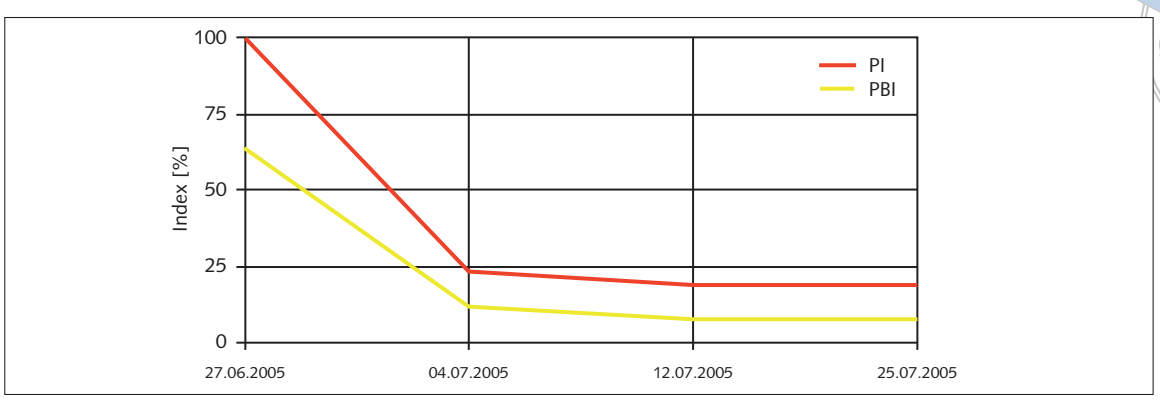


Fig 16 Schematic representation of plaque and bleeding indices (PI = plaque index, PBI = papilla bleeding index).

Weekly check-ups with oral hygiene motivation and reinstruction took place and, when necessary, supragingival biofilm destruction (oral hygiene training) was performed. The plaque index (PI, in accordance with Ainamo and Bay[13]) decreased within 4 weeks from 88% to 18% and the papilla bleeding index (PBI, in accordance with Saxer and Muhlemann[14]) decreased from 64% to 7% (Fig 16).

Re-evaluation

Eight weeks after the anti-infectious treatment, re-evaluation took place. The clinical signs of periodontal inflammation had clearly improved (Figs 17 to 22). Using the mechanical treatment, the probing depths could be reduced. However, bleeding on probing and some probing depths of greater than 6 mm could still be detected (Fig 23). Owing to these findings, teeth 18 to 15 were extracted and reinstrumentation of the remaining teeth that displayed increased probing depths and bleeding on probing was carried out.

Extraction of teeth 18 to 15

Teeth 18 to 15 were removed without complications. In addition, reinstrumentation of the deepened pockets was carried out. Eight weeks after this, the periodontal situation was inspected. The probing depths had further improved. However, probing depths of >6 mm could still be detected in the regions of tooth 26, 36 and 46. Due to the defective configuration detected radiographically, the decision was made to perform a microsurgical access flap and to continue to conservatively treat teeth 26 and 47 (Fig 24).

Sinus floor elevation in regions 17 to 15

Sinus floor elevation in the right maxilla took place in accordance with the technique by Boyne et al[15], by outlining the lateral maxillary sinus wall with a mucoperiosteal flap, preparing the Schneider's membrane (Fig 15) and filling the resulting cavity with a mixture of xenogenous bone replacement material (BioOss®, Geistlich Biomaterials, Wolhusen, Switzerland) and autologous bone (Fig 25).

The autologous bone was removed from the operating field using a piezoelectric technique. Owing to a low residual alveolar crest height, simultaneous implant insertion was not performed. The wound was closed with macrosurgical (Gore-Tex® CV5, W.L.Gore & Associates, Putzbrunn, Germany) and microsurgical suture material (Seralene®, Serag Wiesner, Naila, Germany).

Microsurgical access flap 35 to 36

In the same session, a microsurgical access flap was performed in accordance with the modified papilla preservation technique of Cortellini et al[16], with a regenerative attempt in regions 37 to 35. After making a sulcular incision near the tooth roots, separation of the papilla displaced to the buccal side took place as, on the basis of the wide interdental cavity, sufficient blood supply could be expected to the lingual papilla that was to be mobilised.

To avoid vertical discharge incisions, the cross-section was extended horizontally by a tooth width from the mesial side to the buccal and lingual sides. After elevating the mucoperiosteal flap in the buccal and lingual area, the periodontal defect was degran-

Fig 17 Frontal view of the maxilla at the point of re-evaluation.

Fig 18 Frontal view of the mandible at the point of re-evaluation.

Fig 19 Occlusal view of the maxilla at the point of re-evaluation.

Fig 20 Occlusal view of the mandible at the point of re-evaluation.

Fig 21 Lateral view right.

Fig 22 Lateral view left.

ulated and the root surface was cleaned using a diamond-tipped ultrasonic instrument. An infra-alveolar bone defect of approximately 6 mm was detected (Figs 26 and 27).

After conditioning with EDTA gel (ethylenediaminetetraacetic acid; Pref-Gel™, Straumann, Basel, Switzerland), the root surfaces were applied with an enamel matrix protein (Emdogain™, Straumann) and the defect was filled in with a xenogenous bone replacement material (BioOss®). The additional filling of the defect with a bone replacement material had the aim of preventing a collapse of the flap in the defect area (Fig 28).

The microsurgical suture closure was carried out with polypropylene sutures of strength 7 to 0 (Seralene®) using a modified suture technique (double

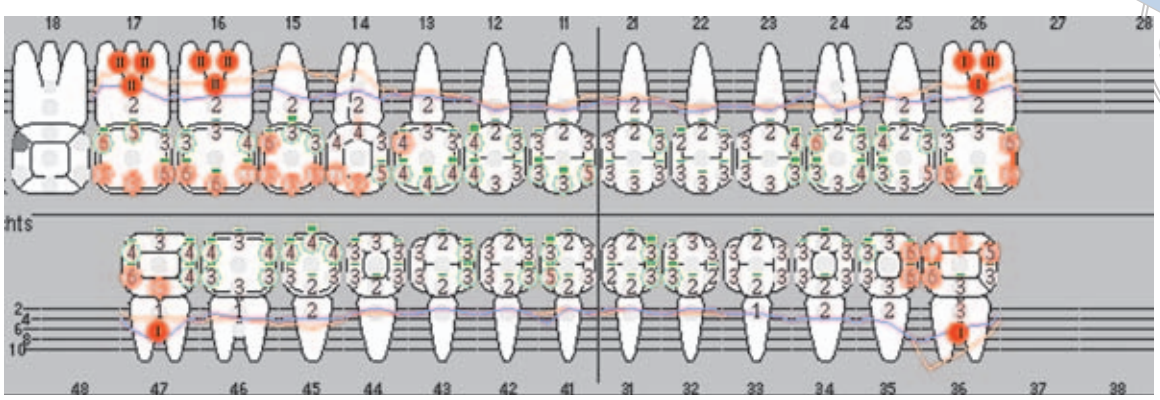


Fig 23 Periodontal status at the point of re-evaluation.

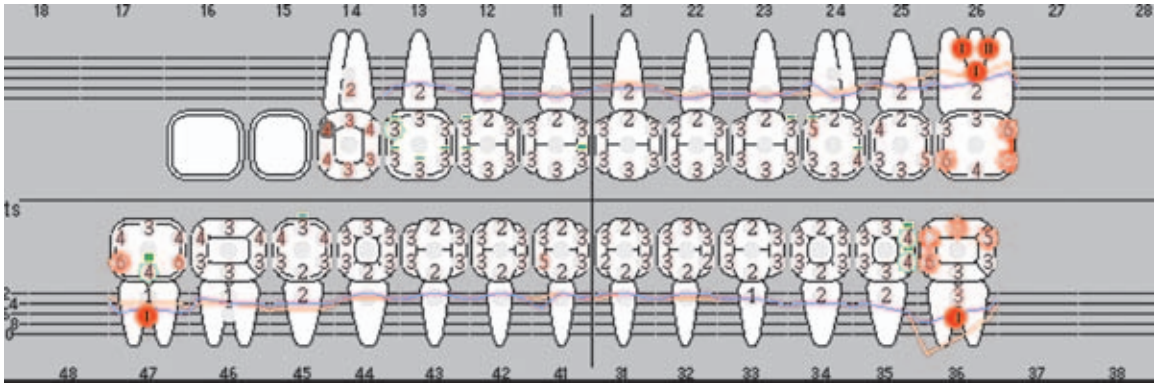


Fig 24 Renewed periodontal status 8 weeks after tooth extraction.

Fig 25 Sinus floor elevation with a mixture of autologous bone and xenogenous bone replacement material.

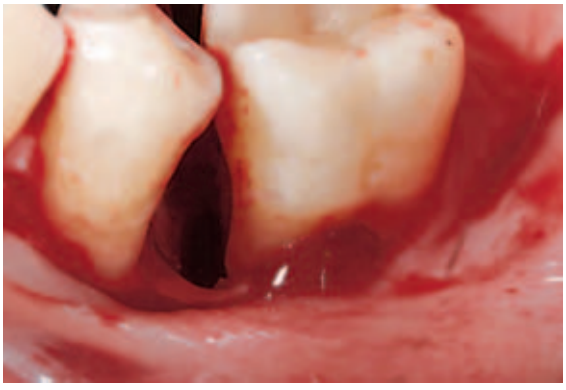


Fig 26 Microsurgical access flap in region 36 and 35.

sling suture in accordance with Wachtel et al[17]) (Fig 29). The patient was provided with an analgesic and antibiotic medication and the wound area was rinsed with 0.2% chlorhexidine solution.

After 7 days the stitches were removed and the wound was healing well, with primary wound closure (Figs 30 to 32).

After rubber cup polishing of the operated area and application of chlorhexidine gel (Chlorhexamed Gel®, GlaxoSmithKline), the patient was scheduled to return every week for 4 weeks for supragingival polishing with chlorhexidine gel, in accordance with a modification of the post-operative recommendations of Heitz et al[18].

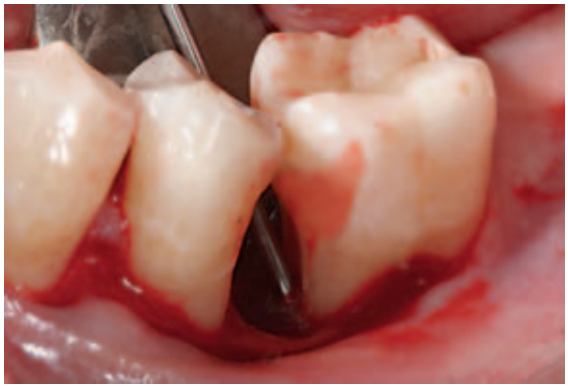


Fig 27 Representation of infra-alveolar components.

Fig 28 After application of an enamel matrix protein, the infra-alveolar defect is filled with a xenogenous bone replacement material.

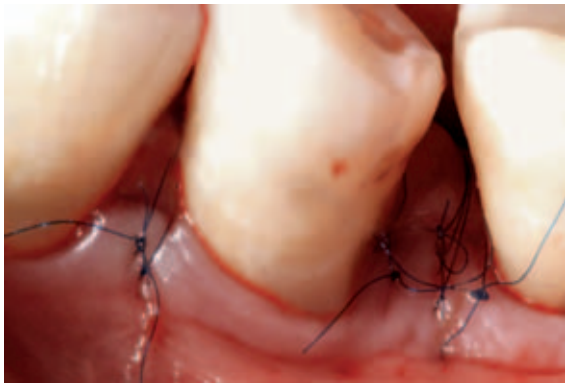


Fig 29 Microsurgical suture closure.

Fig 30 Seven days after intervention.

Fig 31 Healing, without complications, 7 days post-operative.

Fig 32 Clinical situation after removal of the sutures.

Implant insertion in regions 17 to 15

Six months after the sinus floor elevation, three implants (Osseotite®, 3i Implant Innovations, Palm Beach, CA, USA) were fitted with primary stability. The implants were closed with cover screws and the wound was closed with a macrosurgical suture material. The wound healed without complications. Fig 33 shows the post-operative radiograph.

Re-evaluation II

Twelve months after the surgical periodontal treatment, the operated area was completely free from inflammation in clinical terms and a reduction of probing depths to 4 mm was determined in the operated area. The defect filling was monitored radiographically (Fig 34).

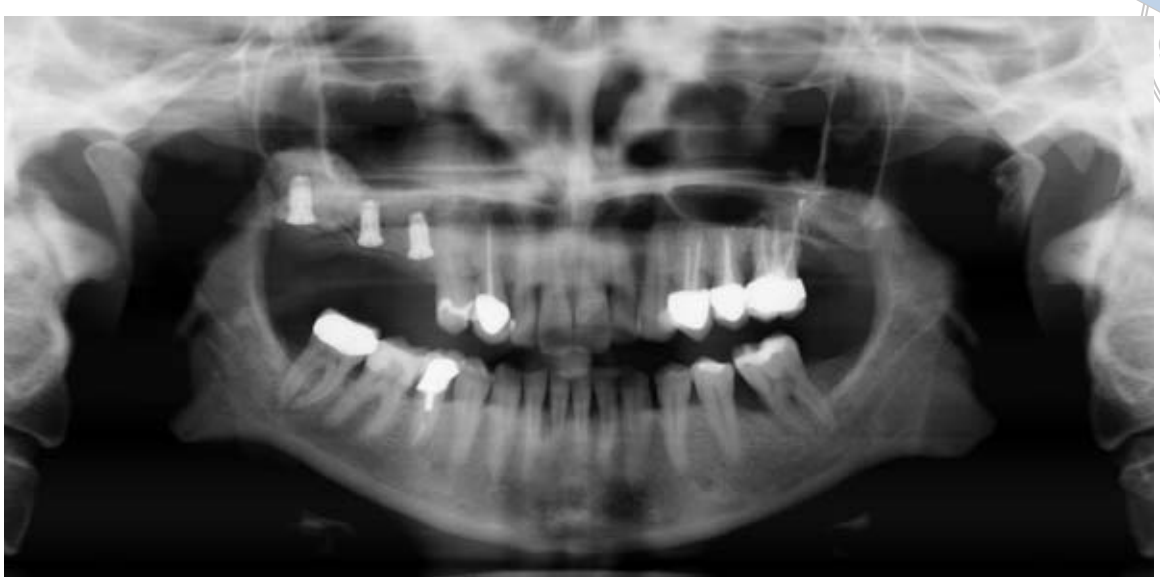


Fig 33 Orthopantogram after inserting the three implants.

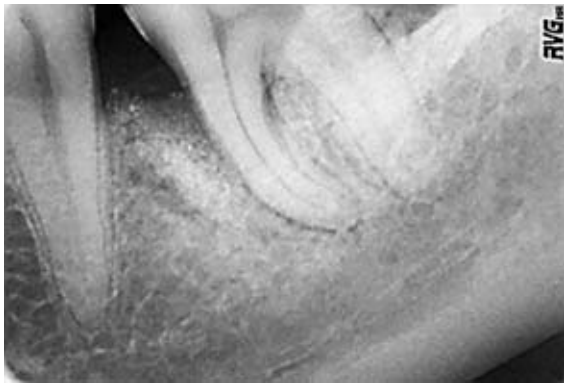


Fig 34 Radiograph of tooth 36, 6 months after treatment. Defect filling can be seen.

Fig 35 Exposure of the implants 6 months after insertion.

Exposure of implants

Six months after the insertion of the implants, they were exposed. For further development of keratinised gingiva, palatal gingiva was displaced on the buccal side. The wound was closed using macrosurgical suture material (Fig 35).

Temporary implant-supported construction in maxilla

Four weeks after the exposure of the implants in the maxilla, the impression for a temporary implant-supported construction was taken. The impression was carried out with individually constructed spoons using an open impression method and a polyether material (Permadyne Garant 2:1/Permadyne Penta

Fig 36 Definitive implant-supported reconstruction.

Fig 37 Lateral view of implant-supported reconstruction.

H, 3M Espe, St. Paul, USA). The temporary solutions, which were connected directly with the implants, were manually screwed in and sealed with foam pellets and Fermit® (Ivoclar Vivadent, Schaan, Liechtenstein).

The temporary construction initially took place in an infraocclusion position. In weekly check-ups, the implants were progressively loaded. This took place through an intraoral construction of the contact surfaces with a fine-particle hybrid composite (Tetric Ceram®, Ivoclar Vivadent).

Definitive construction

Two months after the temporary construction, the definitive reconstruction took place.

As well as the implant construction, a prosthetic reconstruction of teeth 13, 47, 46 and 45 was carried out. On teeth 13 and 45, revisions of the root canal treatments had already taken place.

The construction of the implants was performed using screwed titanium abutments and interlocked full-ceramic crowns on a zirconium oxide basis. After fitting the titanium abutments with the help of a plastic tool prepared by the dental technician, the abutments were fixed with a torque spanner (20 Ncm).

After closing the screw openings with guttapercha and fine-particle hybrid resin composite (Tetric Ceram®), the definitive reconstruction was fastened using a temporary cement (TempBond, Kerr, Karlsruhe, Germany) (Figs 36 and 37).

Teeth 13, 47 and 45 were restored with full-ceramic crowns, which were fastened with a glass-ionomer cement (Ketac™ Cem, 3M ESPE, Seefeld, Germany).

Tooth 46 was prepared for a ceramic onlay, which was applied with a fluid light-curing resin composite (Tetric® Flow, Ivoclar Vivadent, New Zealand).

Supporting periodontitis treatment

During and after the active treatment, the patient was scheduled for supporting periodontal treatment. The recall intervals were determined with help of multi-dimensional risk diagrams[19]. These showed an average risk of periodontitis with a recall interval of 4 months. In the recall sessions, special significance was placed in remotivation and the removal of supragingival and subgingival biofilms. The probing depths (Fig 40) and the oral hygiene indices (Fig 41) were shown to be stable in the recall sessions. Figs 42 to 47 show the final clinical findings and Fig 48 shows the final radiograph.

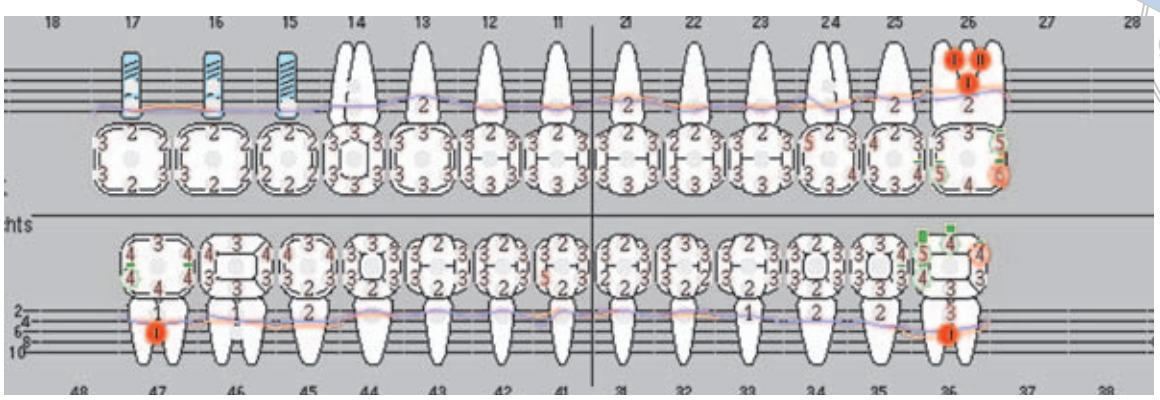


Fig 38 Final periodontal findings.

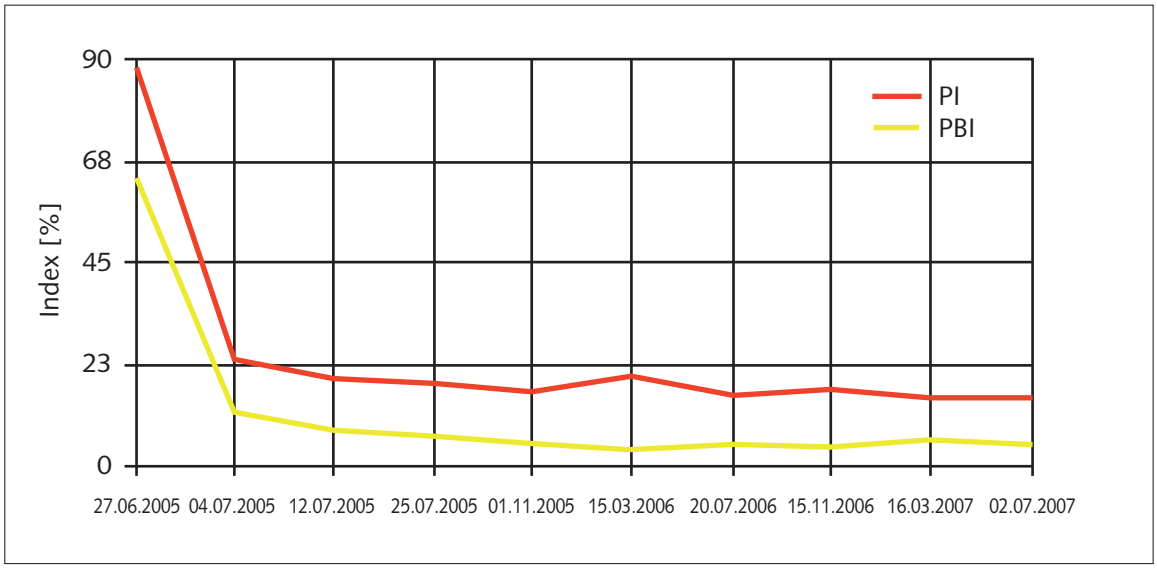


Fig 39 Development of oral hygiene indices during active treatment.

■ Epicrisis and prognosis

The present case demonstrates the treatment of advanced periodontitis. In this case, it is especially interesting that the decision was made to extract and implant on the right side and to use a conservative approach on the left side. Owing to the serious periodontal destruction with extensive furcation involvement, in connection with insufficient root canal treatments and restorations, the cost of retaining these teeth was too high in relation to their periodontal prognosis. For these reasons, the decision was made to use an implant-supported solution on the right side. On the left side, tooth 26 still had to be assessed as questionable at the end of active treatment because of the advanced bone loss and furcation involvement. However, as teeth 24 to 26 reacted well to the first phase of periodontal treatment and the root treatment and restorations were assessed as acceptable both clinically and radiographically, a conservative process in this area was justified. As the patient was recalled at short intervals, treatment could immediately be given should the situation worsen.

When re-evaluating the clinical condition 8 weeks after the anti-infectious treatment, isolated cases of increased bleeding on probing were still found. Renvert and Persson[20] demonstrated that probing depths of more than 6 mm have to be seen as a marker for further progression of periodontitis. In addition, the factor of bleeding on probing, particularly with advanced periodontitis, seems to be another marker for further progression[20]. As a result, the decision was made to carry out surgical periodontal treatment in accordance with the modified papilla preservation technique of Cortellini[16]. In this context,

Fig 40 Frontal view of final situation.

Fig 41 Frontal view of final situation.

Fig 42 Occlusal view of the maxilla after treatment.

Fig 43 Occlusal view of the mandible after treatment.

Fig 44 Lateral view right.

Fig 45 Lateral view left.

the ability to achieve primary interdental flap closure was an important deciding factor, as this is not possible with other techniques (e.g. modified Widman flap[21]). In addition to the flap technique, a microsurgical procedure can support the predictability of the primary interdental flap closure[22]. In particular, a delicate and unstressed suture technique and low tissue trauma seemed to be of huge importance in the healing process in this case[23].

To expose the implants, keratinised gingiva was used in an attempt to reach the implants through apical repositioning. The presence of fixed gingiva seems to be important in the long-term prevention of inflammation, especially on the implants[24-26]. In contrast the mandible, free mucosa transplants were avoided in the maxilla, and advancement flaps of the palatal mucous membrane on the buccal side were used.

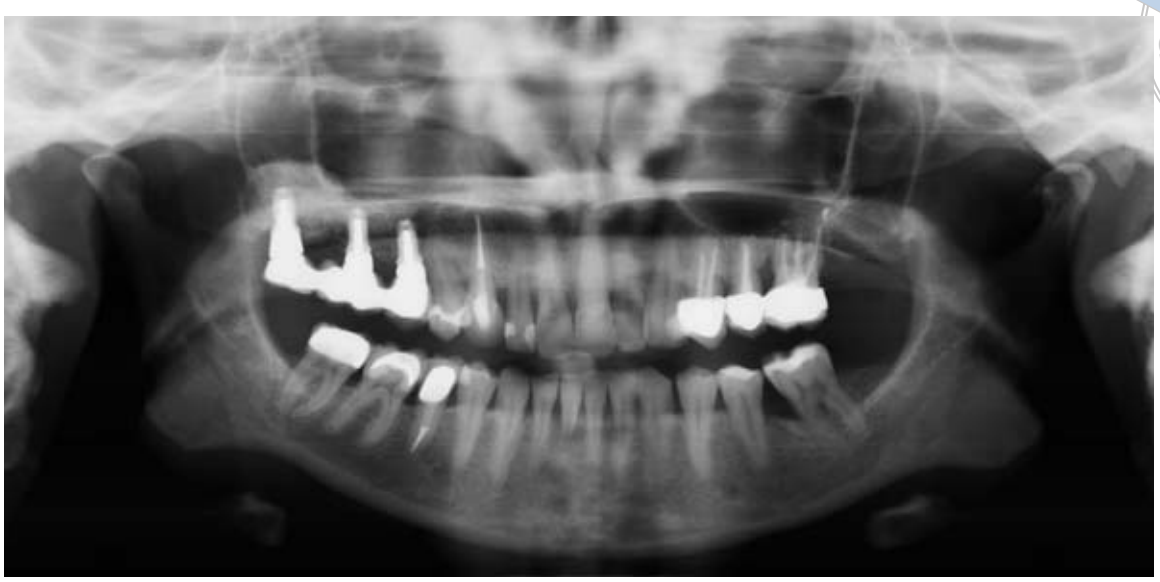


Fig 46
Orthopantogram of final situation.

After the impression of the implants was taken, temporary construction was initially attempted in order to check the phonetic and functional parameters and to carry out gradual loading of the implants. The definitive restoration took place with screwed titanium abutments and interlocked zirconium oxide fixed partial dentures.

According to Abrahamsson et al[27], titanium abutments show better biological integration in comparison with other materials. The abutments were created with a reduced diameter in comparison with the implants. Through the inward displacement of the microbiologically settled gap between the implant shoulder and abutment, this concept (platform switching) seems to be capable of being able to prevent any patelliform defects occurring after the abutment has been connected[28]. Prospective long-term examinations with standardised radiographs are not presently available.

The final findings show that the combined periodontal and implantological treatment should be classed as a success and that a good long-term prognosis for the further retention of teeth and implants exists with good compliance and oral hygiene. The prognosis of tooth 26 is still questionable. However, this can be immediately treated if its condition worsens.

■ References

1. McGuire MK. Prognosis versus actual outcome: a long-term survey of 100 treated periodontal patients under maintenance care. J Periodontol 1991;62:51-58.
2. McGuire MK, Nunn ME. Prognosis versus actual outcome. II. The effectiveness of clinical parameters in developing an accurate prognosis. J Periodontol 1996;67:658-665.
3. McGuire MK, Nunn ME. Prognosis versus actual outcome. III. The effectiveness of clinical parameters in accurately predicting tooth survival. J Periodontol 1996;67:666-674.
4. McGuire MK, Nunn ME. Prognosis versus actual outcome. IV. The effectiveness of clinical parameters and IL-1 genotype in accurately predicting prognoses and tooth survival. J Periodontol 1999;70:49-56.
5. Hirschfeld I. A study of skulls in the American Museum of Natural History in relation to periodontal disease. J Dent Res 1923;5:241-265.
6. Konig J, Plagmann HC, Ruhling A, Kocher T. Tooth loss and pocket probing depths in compliant periodontally treated patients: a retrospective analysis. J Clin Periodontol 2002; 29(12):1092-1100.
7. McFall WT jr. Tooth loss in 100 treated patients with periodontal disease. A long-term study. J Periodontol 1982; 53:539-549.
8. Hamp SE, Nyman S, Lindhe J. Periodontal treatment of multirooted teeth. Results after 5 years. J Clin Periodontol 1975;2:126-135.
9. Beikler T, Schnitzer S, Abdeen G, Ehmke B, Eisenacher M, Flemmig TF. Sampling strategy for intraoral detection of periodontal pathogens before and following periodontal therapy. J Periodontol 2006;77:1323-1332.
10. 1999 International Workshop for Classification of Periodontal Disease and Conditions. Paper. Oak Brook, Illinois, October 30–November 2, 1999. Ann Periodontol 1999; 4:1-112.
11. Quirynen M, Mongardini C, Pauwels M, Bollen CM, van Eldere J, van Steenberghe D. One stage full- versus partial-mouth disinfection in the treatment of chronic adult or generalized early-onset periodontitis. II. Long-term impact on microbial load. J Periodontol 1999;70:646-656.
12. van Winkelhoff AJ, Rodenburg JP, Goene RJ, Abbas F, Winkel EG, de Graaff J. Metronidazole plus amoxycillin in the treatment of Actinobacillus actinomycetemcomitans associated periodontitis. J Clin Periodontol 1989;16(2):128-131.
13. Ainamo J, Bay I. Problems and proposals for recording gingivitis and plaque. Int Dent J 1975;25:229-235.

14. Saxer UP, Mühlemann HR. Motivation und Aufklärung. SSO Schweiz Monatsschr Zahnheilkd 1975;85:905-919.
15. Boyne PJ, James RA. Grafting of the maxillary sinus floor with autogenous marrow and bone. J Oral Surg 1980; 38:613-616.
16. Cortellini P, Pini-Prato G, Tonetti M. The modified papilla preservation technique. A new surgical approach for interproximal regenerative procedures. J Clin Periodontol 1995;66:261-266.
17. Wachtel H, Fickl S, Zuhr O, Huerzeler M. The double-sling suture: a modified technique for primary wound closure. EJED 2006;4(1):216-226.
18. Heitz F, Heitz-Mayfield LJ, Lang NP. Effects of post-surgical cleansing protocols on early plaque control in periodontal and/or periimplant wound healing. J Clin Periodontol 2004;31(11):1012-1018.
19. Lang NP, Tonetti MS. Periodontal risk assessment (PRA) for patients in supportive periodontal therapy (SPT). Oral Health Prev Dent 2003;1(1):7-16.
20. Renvert S, Persson GR. A systematic review on the use of residual probing depth, bleeding on probing and furcation status following initial periodontal therapy to predict further attachment and tooth loss. J Clin Periodontol 2002;29(Suppl 3):82-89; discussion 90-81.
21. Ramfjord SP, Nissle RR. The modified Widman flap. J Periodontol 1974;45:601-607.
22. Wachtel H, Schenk G, Böhm S, Weng D, Zuhr O, Hürzeler M. Microsurgical access flap and enamel matrix derivate for the treatment of periodontal intrabony defects: a controlled clinical study. J Clin Periodontol 2003;30:496-504.
23. Burkhardt R, Lang N. Coverage of localized gingival recessions: comparision of micro- and macrosurgical techniques. J Clin Periodontol 2005;32:287-293.
24. Roos-Jansaker AM, Lindahl C, Renvert H, Renvert S. Nine- to fourteen-year follow-up of implant treatment. Part I: implant loss and associations to various factors. J Clin Periodontol 2006;33(4):283-289.
25. Roos-Jansaker AM, Lindahl C, Renvert H, Renvert S. Nine- to fourteen-year follow-up of implant treatment. Part II: presence of peri-implant lesions. J Clin Periodontol 2006;33(4):290-295.
26. Roos-Jansaker AM, Renvert H, Lindahl C, Renvert S. Nine- to fourteen-year follow-up of implant treatment. Part III: factors associated with peri-implant lesions. J Clin Periodontol 2006;33:296-301.
27. Abrahamsson I, Berglundh T, Glanz P, Lindhe J. The mucosal attachment at different abutments. J Clin Periodontol 1998;25:721-727.
28. Lazzara R, Porter S. Platform Switching: A new concept in implant dentistry for controlling postrestorative crestal bone levels. Int J Periodontics Restorative Dent 2006;26(1):8-17.

Originally published (in German) in Parodontologie 2008;19(2):135-150.