Implant Versus Tooth Retention from the Periodontal Perspective

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The decision to retain a tooth or to place an implant should be based on the probability of long-term success of one or other of the treatment modalities. However, the periodontological and implantological studies published on this subject only allow a limited direct comparison because of the heterogeneous definition of treatment success. From a clinical point of view, it makes sense to adopt a method in which five periodontal prognostic categories (very good, good, fair, poor and hopeless) are established, based on a combination of various parameters (e.g. attachment loss, furcation involvement, mobility). Teeth with a 'fair' prognosis or better can be treated by periodontal therapy and maintenance in the long term, with a high probability of success. For teeth with a 'poor' prognosis (50% to 75% attachment loss and/or inaccessible class II furcation involvement, class III furcation involvement and/or mobility class II), however, the recommendation is extraction and replacement with implants, when prosthetic anchorage is needed at the site. As a rule, extraction is the treatment of choice for teeth with a hopeless prognosis. Generally accepted guidelines on the definition of treatment success are required, so that the results of alternative treatment modalities can be compared directly and the treatment outcome rendered more predictable.

Key words: dental implant, extraction, periodontal therapy, periodontitis, tooth retention

INTRODUCTION

There is growing acceptance of dental implants among dentists and patients in the industrial nations around the world. In Germany alone, roughly 200,000 dental implants from various manufacturers are inserted every year, and the trend is growing (Deutsche Gesellschaft für Zahn-, Mund- und Kieferheilkunde, 2000). Given the right indication, implantation is undoubtedly a sensible treatment option for the purposes of oral rehabilitation. At the same time, however, increasingly widespread use of implants is also evidence of a supposed paradigm shift in dentistry: away from tooth retention towards implant-supported tooth replacement.

In answer to the question 'implant or tooth?', there are diverging clinical and scientific approaches and the actual problem is overlooked as a result of this controversy. It is not a matter of proving the superiority of one modality over another, but defining the right indication for tooth-retaining or implantology measures. The foundation of this decision-making process should be the greatest possible predictability of treatment outcome.
Thus the aim of this article is to provide readers with criteria that will enable them to assess the prognosis of periodontally damaged teeth and compare this prognosis with the treatment outcome when placing implants. This should contribute towards efficient treatment planning with the greatest possible predictability of outcome.

RISK VERSUS PROGNOSIS

Periodontitis does not follow the same course in every patient, but patients can basically be divided into three groups. Over a period of up to 22 years, Hirschfeld and Wasserman (1978) studied 600 patients (15,666 teeth) with largely moderate to severe, generalised periodontitis. During the observation period (maintenance after initial therapy) 300 patients (50%) did not lose any teeth, 199 lost one to three teeth (33%; 'well maintained group'), 76 patients lost four to nine teeth (25%; 'downhill group') and 25 patients lost 10 to 23 teeth (4.1%; 'extreme downhill group'). Out of 2139 teeth with an initially questionable prognosis (defined as furcation involvement, deep pockets impossible to eliminate, severe alveolar bone loss and class II to III loosening), 666 teeth (31%) were lost; more than half of these (394 teeth) in only one sixth of patients. Only 460 of the 1464 teeth with initial furcation involvement were lost; interestingly, more than half of these (240 teeth) were again in only one sixth of the patients. These and other findings show that the majority of patients can be stabilised in the long term by periodontal therapy (Preshaw et al, 1999; Kocher et al, 2000; Harrel and Nunn, 2001). In contrast, the disease can be expected to progress to tooth loss during aftercare in only a small group of patients.

The reasons for this are diverse and a matter of some controversy. This makes it difficult to assess the prognosis in advance (just as with any other form of treatment). Hence criteria that allow a firm prediction to be made are extremely interesting from the point of view of treatment planning. Unfortunately, only a few definite prognostic factors have been described in the literature because research mainly focuses on identifying risk factors (Beck, 1994; Michalowicz, 1994; Albandar, 2005; Burt, 2005; Hacker and Roberts, 2005).

Risk factors are causally associated with the development of a disease, whereas prognostic factors allow the course of the disease to be predicted without necessarily being linked to the aetiology of the disease (Oliver and Tervonen, 1994). This distinction is important because the prognostic and not the aetiological significance of a finding has priority for the clinician in individual case planning. In a series of studies, McGuire and Nunn (McGuire, 1991; McGuire and Nunn, 1996a, 1996b, 1999) attempted to determine the prognostic value of clinical parameters. These studies are based on 100 patients (2509 teeth) with generalised, chronic, moderate to severe periodontitis, who were observed over a period of 15 years. All the patients were treated by one dentist and underwent regular aftercare (every three months), given average oral hygiene. This patient population was basically equivalent to the 'well maintained group' described above in the Hirschfeld and Wasserman study (1978).

PROGNOSTIC CRITERIA AND IMPORTANCE OF CLINICAL PARAMETERS IN PERIODONTITIS

In the first article in the series, the author set out to investigate how much the long-term prognosis for individual teeth can actually be predicted on the basis of clinical parameters (McGuire, 1991). To this end, each tooth was assigned to a particular prognostic category (very good, good, fair, questionable, hopeless; for definitions see Table 1) according to generally accepted clinical parameters. The initial prognosis of the individual teeth was compared with the prognosis recorded after five and eight years. It was found that, with a few exceptions, teeth that initially had a very good prognosis could still be classified in this category after five and eight years. A further finding was that the prognosis was usually more reliable for single-rooted teeth than for multi-rooted teeth. However, teeth with a good prognosis could switch either to the 'very good' or 'questionable' category after five and eight years. As the long-term prognosis determined using prognostic categories based on the generally valid clinical parameters (see above) only correlated with the initial prognosis to a limited extent, the parameter 'tooth loss' was selected as the target variable instead of 'prognosis at a specific point in time' (McGuire and Nunn, 1996b). The aim was to investigate the extent to which those clinical parameters that were also used to evaluate the prognosis are associated with tooth loss. This was in order to ascertain whether a single clinical parameter is more strongly associated with tooth loss than any other. Only 131 (5.2%) of the 2509 teeth initially examined were lost for periodontal reasons and it was shown that the parameters 'increased probing depth', 'furcation involvement', 'bone loss', 'mobility' and 'smoking' were associated with a greater risk of tooth loss.

Table 1 Classification of prognosis after McGuire (1991).

Category	Definition
very good	<25% attachment loss
good	25% attachment loss and/or class I furcation involvement
fair	25–50% attachment loss and/or easily accessible class II furcation involvement
poor	50–75% attachment loss and/or class II inaccessible furcation involvement, class III furcation involvement, class II mobility
hopeless	>75% attachment loss, class III mobility

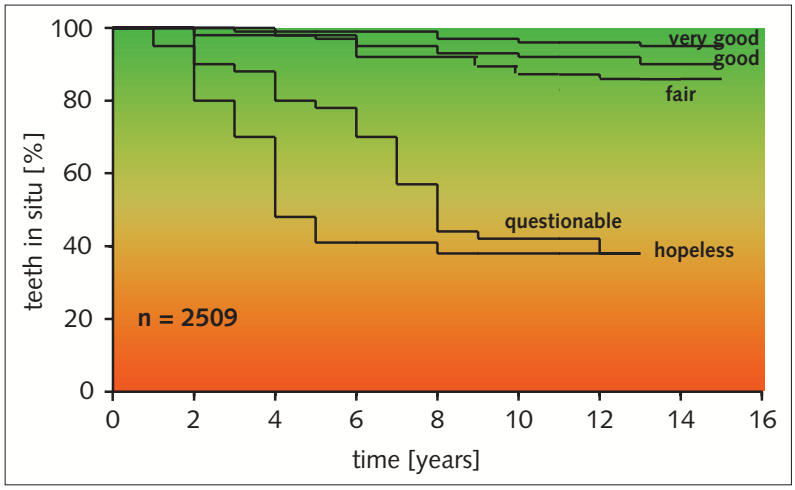

Fig 1 Survival statistics (Kaplan and Meier analysis) of teeth as a function of the initial prognosis (McGuire and Nunn, 1996b).

INFLUENCE OF PROGNOSIS ON TOOTH RETENTION IN PERIODONTITIS

Subsequently the Kaplan-Meier survival statistics for the individual teeth were analysed. The Kaplan and Meier analysis of survival is a statistical method for time-dependent analysis of the influence of different variables on loss rates (Lee and Go, 1997; Mathew et al, 1999). To be precise, the probability of retaining the teeth in situ, based on their loss rate over time, was analysed as a function of the initial prognosis. It was found that teeth with the prognosis 'questionable' or 'hopeless' actually have relatively poor survival statistics as well. Interestingly, however, 40% of the teeth with this category of prognosis were still in situ after 12 years, although no statements about the functional, prosthetic or aesthetic quality of these teeth were made based on this observation method. These data nevertheless indicate that a conservative approach may be entirely justified in the individual case where there are local or systemic contraindications to surgical implantology measures (O'Neal and Butler, 2002).

In contrast, analysis of the survival of teeth with the prognosis 'very good', 'good' or 'fair' clearly shows that 85% of these teeth and more are still in situ after 15 years (Fig 1). In other words, this means that there is a high probability of long-term retention of teeth with up to 50% attachment loss and/or with class II furcation involvement. This is true, provided the patient receives efficient periodontal treatment and aftercare (Figs 2 to 5). If periodontal treatment is abandoned, however, there is an increased risk

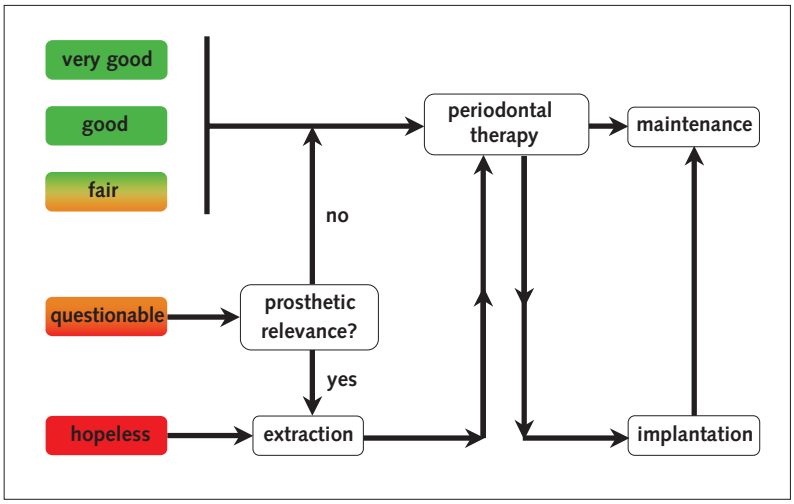

Fig 2 Decision tree to illustrate efficient treatment planning for periodontitis patients.

Fig 3a to 3c Patient (aged 18) with generalised, aggressive periodontitis prior to periodontal therapy.

Fig 3a Photographic status: there is an 11–12 diastema.

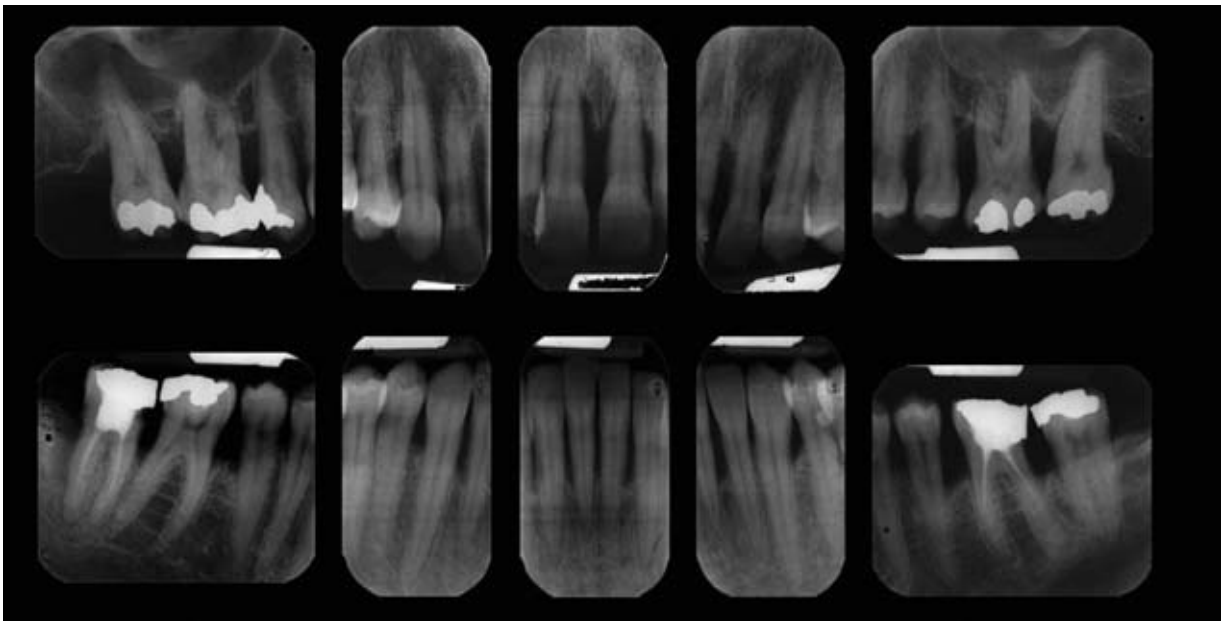

Fig 3b Radiographic status: in all quadrants, there is severe, particularly interdental, loss of attachment of between 30% and 80%.

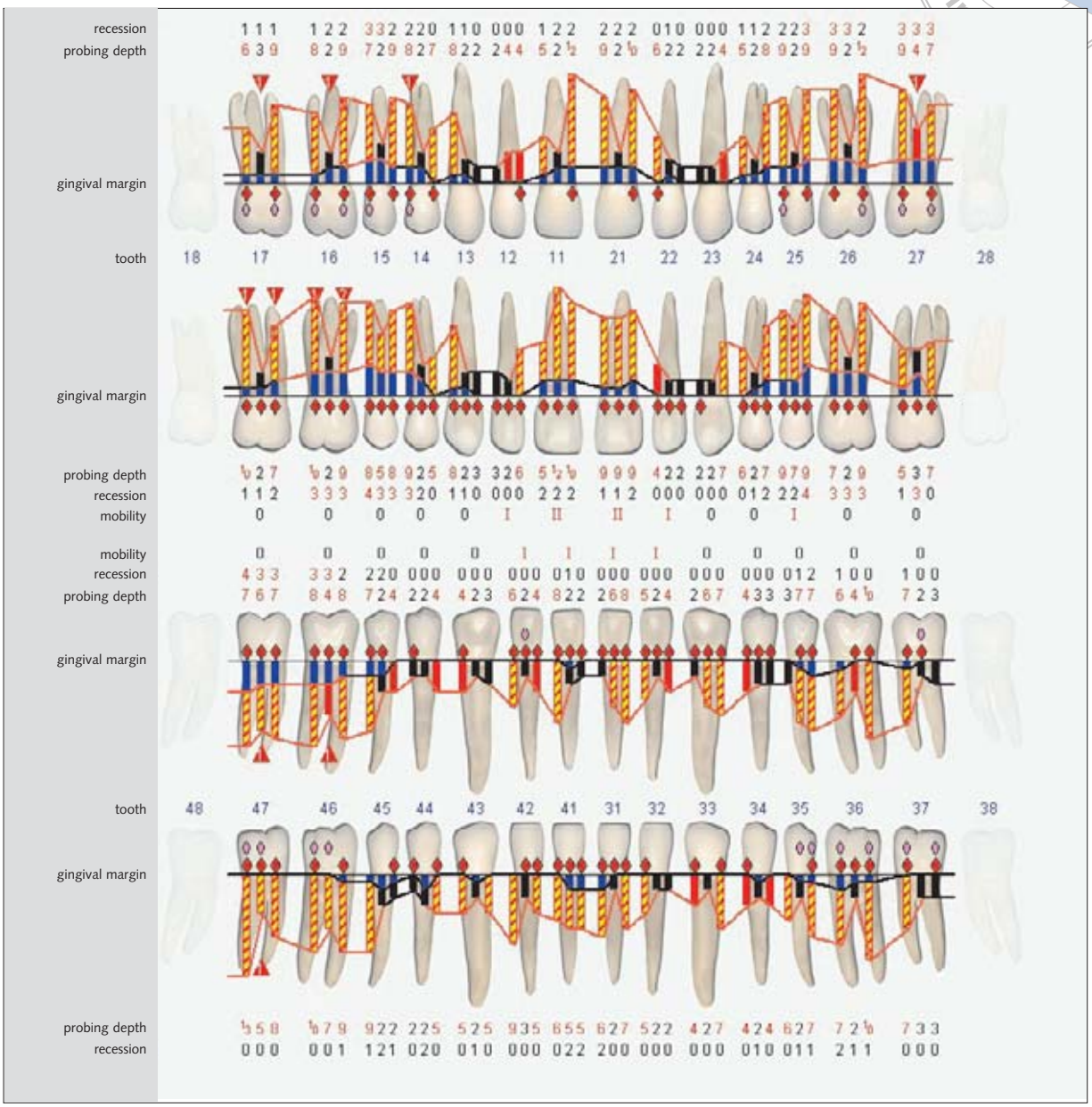

Fig 3c Clinical parameters (Florida probe®): there are greatly increased probing depths, with a noticeably low plaque index and severe bleeding after probing. Tooth loosening is more pronounced in the maxillary anterior region than in the mandibular anterior region.

of disease progression (Kocher et al, 2000; Harrel and Nunn, 2001; Harris, 2003) with subsequent bone loss even affecting adjacent, periodontally healthy teeth (Machtei et al, 1989) or an increased risk of peri-implant complications. These results have been endorsed in numerous other studies (Preshaw et al, 1999; Rosen et al, 1999; Harrel and Nunn, 2001; Serino et al, 2001; Matthews, 2005). Extraction of periodontally damaged teeth with a fair prognosis or better, instead of periodontal therapy, does not seem justified at present. The approach based on 'early extraction of periodontally damaged teeth to retain the alveolar crest for insertion of implants' usually results in over-treatment.

Fig 4a to 4 c Patient from Fig 3 five years and eight months after complex treatment for periodontitis, involving supragingival and subgingival debridement in combination with adjuvant systemic antibiotic treatment followed by resective and regenerative surgery in the molar region in all quadrants, local antibiotic treatment in the maxillary anterior region and regular recall (every three to four months).

Fig 4a Photographic status: the 11–12 diastema was concealed by means of composite (not completely closed, at the patient's request).

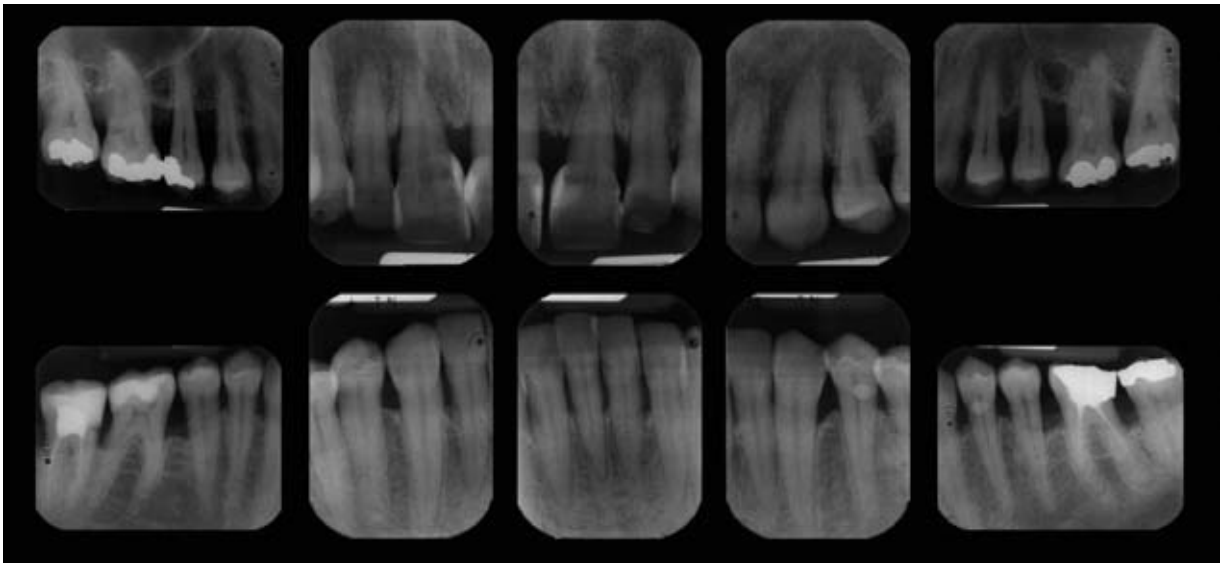

Fig 4b Radiographic status: there is no progression in comparison with the situation prior to periodontal therapy. To some extent, complete resolution of the intraosseous defects can be seen (e.g. distal 47).

Furthermore, it is important to differentiate between different kinds of teeth. It is interesting to note in this respect that multi-rooted teeth, above all, are more likely to be lost. In the classic study by Hirschfeld and Wasserman (1978) it was shown that 31.4% of molars but only 4.9% of single-rooted teeth were lost over the observation period of 22 years. In view of the range of variation in the treatment outcome for periodontally damaged molars (Hamp et al, 1975; Langer et al, 1981; Erpenstein, 1983; Buhler, 1988, 1994), it would appear that the outcome cannot be reliably predicted where there is extensive furcation involvement (class II inaccessible furcation involvement, class III furcation involvement) and attachment losses of over 50% affecting the molars. This fact and the therapeutic, as well as financial, outlay involved in retaining multi-rooted teeth would suggest that implantation is a good alternative. In contrast, single-

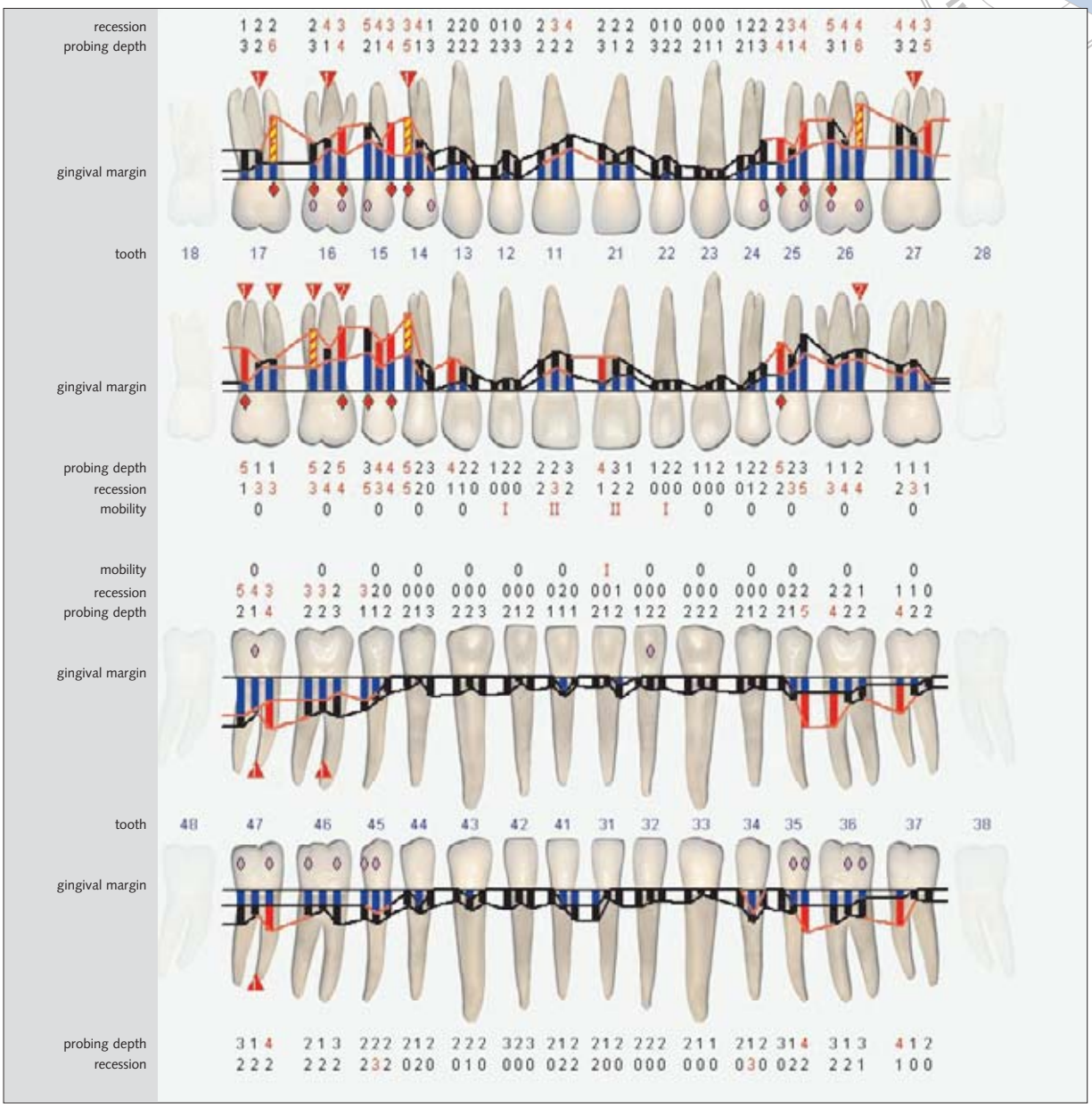

Fig 4c The clinical parameters (Florida probe®) were markedly improved in comparison with the findings prior to periodontal therapy.

rooted teeth have a markedly better long-term prognosis, which can be achieved even with relatively minimal therapeutic, and hence financial, outlay. Thus it is important to consider very carefully whether implant placement is actually more efficient, especially in the maxillary anterior region, which is surgically and prosthetically challenging as well as aesthetically sensitive, and to consider whether implants offer a higher probability of success than tooth retention.

PROBABILITY OF SUCCESS OF IMPLANTS

When the decision is being made whether or not to retain a tooth, the prognosis and probability of success of an alternative treatment – to be specific, implant placement – must be compared with retention of the tooth. It is indisputable that, regardless of the implant system, more than 85% of implants can be described as successful in the long term in

Fig 5a to 5c Patient (aged 46) with generalised aggressive periodontitis. In the active treatment phase, supragingival and subgingival debridement, surgical elimination of pockets in the area of the posterior teeth, extraction of teeth 16, 31 and 41 as well as restorative measures were performed. As there was no functional or aesthetic impairment, the gap in area 16 was left. During the supportive periodontal therapy, local defects occurred in teeth 14 and 24, which were initially treated by local application of antibiotics and subsequently by a regenerative periodontal surgical procedure.

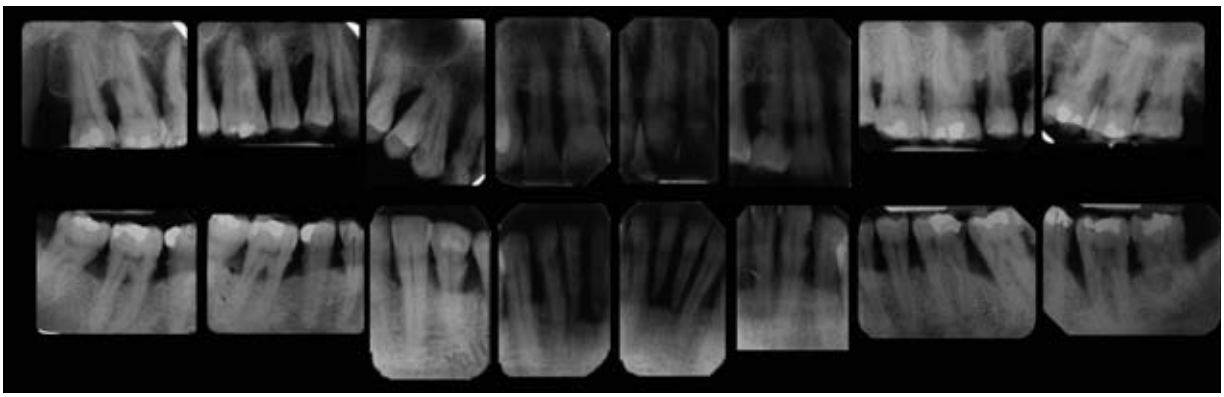

Fig 5a Radiographic status prior to periodontal therapy.

Fig 5b Photographic status 16 years after periodontal therapy.

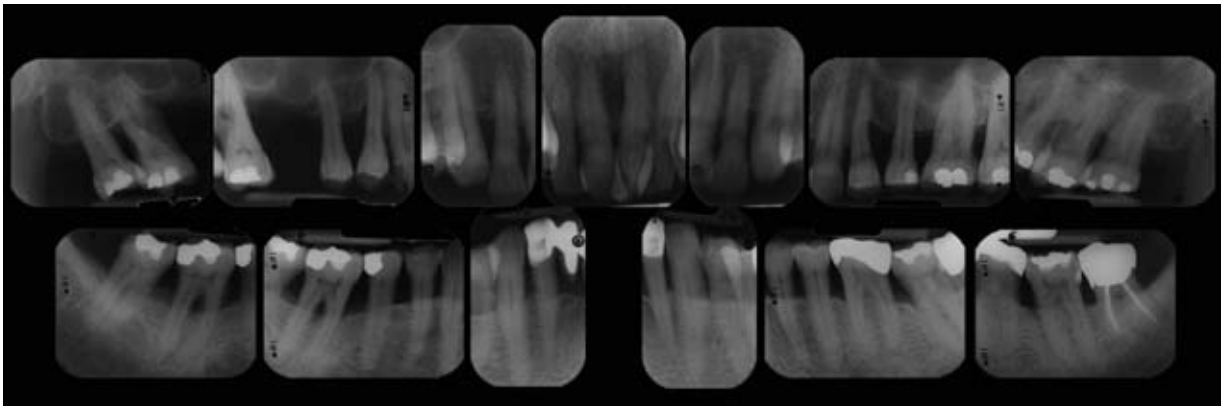

Fig 5c Radiographic status 16 years after periodontal therapy.

healthy patients who have no local risk factors (insufficient bone, radiotherapy, etc.) and/or systemic risk factors (poorly controlled diabetes, immunosuppression etc.) (Buser et al, 1997; Behneke et al, 2002; Astrand et al, 2004). It should be noted, however, that this is not the patient population that is most likely to present for implant placement in routine clinical practice. Implant patients are often recruited from groups of patients who do have local and/or systemic risk factors, which have led to

tooth loss and/or can endanger implant survival. Commenting on these risk factors in detail would go beyond the scope of this article. Therefore reference should be made to the relevant literature (Sugerman and Barber, 2002; American Academy of Periodontology, 2003; Beikler and Flemmig, 2003).

It should further be noted that there is currently no widely held consensus on how to define the success of dental implants and hence on comparing the success of different implants, which makes it difficult to assess the certainty of success realistically. In this respect, it was shown that, when different success criteria were adopted [according to Albrektsson et al (1986), Jahn and d'Hoedt (1992), Buser et al (1990), Naert (Gettleman et al, 1978), National Institutes of Health (NIH) (Gettleman et al, 1978; Schnitman and Shulman, 1979] based on a 93% survival rate (Kaplan and Meier analysis), implant success within a population after six years ranged from 75% to 89% (Buch et al, 2003). This is a wide range to be covered by the term 'implant success'.

CONCLUSIONS

For teeth with a prognosis classified as 'very good' to 'fair', extraction alone does not seem to be justified from the periodontological point of view. In order to stabilise the periodontal conditions in the long term, periodontal therapy followed by maintenance must be provided (see Fig 2). For teeth with a questionable prognosis, a procedure that gives prominence to the strategic importance of the tooth seems to make sense. If the tooth is of high prosthetic value and if, for example, it is to serve as an abutment tooth for a restoration, retention does not seem to be justified because of the uncertain periodontal prognosis of the tooth and hence of the whole construction. In this case, extraction of the tooth makes more sense. However, if the tooth is not of high prosthetic value, tooth retention should certainly be considered as a cost-effective approach. Extraction is the treatment of choice for teeth with a hopeless prognosis.

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