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Implant prognosis of 601 Semados implants

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Survival analyses in connection with the prognosis of endosseous implants enable predictions to be made about their likely clinical success. These analyses must be based on actual survival times rather than percentages to enable the survival rates established to be compared with those of other studies. At present only a few survival analyses of the Semados implant manufactured by Bego (Bremen) are available. Consequently, it is not possible to assess the success prognosis of this implant system. In this long-term study, the survival times of a total of 601 Semados implants were determined in accordance with Kaplan and Meier's method and compared with the data from other long-term studies. The survival rates were 97.0% after one year and 95.9% after five years and nine years. It was thus shown that the implant system studied is comparable to other systems with regard to the prognoses described in the literature, and that it may be expected to survive equally as long.

Introduction

Since the recognition by the DGZMK of implantology as a scientifically supported therapy in 1982, numerous implant types have been developed with varying dimensions, macro- and microstructures and design of the connection with the prosthetic superstructure. However, the crucial factor in establishing an implant's market presence should be how successfully the system can be expected to perform. Studies of the clinical efficacy of an implant system enable predictions to be made about its likely success. This success is normally defined in the literature as the implant's in situ survival rate, though the approach adopted by Albrektsson[1,2] and by Jahn and d´Hoedt[3] also takes into account[4] additional parameters relating to the implant's strength and its peri-implant hard and soft tissue conditions, as ascertainable clinically and radiologically.

Survival analysis should be time-related[5]. This is because a simplistic assessment of success, i.e. a simple calculation of the percentage survival, overestimates[6] the success rate for short observation periods and underestimates it for longer periods. The minimum requirement for a successful implant system is a survival rate of 85% after five years and 80% after ten years[1], which is in fact achieved by established implant systems[6-16] according to numerous studies.

The survival time analysis[18-22] presented in 1958 by Kaplan and Meier[17] is regarded as a statistical standard procedure for a time-related study of the

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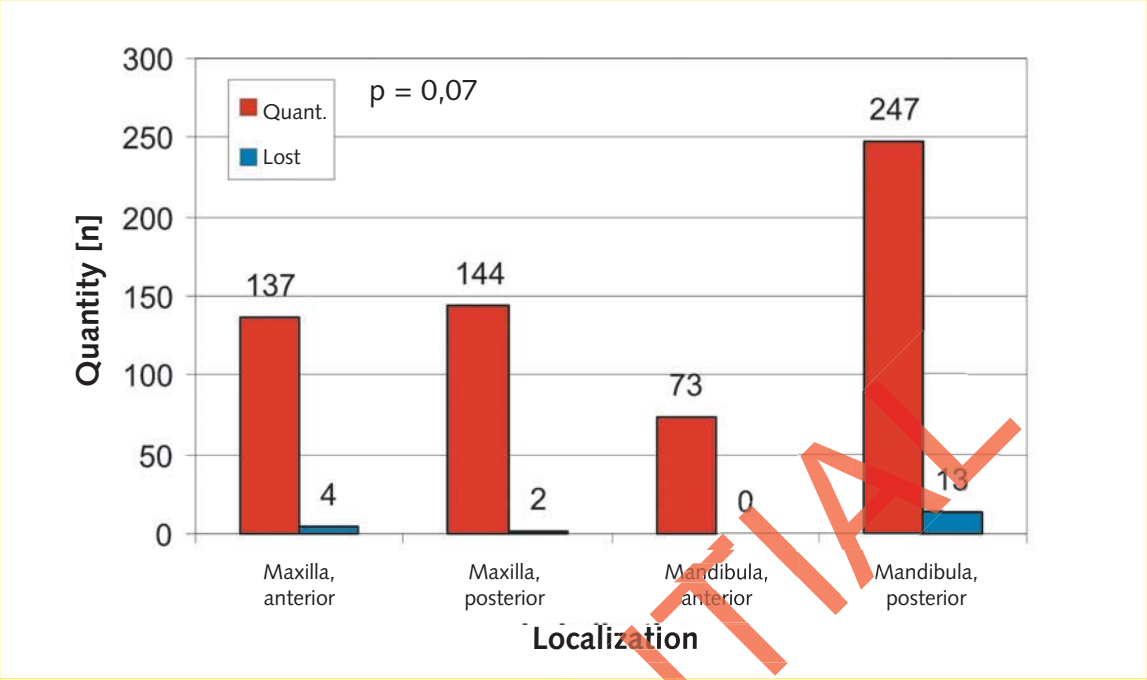

Fig. 1 Distribution of implants according to location in the maxilla and mandible and in the anterior and posterior region (n = 601).

parameter of "implant failure". In this analysis the curve begins on the day of the implant placement with a survival rate of 1 for that day; at the time of an observed implant failure, the curve shows a graduated fall.

Since no survival analyses for the Semados endosseous solid screw implant (Bego, Bremen) are presently available, an account of the corresponding tests carried out is set out below.

Material and Method

Between April 1996 and December 2005, 601 Semados implants were placed in our department by a dentist and followed up. The following parameters were defined as success criteria based on the recommendations of Albrektsson[1,2].

- Implant in situ
- Immobility in the sense of a degree of mobility of 0
- Follow-ups carried out at least annually
- Absence of all signs and symptoms of pain, infection, neuropathy, paraesthesia or injuries to the mandibular canal
- Sulcus depth not exceeding 4 mm in two consecutive checks.

The distribution of the implants both in the maxilla and mandible and in the anterior and posterior regions were represented on a bar chart (Sigma Plot 2001, SPSS, Munich), as was the distribution of the implant sizes. The chi-square test (Sigma Stat, 3.0, SPSS, Munich) was used to check for statistically significant differences.

Finally, the cumulative survival rates of the inserted implants over 72 months was determined using Kaplan and Meier's[17] method and entered on a line graph (SPSS 10, SPSS Inc., Chicago, USA). The success rates of the different implant sizes and positions were subsequently checked for significant differences ($p < 0.05$) using the Tarone-Ware Test.

Results

At the time of evaluation, the average time since placement of the implants was 110 months, with the longest period of observation being 117 months.

Figure 1 shows the distribution of the implants in the maxilla and mandible and in the anterior and posterior regions. Most of the implants were placed in the posterior region of the mandible (247), followed by the posterior region of the maxilla (144). The fewest implants were placed in the anterior region of

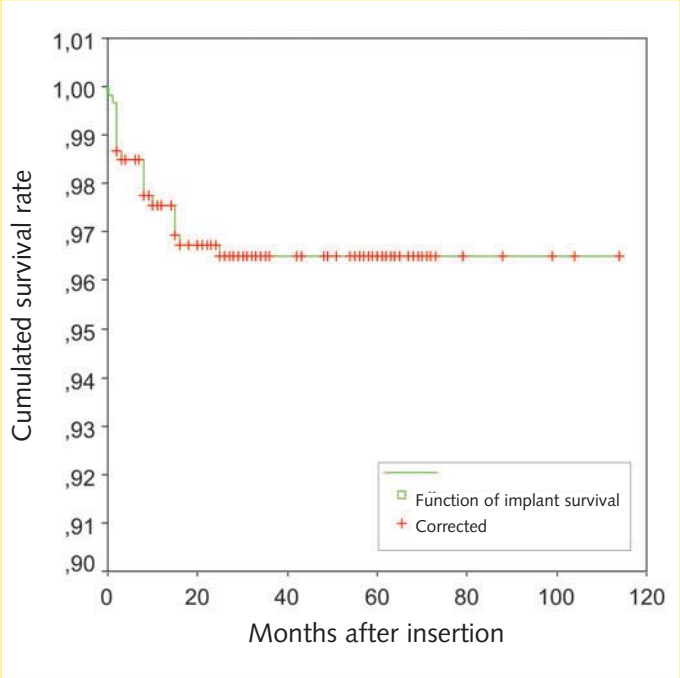

Fig. 2 Cumulative survival rates of all Semados implants studied.

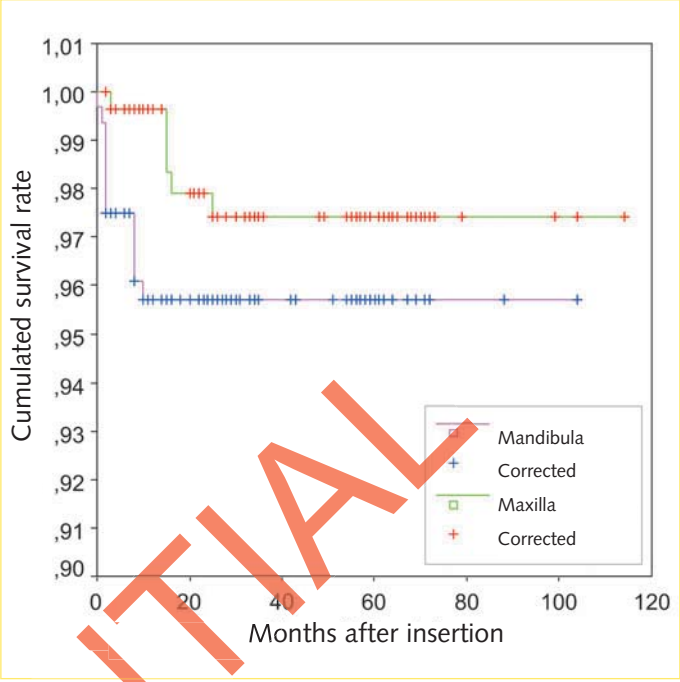

Fig. 3 Dependency of cumulative survival rates on location in the maxilla and mandible.

the mandible (72). A significantly greater number of explantations was not observed (p = 0.07) in any one group. The failure rates were 0% for the anterior region of the mandible and up to 5.3% for the posterior region of the mandible.

Figure 2 shows the survival rates of the implants that were examined. Here there were only eleven implant failures in the healing phase, enabling a healing rate of 98.0% to be achieved. In the post-prosthetic phase the percentage of successfully placed implants fell to 97.3% after nine months. By the 36th month six further implant failures led to a reduction in the success rate to 95.9%, which remained constant until the end of the observation period of 117 months.

There was no indication that the success prognosis was affected by the implant location. A tendency for the prognosis of implants placed in the maxilla to be more favourable was not proven statistically. Neither location in the maxilla or mandible (Fig. 3; p = 0.128) nor placement in the anterior or posterior region (Fig. 4; p = 0.141) had any effect on the observed failure rates. Nor could any positive influence of longer implants be established (Fig. 5; p = 0.270).

On the other hand, the diameter of the placed implants had a significant importance for the long-term survival rate. As regards the survival rate, however, only implants with a diameter of 4.5 mm (Fig. 6; p = 0.02) resulted in a worse prognosis.

Discussion

A comparison of the observed survival rates with the results of other long-term studies[6-11,13,14,16,23-31] shows that the Semados implants, which are the subject of this study, have a five-year survival rate comparable to other implants. As regards the suitability of the Semados implant for use in dental practices, the high survival rates of 95.9% after an observation period of over nine years indicates that this implant can be used in routine clinical practice[1] with a good success prognosis. However, since no radiological findings were obtained, the period of observation should be extended to ten years according to the recommendations of van Sternberghe[4].

After an extensive meta analysis of the literature relating to implantology, Esposito et al.[32,33] concluded that many factors are involved in implant failure. According to the authors, the patient's general health, the surgical trauma and the maintenance of sterile conditions during implant placement are important factors to be borne in mind in avoiding implant failure. In addition, the design of the implant, the time

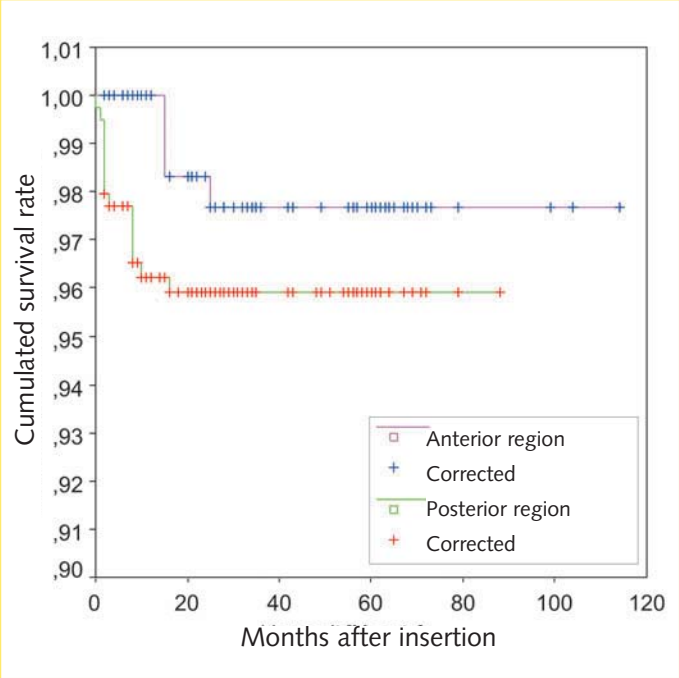

Fig. 4 Dependency of cumulative survival rates on location in the anterior and posterior region.

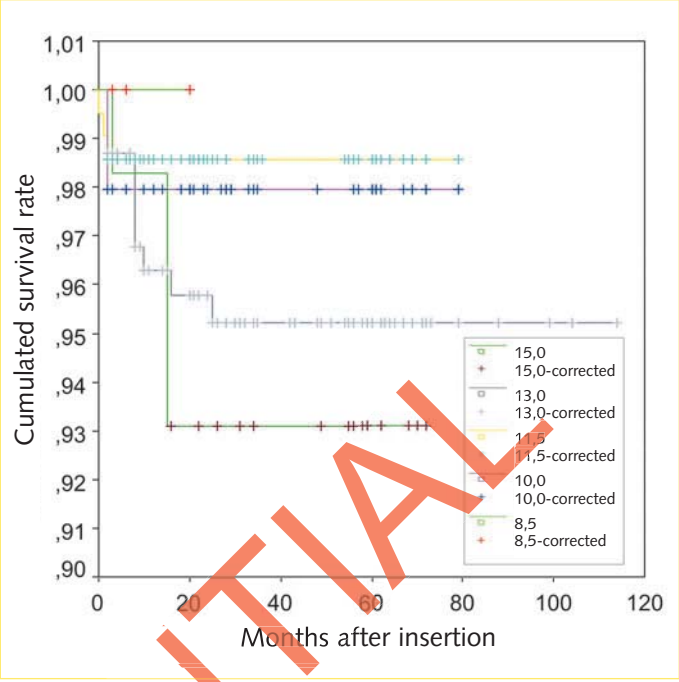

Fig. 5 Dependency of cumulative survival rates on implant length.

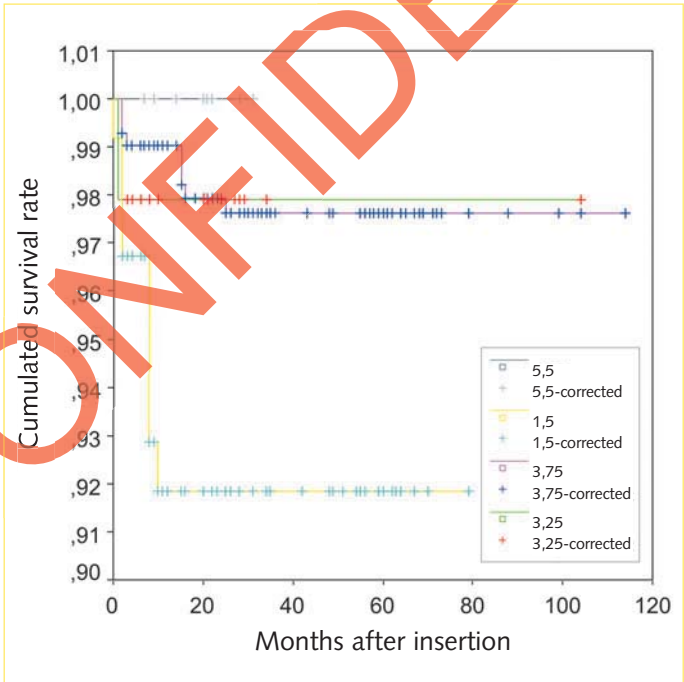

Fig. 6 Dependency of cumulative survival rates on the implant diameter.

of loading and the prosthetic concept of the superstructure are important prognostic parameters.

This is confirmed by the fact that, in the present study, the implants with a diameter of 4.5 mm had the lowest success prognosis whereas the implants with a diameter of 5.5 mm had the highest success prognosis, indicating the influence of additional parameters. All in all, however, little is known about the degree to which the individual parameters have an influence on possible implant failure[32]. There is, for example, no correlation between the conventional periodontal parameters, such as "probing depth" or "bleeding on probing" and peri-implant bone resorption[34]. Hitherto, only the height and width of the peri-implant osseous lamella[6,35] could be statistically confirmed as prognostically relevant factors. However, in this study they were not considered.

Scurria et al.[14] also consider a posterior location of implants of diameter of less than 4 mm to be a negative prognosis. However, we are unable to confirm this observation on the basis of our data, which is supported by the results of Eckert et al.[36] and Davarpanah et al.[37] Neither larger implant diameters nor anterior positioning had a positive influence on the survival rate in our sample group.

Nor does the literature conclusively prove[38] a positive influence of implant length on the long-term prognosis of endosseous implants, though the results of the studies by Ferrigno et al.[12] and Beschnidt et al.[39] show a poorer long-term prognosis for implants under 10 mm in length.

On the other hand, the increased probability of failure established in this study for implants with a diameter of 4.5 mm could be interpreted as an indication of possible overheating when drilling the correspondingly large implant bed, especially since comparable results were found in a similarly designed study for particularly long implants[40]. For this reason careful attention should be paid to ensuring adequate water cooling, especially when preparing a large implant bed. By way of contrast, there were excellent success prognoses for the implants with a diameter of 5.5 mm, which could not, however, be statistically confirmed. This supports the assumption that other cofactors, apart from the size of the implant, have a crucial effect on the success prognosis of endosseous implants.

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