A retrospective study on the probability of success of two different diameter-reduced-implant systems

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1. Introduction

After some decades with different implant geometries, rotationally symmetrical implants (usually screw implants) have implemented now a days. There are three different types of implants. A distinction is made between submucosal, subperiosteal and enossal implants. Considering that the development of dental treatment with endosseous implants, you will find that the range of prosthetic treatment has been expanded significantly and substantially changed. They have become a reliable form of therapy, provided basic concepts of osseointegration are considered [18]. Using the light microscope, Brånemark [2] described the osseointegration as a stable contact zone between the implant surface and bone without intervening soft tissue. Biomechanically osseointegration is defined as a connection between implant and bone, which has a higher retention than the connection of the individual bone cells with each other. Decisive parameter for the success of implantation, are the length and the diameter of the implant. Implants with 9 mm, 11 mm, 13 mm and 15 mm lenghts have been successful, shorter lengths are have a greater risk of loss. The greatest load is in the cervical cortical bone area and not as previously assumed in the apical region [4]. More important than the length of the implant is the diameter in the cervical support area (pressure = force / area) [13], [10]. The contact surface, so the diameter of the implant should match that of the tooth to be replaced on gingival level. The following diameter have proved to be reliable: 3.0 mm, 3.4 mm, 3.8 mm, 4.3 mm, 5.0 mm and 6.0 mm [4]. In addition to standard implants with a diameter greater than 4 mm there are dental implants with a reduced diameter for several years now. So called small diameter implants are implants with less then 4 mm in diameter. Reduced diameter implants were placed on the market by various implant manufacturers and the available treatment options have added enormously. Implants with small-diameters may be used where bone width is reduced but sufficient vertical bone height is available, or in single-tooth gaps with limited mesio-distal space, such as for the replacement of frontal and lateral maxillary or mandible incisors. Using diameter reduced implants, bone augmentation can be avoided [5], [9], [17]. Advantages here are e.g. to reduce costs, a shorter period of healing and, indirectly, a reduction of existing risks [12], [14]. The guidelines for the surgical and prosthetic procedures are roughly similar to those of standard implants.

2. Aim of this study:

The aim of this study was to retrospectively determine a probability of success of two implant systems (XiVE ® and templant ®) with a reduced diameter. A reduced diameter means a small contact area of the implant to the bone. This raises the question whether the osseointegration is sufficient despite the lower contact surface to withstand the loading forces. Next ask yourself the question, how much are in any implant loss directly or indirectly related to the implant diameter? Other parameters are correlated with the loss of the implants? What causes are also responsible for the eventual failure? Reduced-diameter implants are an adequate alternative to the standard implants, even if a compelling indication is not given for a reduced diameter? Is the success rate of the reduced-diameter implant systems templant® and XiVE ® similar to the success rate of small diameter implants from other manufacturers?

3. Material and Method:

All patients in whom the period September 2000 to February 2008 in the University Hospital of Cologne, Department of Clinic and Policlinic for Oral and maxillo-facial plastic surgery, reduced-diameter implants XiVE ® and / or templant ® were placed, are included in the present study. There were a total of 108 patients, of whom 56% were female (n = 60) and 44% male (n = 48) with 469 implants, of which 75.7% XiVE ® (n = 355) and 24.3% templant ® (n = 114) implants were inserted. Most of the implants are late implantations and only in individual cases immediate or delayed immediate implantations.

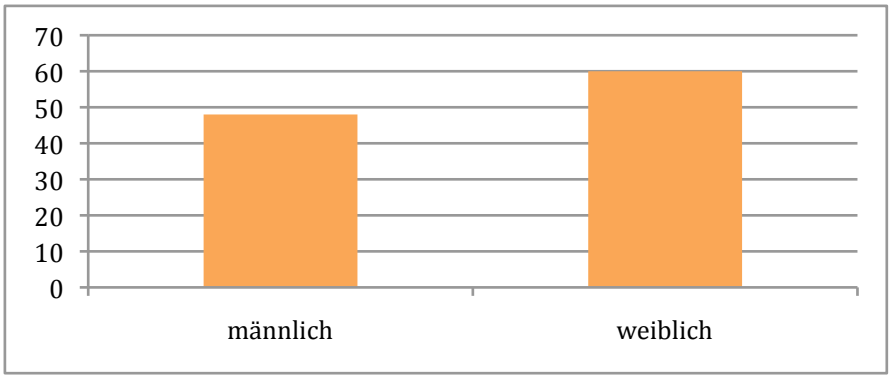


Fig. 1: Gender distribution

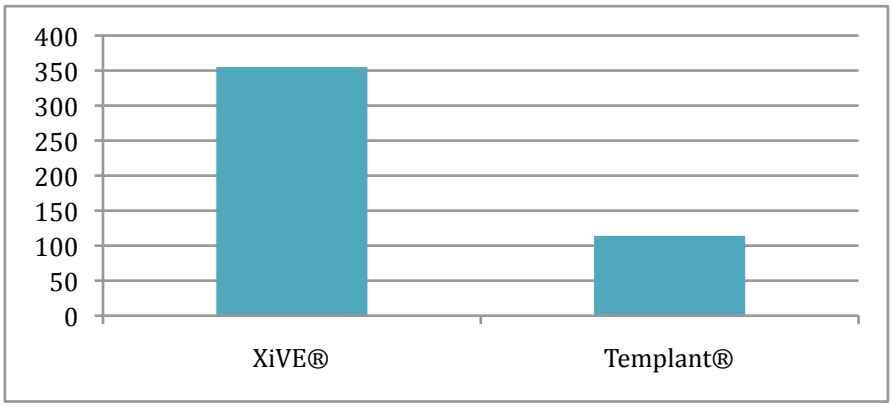


Fig. 2: Implant count of different manufacturer

XiVE® is produced by Friadent/Dentsply GmbH. The basis of the sub-and transgingival XiVE® implant consists of a cylindrical core, which is provided with a self-tapping screw.

Medentis medical company has introduced the templant® implant in 2001. The implant consists of a threaded osteotome, which according to the manufacturers, displaces evenly the cancellous bone, while it condenses the bone structure [16]. In the neck region of the implant templant® are micro-grooves. The external hexagon is used to attach the abutment.

3.1 Data acquisition

For this retrospective study, the data was collected over a period from 2000 to 2008 from the OP-books and index cards of the Department of Oral and Maxillofacial and Plastic Facial Surgery, University of Cologne. Using the tabs on both groups of patients were able to document the following information:

- Number of patients served
- Age of patients at the time of implantation
- Sex distribution of patients
- The number of implants inserted
- rate of the implants
- survival time of implants inserted

• diameter of implants inserted
• manufacturers (XiVE ® or ® templant)
• region of insertion
• Post-operative complications

3.2 Radiological evaluation

To find out the possible reason for implant losses, X-ray images (digital or digital volume tomography orthopantomograms) was prepared. In the evaluation of the produced X-ray images, the peri-implant bone loss was determined using a "virtual" ruler in the next generation SIDEXIS program (Sirona Dental Systems GmbH). The bone loss rate in the implants corresponded to the mean of the mesial and distal measurements on radiographs (angular bone defect). The reference used was an immediate postoperative radiograph-made (usually a digital panoramic radiograph).

3.3 Statistic evaluation

The data obtained were statistically evaluated using the following criteria:

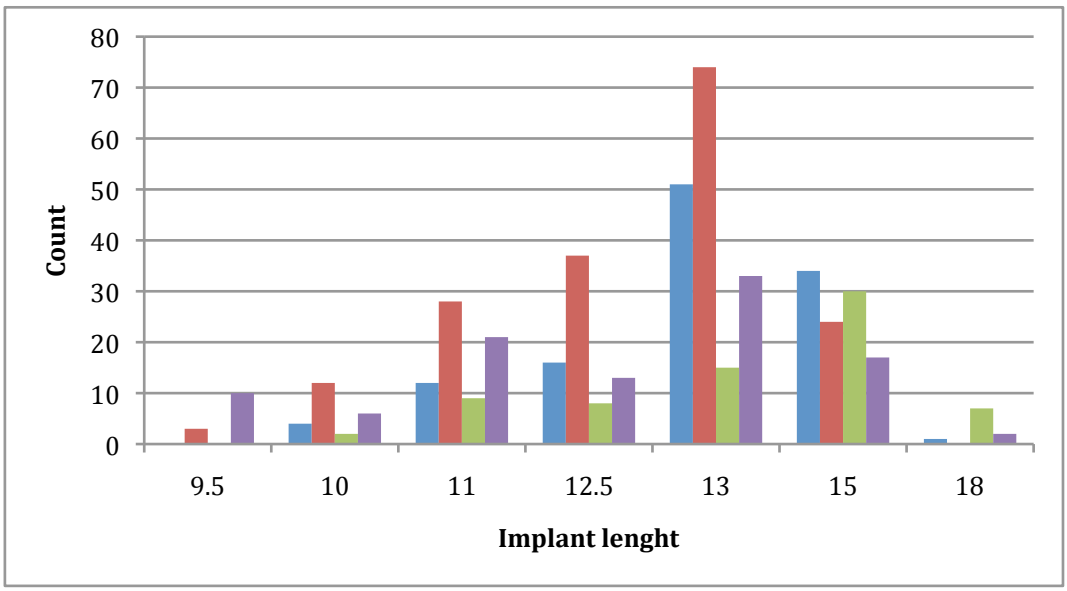
• Age distribution
• Topographic distribution per sex
• Topographic distribution per unit length of the implant
• Topographic distribution per diameter of the implant
• Topographic distribution per manufacturer
• Gender distribution per manufacturer
• rate of the implants
• survival and loss

All in the study collected data were evaluated using descriptive statistics (frequency distribution, mean, standard deviation) and explorative statistics (survival function by Kaplan-Meier) using the program Mircosoft Excel 2007 for Windows (Microsoft Corp.). And statistics program SPSS 17 for Windows (SPSS Inc.).

4. Results

4.1 Results by length of the implant:

Figure 3 shows the frequency of the used implant lengths. 13 mm length has the most use; found (n = 173; 36.9%), 18 mm length, the lowest (n = 10; 2.1%).

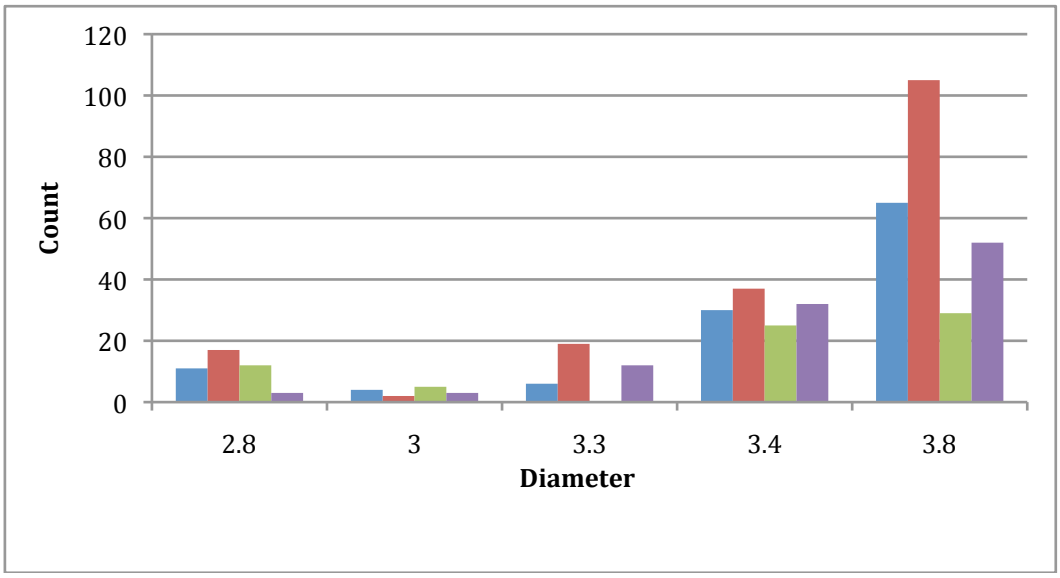


blue: upper front; red: upper side; green: lower front; purpel: lower side Figure 3: Topographic distribution on the length of the implant

Furthermore, it can be seen that implants with a length of 13 mm in both the entire upper jaw, lower jaw and in the posterior region (34-37, 44-47) , were implanted most frequently(n = 158 33.7%). Mandibular anterior teeth (33-43) 15 mm length implants were used mostly (n = 30, 6.4%).

4.2 Results on the diameter of the implant:

Figure 4 shows the frequency of the used implant diameter. 3.8 mm in diameter has the most use; found (n = 251 53.5%), 3 mm diameter, the smallest (n = 14, 3.0%).



blue: upper front; red: upper side; green: lower front; purpel: lower side

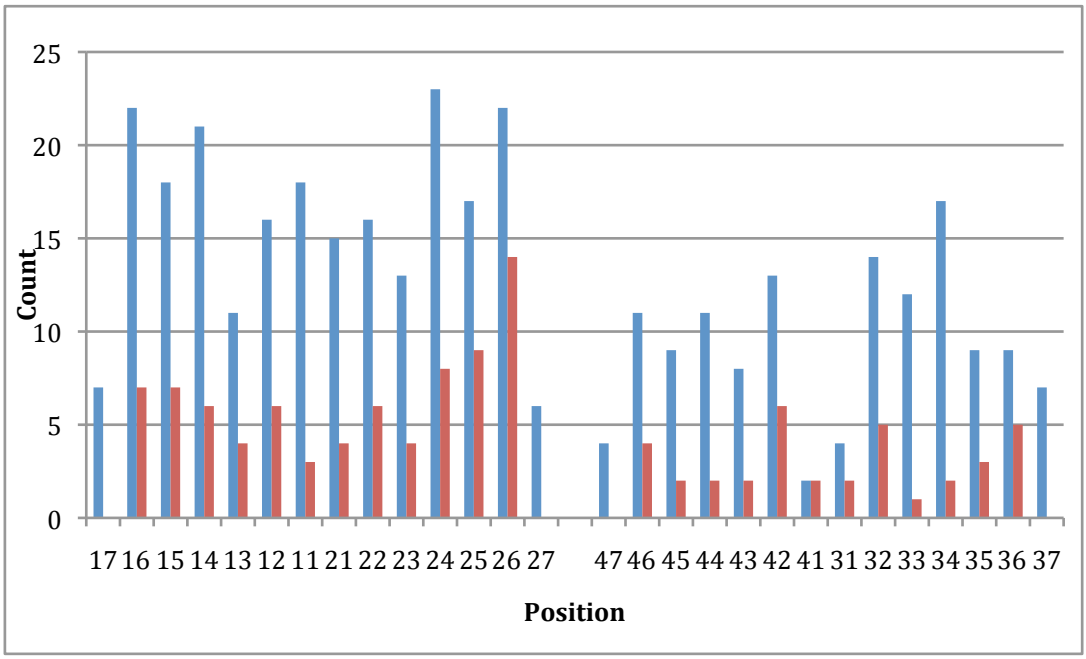
Figure 4: Topographic distribution of the diameter of the implant

Furthermore, it can be seen that implants with 3.8 mm diameter in both the entire upper jaw were most commonly implanted (n = 170;; 36.2%), as well as throughout the mandible (17.3 % n = 81).

4.3 Results manufacturer

As previously mentioned, during the period September 2000 to February 2008 n = 469 reduced-diameter implants were inserted, of which n = 355 (75.7%) is of the manufacturer XiVE ® and n = 114 (24.3%) is of templant ®.

In the upper jaw were nearly twice as many XiVE ® implants (n = 225 63.4%), than in the mandible (n = 130, 36.4%). Templant ® implants were in the maxilla (n = 78, 68.4%) more than twice as many as in the mandible (n = 36, 31.6%).



Blue: XIVE® implants Red: Templant® implants

Figure 5 Topographic distribution by manufacturers

Most XiVE ® implants were implanted in region 024 (n = 23, 6.5%) , the least in region 041 (n = 2, 0.6%).

The largest number of templant ® implants were found in region 026 (n = 14, 12.3%). In the region of the second molars, both upper and lower jaw, no templant ® implants were placed.

4.4 Time overview

The average survival rate of the reduced-diameter implants in this study is 29 months (2 years 5 months), with the longest time was in situ in February 2008 93 months (7 years and 9 months) and the shortest time in situ 3 months.

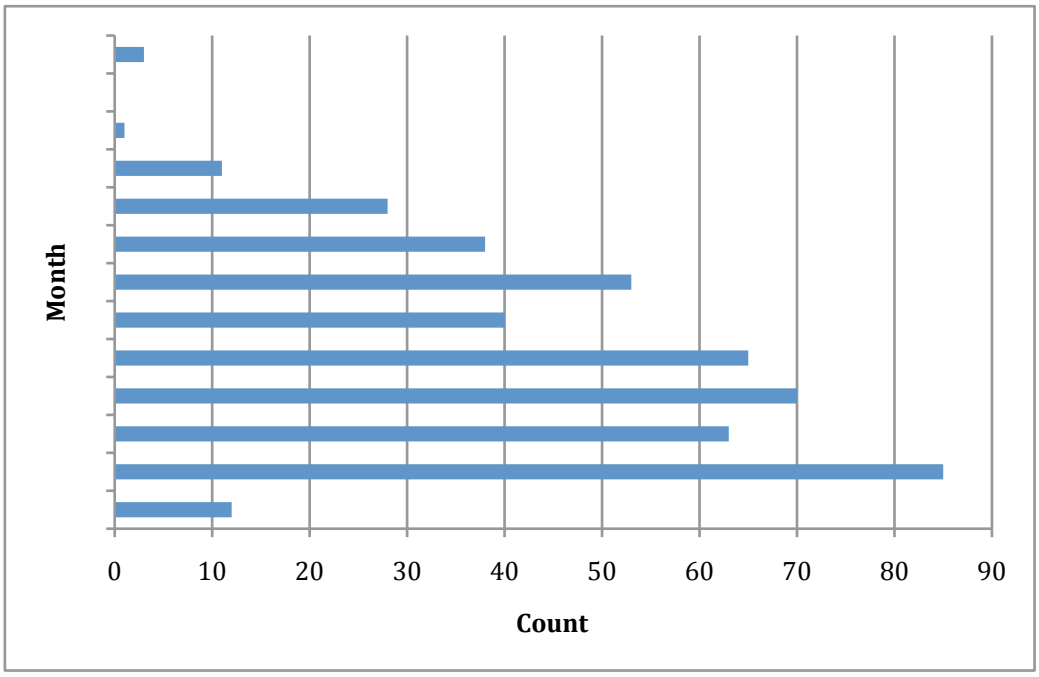


Fig. 6: Survivaltime

Figure 6 gives an overview of the test time in situ with the respective number of implants. Most implants were at the time of the search 7-12 months in situ (n = 85, 18.1%).

4.5 Losses

Reexamined all of small diameter implant, the records indicate that 98.5% were still in situ (n = 462). In 1.5% (n = 7) of the cases was explanted.

The most common cause of implant failure was a failed osseointegration during the healing phase (1.1%, n = 5), followed by peri-implantitis (0.4%, n = 2).

The frequency distribution and the causes of implant failures are shown in table 7.

n = 469	n=	%
in situ	462	98,5
explanted	7	1,5
Failure reason:		
Losening due to lack of osseointegration	5	1,1
Peri-implantitis	2	0,4

Table 7

In Tables 8 and 9, the frequency distributions for each implant system (XiVE templant ® and ®) are listed. XiVE ® has a loss rate of 1.4% (n = 5), templant ® of 1.8% (n = 2).

XiVE ® (n = 355)	n=	%
in situ	350	98,6
explanted	5	1,4
Failure reason:		
Losening due to lack of osseointegration	3	0,8
Peri-implantitis	2	0,6

Table 8: Frequency distribution of implant losses and causes of failure XiVE ®

templant® (n = 114)	n=	%
in situ	112	98,2
explanted	2	1,8
Failure reason:		
Losening due to lack of osseointegration	2	1,8
Peri-implantitis	0	0

Table 9: Frequency distribution of implant losses and causes of failure templant ® (n = 114)

The following Table 10 gives an overview of the different parameters of the n = 7 implant losses.

Gender	Age	Implantat-system	Implantat-position	Implantat-lenth (mm)	Implantat-diameter (mm)	Month in situ	Bone-resorption (mm)	Reason Loss
	Years							
male	74	Templant®	26	2,8	12,5	15	4	Loosening
female	70	XiVE®	43	3,8	15	8	2	Peri-implantitis
female	51	Templant®	26	3,3	12,5	10	4,5	Loosening

Table 10: Implantloss reasons

4.6 Survival time

To determine the survival time 355 XiVE ® implants and 114 templant ®implants were included . The length of stay performance was evaluated according to the criterion "in situ implants or implant loss." The result of the survival time by Kaplan-Meier shows the XiVE ® implants have a success rate of 98.6% for 56 months and 87% for the maximum observation period of 7.75 years (Fig. 11).

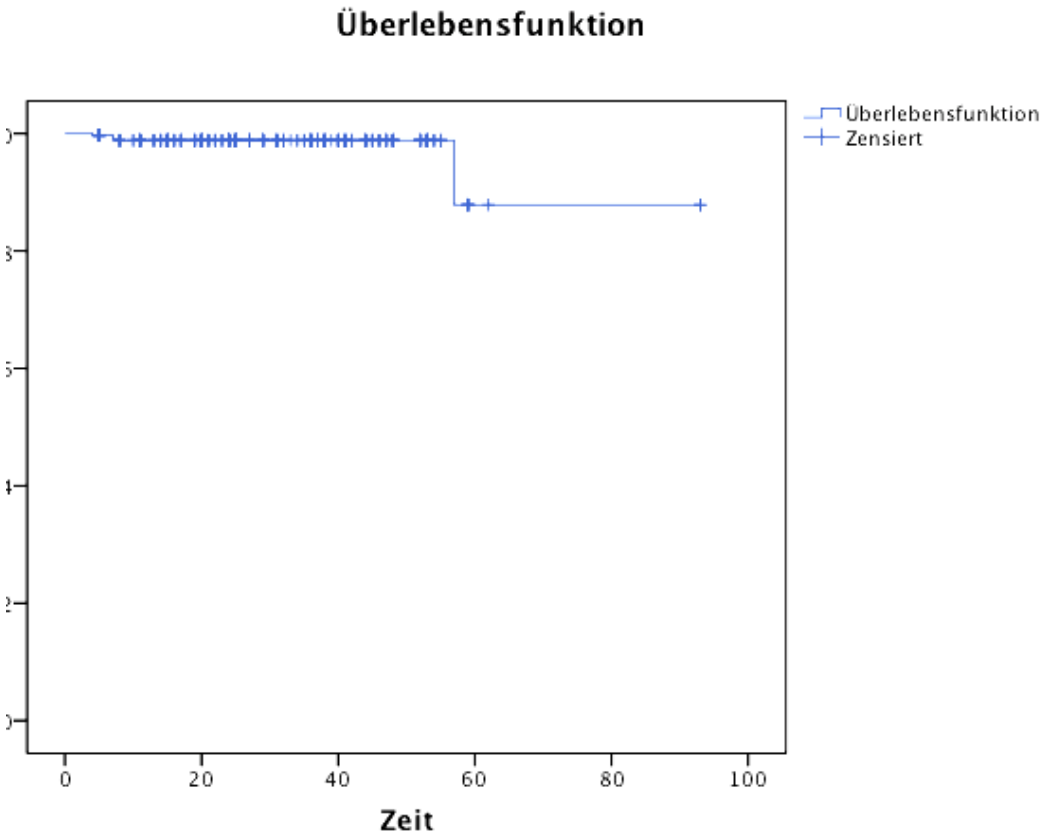


Figure 11: Survival time of Xive®-Implants

Description for templant ® implant: In Figure 12 the probability of success shown for templant® implants (98.2% after 14 months and 96% after 31 months).

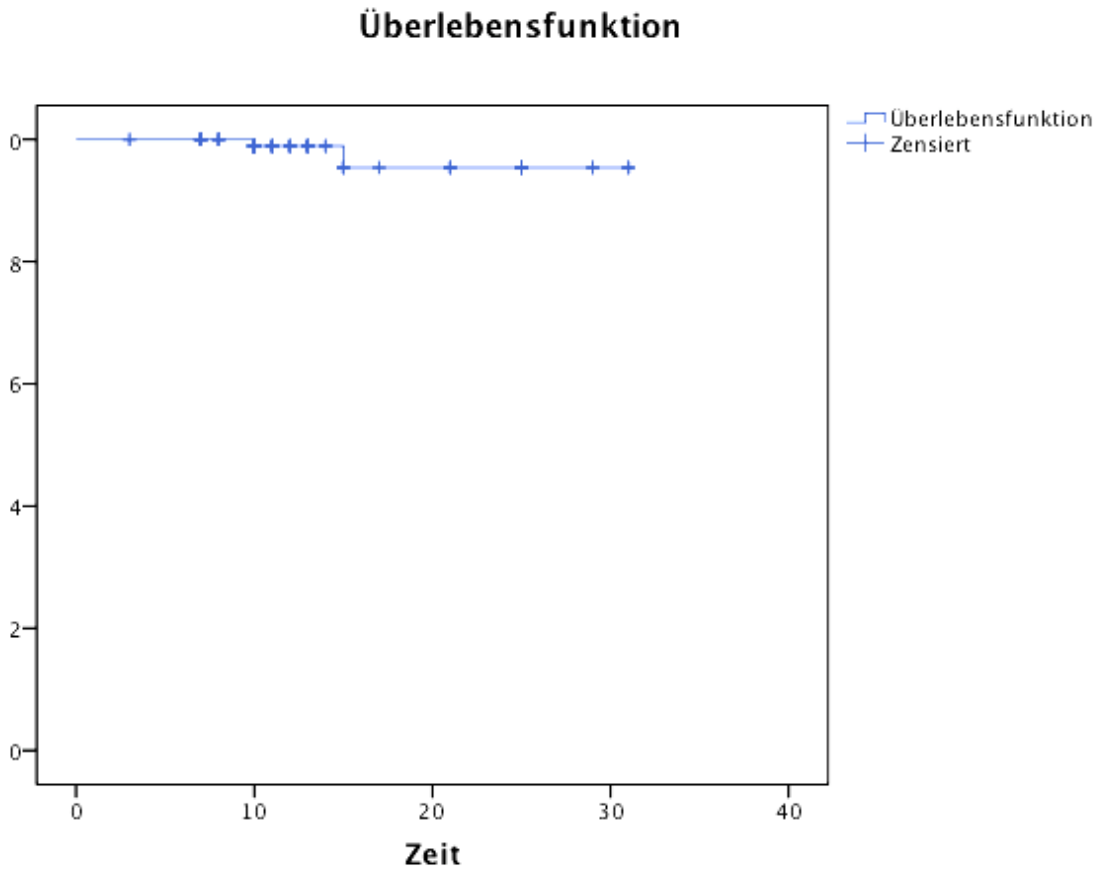


Figure 12: Survival time of templant® Implants

The difference in the probability of success for XiVE® implants and templant® implants is not a significance level of p <0.05.

5. Discussion

XiVE® vs. templant®:

Three-quarters of implants were XiVE ® implants. templant ® implants came on the market in the middle of the observation period. This helps explain why more often in the Department of Oral and Maxillofacial and Plastic Facial Surgery, University of Cologne XiVE ® implant were used. The Dentsply company has a long experience with implant manufacturing. XiVE® implants have been mentioned now in a study of Degidi et al. [6] . templant ® implants have yet to establish themselves and prove themselves in clinical practice in the long term. 60.5% (n = 69) of all templant ® implants have been implanted in the posterior region, n = 2 (2.9%) were a failure. Of all XiVE ® implants are also 60% (n = 213) were inserted in the posterior region, n = 3 (1.4%) were explanted. The difference is small and could possibly be due to the lack of experience with the templant ® implant system.

Length of stay:

The longer the observation period or the test time is, the more effective conclusions can be drawn from the survival rate. The average length of stay for implants in our study is 29 months, for the XiVE® implant system 31 months, for the templant® implant system 14 months. Many studies, both for standard as well as reduced-diameter implants, have similar observation periods [1], [8], [11], [15]. In some studies, for example Vigolo et al. (84 months) [16], the oberservation period is longer.

Probability of success:

In the graphical presentation of the probability of success for XiVE ® implants the implant loss drops sharply after 57 months. This is because only a few implants have been received with a longer length of stay in the data collection. We therefore expect the average success rate of 98.6% for XiVE ® implants and 98.2% for templant ® implants. In the literature is the probability of success at follow-up analog for standard implants, as well as reduced-diameter implants for between 93% [3] and 99.4% [8] at a mean follow-up period of 48 months specified. The calculated

probability of success in our study, 98.6% (XiVE ® implants) and 98.2% (templant ® implants) for the maximum observation period of 93 months is comparable with other studies.

The success of implants in Review shows a large spread of results, which is based on the use of different implant systems and different assessment criteria of the respective authors [3]. Nevertheless, we can say that has the probability of success by Kaplan-Meier in this case is a reliable explanatory power with respect to the performance assessment of both implant systems.

6. Literature:

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