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Impact of local and systemic factors on the incidence of failures up to abutment connection with modified surface oral implants

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Abstract

Aim: This study aimed to assess the influence of systemic and local bone and intra-oral factors on the occurrence of early TiUnite™ implant failures.

Material and Methods: A total of 283 consecutive patients (187 females; mean age 56.2), who received a total of 720 TiUnite™ implants, at the Department of Periodontology of the University Hospital of the Catholic University of Leuven, were prospectively followed.

The following aspects were particularly assessed: hypertension, cardiac problems, gastric problems, osteoporosis, hypo- or hyperthyroid, hypercholesterolaemia, asthma, diabetes types I or II, Crohn's disease, rheumatoid arthritis, chemotherapy, hysterectomy and intake of medication (antidepressants, steroids, hormone replacement), radiotherapy of the concerned area, breach of sterility during surgery, implant parameters, bone (quality, quantity, dehiscence or perforation), type of edentulism, antibiotics prescription, fenestration of the implant in the sinus/nasal cavity, immediate implant placement, apical lesion detection and insertion torque.

Results and Conclusion: A global failure rate of 1.9% was recorded. Owing to the very few failures, no definitive conclusion concerning statistical significance can be achieved. However, a tendency for more failures was noticed for apical lesions, vicinity with natural dentition, smoking, hormone replacement, gastric problems, Crohn's disease, diabetes I and radical hysterectomy.

Key words: dental implants; oral implants; osseointegration; systemic disease; TiUnite

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Failures of endosseous osseointegrating implants can be subdivided into early or late failures, depending on whether they occur up to abutment connection (= early) or rather after the abutments are exposed to the oral microbial environment and occlusal loading took place (= late). This subdivision is necessary because the aetiology of failures during the two periods may be different. Early implant failure results from an inability to establish an intimate bone-to-implant contact (Esposito et al. 1998). This means that bone healing after implant insertion is impaired or jeopardized. The mechanisms that normally lead to wound healing by means of bone apposition do not take place, and a fibrous scar tissue is rather formed in between the implant surface and the surrounding bone (Esposito et al. 1999). The latter leads to epithelial downgrowth, saucerization of the implant and results in mobility or even implant loss. This will compromise the anchoring function of the endosseous implant. The late implant failures have been associated with both peri-implantitis resulting from plaque-induced gingivitis and/or occlusal overloading (van Steenberghe et al. 1990).

It remains a matter of debate as to which systemic factors compromise the achievement of an intimate bone–implant interface and/or rather its maintenance over time. It is especially during the healing time, up to abutment surgery, that systemic factors can be most easily identified as other risk factors that occur after abutment surgery do not apply (van Steenberghe et al. 2003, Mombelli & Gionca 2006). The influence of general health problems on the

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osseointegration process is still poorly documented (van Steenberghe et al. 2002).

Advanced jawbone resorption and poor bone quality have been linked to higher rates of implant failure (Bass & Triplett 1991, Jaffin & Berman 1991). The improvement of the surface characteristics of the implant to enhance the bone response was a way to improve the clinical success rate. Numerous experimental studies focusing on roughened implant surfaces (i.e., plasma spraying, grit blasting, acid etching) have found a faster and improved bone response, in terms of implant–bone contact and removal torque, as compared with a turned surface (Carlsson et al. 1988, Buser et al. 1991, Huré et al. 1996).

An implant with an increased oxide layer (TiUnite™, Nobel Biocare, Göteborg, Sweden) become available some 5 years ago. The surface is created by anodic oxidation (Hall & Lausmaa 2000). Animal studies have shown a stronger bone reaction compared with turned implants, as measured with removal torque tests and histomophometry (Albrektsson et al. 2000, Henry et al. 2000). A histological study in human jawbone demonstrated higher bone response to anodic-oxidized titanium implants than for implants with a turned surface (Ivanoff et al. 2003).

Although the clinical evaluation of oxidized surface titanium implants (TiUnite™) is limited, the available studies demonstrated that the TiUnite™ surface implants have a better primary stability and help to achieve secondary stability earlier when compared with the machined surface implants (Rocci et al. 2003).

This study is aimed to be exploratory to identify systemic, local bone and other intra-oral factors related to the incidence of early implant failure. Although a statistical analysis has been performed, the main purpose of the study is to suggest which factors may influence an early implant failure. To evaluate their effect rigorously, further studies explicitly designed for this purpose would be needed.

Material and Methods

In agreement with the exploratory nature of the prospective study we enrolled, in a cross-sectional manner, all patients treated by means of endosseous implants during (November 2003–June 2005) at the Department of Periodontology of the University Hospital of the Catholic University of Leuven. It is a general policy of the department to accept all patients who may benefit from implants for their oral rehabilitation even if systemic or local factors can compromise the outcome. The patient group consisted of 283 consecutive patients (187 females; mean age 56.2, age range 18–86). These patients received a total of 720 MkIII TiUnite™ implants. The classical two-staged surgical protocol with strict sterility measures was used for all surgeries. At implant insertion, a minimal bone height of 7 mm had to be available. The study fulfils a high degree of homogeneity for both the implant type and the surgical phase.

Early failures – i.e. before and up to abutment connection- were related to the presence of health or behavioural factors, implant length and diameter, bone quality and quantity, implant location, type of edentulism, prescription of antibiotics pre- or immediately after surgery, dehiscence or perforation of the jaw bone during surgery, fenestration of the implant in the sinus or the nasal cavity, immediate insertion of the implant after tooth extraction, apical lesion detection radiographically, and torque measurements at the crestal, middle and the apical third during implant insertion.

The general health and the behavioural history of the patient were carefully recorded, through questioning the patient pre-operatively according to a printed questionnaire. Moreover, the patient's medical status was also evaluated through hospital files, which are available on the intranet hospital system. If not, the house doctor was questioned when doubt arose. The following aspects were particularly assessed: smoking habits, hypertension, cardiac problems, gastric problems, osteoporosis, hypo- or hyperthyroid, hypercholesterolaemia, asthma, diabetes types I or II, Crohn's disease, rheumatoid arthritis, chemotherapy, hysterectomy and intake of medication (antidepressants, steroids, hormone replacement). In case of hormone replacement therapy (HRT), the early failure rate was compared between all female patients of $\geqslant 50$ years following HRT, and those who did not.

Local bone factors, such as radiotherapy of the concerned area, were also recorded. Finally, a special note was made of patients with claustrophobia. These patients were treated with reduced coverage of the face, often without a nose cape and as such with a breach of asepsis (van Steenberghe et al. 1997). As the complication often occurred during surgery, removal of some drapes often led to unavoidable microbial contamination of the surgical area.

Jaw bone quality and the degree of jaw bone resorption were evaluated by the periodontologist at implant placement. Tactile evaluation during drilling and assessment of the alveolar crest both radiographically and clinically allowed classification according to Lekholm & Zarb (1985) index. A copy of this grading system was available while the score was given.

Torque measurements were recorded during implant insertion, by means of an electronic torque force measurement device (OsseoCare™, Nobel Biocare, Gothenburg, Sweden), which is a part of a controlled motor device. The latter measures the torque force while tapping or inserting the implant into the crestal, middle and the apical third of each implant insertion trajectory.

The type of edentulism was classified according to the presence and location of natural teeth in the oral cavity related to implant location: full edentulism, teeth present only in the antagonistic jaw, teeth present in the same jaw where the implant is but not neighbouring it and teeth neighbouring the implant.

An implant was considered to be a failure if a peri-implant radiolucency could be detected on the intra-oral radiographs, if an individual implants showed the slightest sign of mobility corresponding to a Periotest® value (Siemens, A. G, Bensheim, Germany) of $\geqslant 5$ and if the patient showed subjective signs of pain or infection that required the implant removal. In the department, a thorough sterility policy allows limiting the systemic use of antibiotics to well-defined indications such as endocarditis prophylaxis, a remaining infection at the site of surgery, coughing or sneezing by the patient during surgery. Use of antibiotics pre- or immediately after implant surgery – was defined as yes or no.

Statistical methods

For exploratory purposes, we constructed for each categorical factor a contingency table that cross-classifies the implants with respect to the levels of the factor and the failure status of the implant evaluated at abutment connection.

The effect of each factor on the early failure of the implant was further evaluated by the Fisher's exact test of independence (e.g., Le 2003, Section 6.6) in the case of the categorical factors and by the Wilcoxon rank-sum test (e.g., Le 2003, Section 7.4) in the case of the continuous factors.

Owing to the fact that for most of the patients several implants were inserted and failure status was evaluated (clustering in the data), we cannot directly assume the independence between the failure events of the implants placed in a single patient. Consequently, both Fisher's exact test and Wilcoxon's rank-sum test are anti-conservative, that is, the p-values obtained by these tests are attenuated toward zero. To correct for clustering, a possibility is offered by the significance test of the regression coefficient in the logistic regression model estimated using the generalized estimating equations (GEE) method (Liang & Zeger 1986, Zeger & Liang 1986). However, the test relies on the fact that sufficient amount of failures in each cell of the corresponding contingency table should be observed. Nevertheless, in our study, the observed number of failures appeared to be very low (in total only 14 out of 720, i.e. 1.9%). For this reason, we present the results (whenever numerically feasible) of the GEE logistic regression only as a mean of the sensitivity analysis to the Fisher's exact and Wilcoxon's rank-sum test. In the following, the symbol ''NA'' indicates that the p-value is not available due to numerical problems.

Statistical analyses were performed using the R 2.2.1 software (R Development Core Team 2005) and the R package gee (Carey 2002).

Results

From the treated patient's population, a total of 14 implants out of the 720 installed implants failed 1–6 months after placement. None were lost in the days following abutment surgery. This corresponds to a 1.9% failure rate. These failures occurred in 14 patients (six males; mean age 48.8, age range: 32–64), (eight females; mean age 59.4, age range: 54–66). For four patients, the failed implants were replaced by new ones of the same type and no failure has been detected for any of them up to abutment connection.

Implant length had no significant effect on early implant failures (p-values: Fisher = 0.94, GEE = 0.89) (Table 1).

Implant diameter had no effect on the early implant failures (p-values: Fisher = 1.000, GEE = NA). Because no failures have been detected for implants with diameters of 3.3 and 5 mm, the former was grouped with 3.75 mm, and the latter with 4 mm; no statistical difference was detected between these two groups (p-values: Fisher = 0.86, GEE = 0.86) (Table 2).

The implant location had no effect on the early implant failures (p-values: Fisher = 0.54, GEE = 0.59) (Table 3).

There was no significant effect of the presence of dehiscence or fenestration of the bone tissue during implant insertion on the early implant failure rate (p-values for dehiscence and fenestration: Fisher = 0.14, 0.38, GEE = 0.15, 0.45, respectively) (Table 4).

The effect of implant perforation in the nasal cavity or into the sinus for all implants inserted in the maxilla (no. 383 implants) was evaluated. For five implants, the perforation was not evaluated. There was no significant effect of implant perforation in the nasal cavity or the sinus on the early implant failures rate (p-values: Fisher = 0.43, GEE = 0.25) (Table 5).

For a total of five implants, an apical lesion was detected on the radiographs. This detection was related to the early implant failures. There was no significant effect of the apical lesion detection on the early implant failures, when Fisher's exact test was used, while a significant effect was found when GEE analysis was used (p-values: Fisher = 0.09, GEE = 0.02) (Table 6).

A total of nine implants were immediately inserted after tooth extraction; none of them failed at abutment connection.

Table 1. Frequency and percentile distribution of length (mm) for the failed and successful implants

	Implant length (mm)		
	7–10	11.5–13	15
Successful implants	243 (97.98%)	243 (98.38%)	220 (97.78%)
Failed implants	5 (2.02%)	4 (1.62%)	5 (2.22%)

Table 2. Frequency and percentile distribution of diameter (mm) for the failed and successful implants

	Implant diameter (mm)	
	3.3 and 3.75	Four and five
Successful implants	489 (98.00%)	217 (98.19%)
Failed implants	10 (2.00%)	4 (1.81%)

Table 3. Frequency and percentile distribution for the failed and successful implants location

	Mandible anterior	Mandible posterior	Maxilla anterior	Maxilla posterior
Successful implants	154 (99.35%)	172 (97.18%)	181 (97.84%)	199 (98.03%)
Failed implants	1 (0.65%)	5 (2.82%)	4 (2.16%)	4 (1.97%)

Table 4. Frequency and percentile distribution of the dehiscences and fenestrations of the jaw bone during implant insertion phase for the failed and successful implants

	Dehiscence		Fenestration	
	no	yes	no	yes
Successful implants	640 (98.31%)	66 (95.65%)	683 (98.13%)	23 (95.83%)
Failed implants	11 (1.69%)	3 (4.35%)	13 (1.87%)	1 (4.17%)

Table 5. Frequency and percentile distribution of the occurrence of implant perforation in the nasal cavity or the sinus for the failed and successful implants inserted in the upper jaw

	Perforation in the nasal cavity/sinus	
	no	yes
Successful implants	238 (97.54%)	138 (99.28%)
Failed implants	6 (2.46%)	1 (0.72%)

Table 6. Frequency and percentile distribution of the apical lesion detection for the failed and successful implants

	Apical lesion detection	
	no	yes
Successful implants	702 (98.18%)	4 (80.00%)
Failed implants	13 (1.82%)	1 (20.00%)

Table 7. Frequency and percentile distribution of antibiotic prescription pre-or immediately after implant surgery for patients with and without early implant failures

	Antibiotic prescription	
	no	yes
Successful implants	330 (98.21%)	371 (98.15%)
Failed implants	6 (1.79%)	7 (1.85%)

Table 8. Frequency and percentile distribution of jaw bone quantity according to Lekholm & Zarb index (1985) for failed and successful implants

	Grade A	Grade B	Grades (C, D, E)
Successful implants	127 (98.45%)	320 (97.26%)	259 (99.23%)
Failed implants	2 (1.55%)	9 (2.74%)	2 (0.77%)

The possible impact of antibiotic prescription before-or immediately after implant surgery was evaluated; for two patients provided with six implants, the antibiotic use could not be evaluated. There was no significant effect of antibiotic use on the early implant failures (p-values: Fisher = 1.00, GEE = 0.95) (Table 7).

There was no significant effect of bone volume according to Lekholm & Zarb (1985) index on the early implant failure rate. (for one implant, bone volume was not evaluated) (p-values: Fisher = 0.46, GEE = NA). Because no failures have been detected for implants inserted into bone quantity grade D and C, these two grades were grouped with grade C; no statistical difference was detected between these grouped grades and the other grades (p-values: Fisher = 0.256, GEE = 0.235) (Table 8).

There was no significant effect of bone quality according to Lekholm & Zarb (1985) index on early implant failure rate (for one implant bone volume was not evaluated) (p-values: Fisher = 0.73, GEE = NA). Because no failure have been detected for implants inserted into bone quality grade 4, this grade was grouped with grade 3. No statistical difference was detected between these grouped grades and the other grades (p-values: Fisher = 0.512, GEE = 0.460) (Table 9).

The type of edentulism affected early failures significantly when the Fisher exact test was used. A higher failure rate was noticed in implants neighbouring teeth (p-values: Fisher = 0.004, GEE = NA). Because no failures have been detected for implants inserted into a jaw having teeth – but not neighbouring the implant, and in an edentulous jaw antagonizing teeth, these categories were grouped with the full-edentulism category. Significantly more failures were detected when an implant is neighboured teeth compared with the other grouped categories (p-values: Fisher/GEE: <0.001) (Table 10).

Smoking habits affected the early implant failures significantly, according to the two statistical methods used (p-values: Fisher = <0.001, GEE = <0.001) (Table 11).

The early implant failures rate was compared between all female patients $\geqslant 50$ years of age following HRT, and those who did not. No significant effect of HRT on early implant failures was found when Fisher exact test was used, but significantly more failures were noted in patients who followed HRT when GEE analysis was used (p-values: Fisher = 0.06, GEE = <0.001) (Table 12).

For a total of 274 patients provided with 682 implants, the placement torque measurements at the crestal, middle and apical thirds were evaluated. A total of 12 implants failed in this group.

No statistical effect of placement torque measurements on the early implant failure was detected, by either the Wilcoxon's rank-sum test or the GEE method [the p-values were: (0.87 and 0.90), (0.81 and 0.79) and (0.27 and 0.24, respectively)] for the crestal third, middle third and apical third, respectively (Fig. 1).

Both systemic disease and medical therapies were analysed using the two statistical methods separately. Because the multivariable and in many cases also univariate GEE analyses are impossible, these results were given a descriptive character only.

Certain factors, such as hypertension, ischaemic cardiac disease, osteoporosis, hypo- or hyperthyroidism, controlled type II diabetes, rheumatoid arthritis, coagulation problems, chemotherapy, claustrophobia, asthma, hypercholesteroleamia, radiotherapy of the concerned area and antidepressant and steroid medications, did not lead to an increased incidence in the early failures (p-values were >0.05 with Fisher and GEE statistical methods). A significant effect of gastric problems on early implant failures was found when the Fisher exact test and GEE analysis were used (p-values: Fisher = 0.04, GEE = 0.01).

A significant effect of Crohn's disease on early implant failures was found when GEE analysis was used (p-values: Fisher = 0.21, GEE = 0.02).

Table 9. Frequency and percentile distribution of jaw bone quality according to Lekholm & Zarb index (1985) for failed and successful implants

	Grade 1	Grade 2	Grades (3, 4)
Successful implants	107 (99.07%)	311 (97.49%)	288 (98.63%)
Failed implants	1 (0.93%)	8 (2.51%)	4 (1.37%)

Table 10. Frequency and percentile distribution of the type of edentulism for patients with and without early implant failures

	Full edentulism/teeth in the antagonistic jaw only/teeth in the same jaw	Teeth neighboring the implant
Successful implants	429 (99.54%)	277 (95.85%)
Failed implants	2 (0.46%)	12 (4.15%)

Table 11. Frequency and percentile distribution of smoking habits for patients with and without early implant failures

	No smoking	Smoking
Successful implants	616 (98.88%)	90 (94.44%)
Failed implants	7 (1.12%)	5 (5.56%)

Table 12. Frequency and percentile distribution of the failed and successful implants for women of $\geqslant$50-years old following HRT or did not

	Women $\geqslant$50 years following HRT	Women $\geqslant$50 years do not follow HRT
Successful implants	19 (90.48%)	362 (98.37%)
Failed implants	2 (9.52%)	6 (1.63%)

HRT, hormone replacement therapy.

A significant effect of diabetes type I on early implant failures was detected when the Fisher's exact test was used (*p*-values: Fisher = 0.02, GEE = NA).

Significantly more early failures occurred for women who underwent radical hysterectomy, when the Fisher exact test and GEE analysis were used (*p*-values: Fisher = 0.04, GEE = 0.04) (Table 13).

Discussion

This study revealed a high success rate of 98.1% up to abutment connection, which could be related to the oxidized surface (TiUnite™ implants). Indeed, in previous studies from the same authors using exclusively or mostly machined surfaces of the same type, the success rate up to abutment connection was (2.8%) and (3.6%) (van Steenberghe et al. 2002, Alsaadi et al. 2007).

Owing to the fact that the number of early failed implants was very low (14 out of 720, i.e. 1.9%), this study could only identify potentially influential factors for the implant failure and could not draw definitive conclusions.

Owing to the cross-sectional nature of the study and the very few failures, none of the conclusions drawn in this paper should be considered to be final. Future studies should direct their attention towards the evaluation of the following factors: apical lesions around the recipient site, vicinity to natural dentition, smoking habits, hormone replacement therapy, gastric problems, Crohn's disease, diabetes I and radical hysterectomy.

Although the apical lesions seems to affect significantly the early failure rate with the use of TiUnite™ implants, this rate is relatively low when compared with machined surfaced implants, which fail to achieve osseointegration and are thus lost. This may be explained by the fact that a faster bone apposition occurring with the TiUnite™ prevents the spread of the inflammatory cells from the remaining apical lesion along the implant surface. With machined surfaces, the bone apposition is much slower and thus this interposition of inflammatory cells can occur, reaching up to the coronal end. Such implants are lost. With a TiUnite™ surface the focus is reactivated by the surgical trauma, but the implant remains osseointegrated (Quirynen et al. 2005).

Several studies have revealed the negative effect of smoking on osseointegration and its dose-related effect (for a review, Bain 1996). This is in accordance with the present findings.

Many recent studies that have used surgical preparation adapted to the bone density, modified surface implants have reported survival rates for short implants and for wide diameter implants which were comparable with those of obtaind with long implants and standard diameter implants (for a review, see Renouard & Nisand 2006). In the present study there were no effects of implant length on implant failure. Moreover, poor bone quality did not aeffect the early failure rate, as ascertained by the Fisher's test for osteoporosis and implant diameter.

Crohn's disease can, as it is a generalized autoimmune disease, affect the entire gastro-intestinal system, and thus even lead to periodontal lesions (van Steenberghe et al. 1976). Crohn's disease is characterized by the presence of many antibody–antigen complexes, leading to autoimmune inflammatory processes in several parts of the body. Symptoms are enteritis, vasculitis, recurrent oral ulceration, arthritis or keratoconjuctivitis. The same can occur at the interface with biocompatible implants, normally considered by the host as a part of the body. In Crohn's patients, they could be recognized as non-self, thus affecting the outcome of implant osseointegration (van Steenberghe et al. 2002). Moreover, the malnutrition encountered in Crohn's patients can also leads to deficient bone healing around the implant (Esposito et al. 1998).

Moy et al. 2005, in a retrospective study, found that women on oestrogen replacement had a significantly lower success rate than the healthy population. Post-menopausal women not on hormone replacement therapy did not have this increased failure rate. In the present study, there was tendency towards more failure among women on HRT.

Conclusion

From the present study, homogenuously using TiUnite™ implants, the incidence of early failures was so small that statistical analysis of interfering factors became difficult. It appears for example that poor bone quality did not influence the

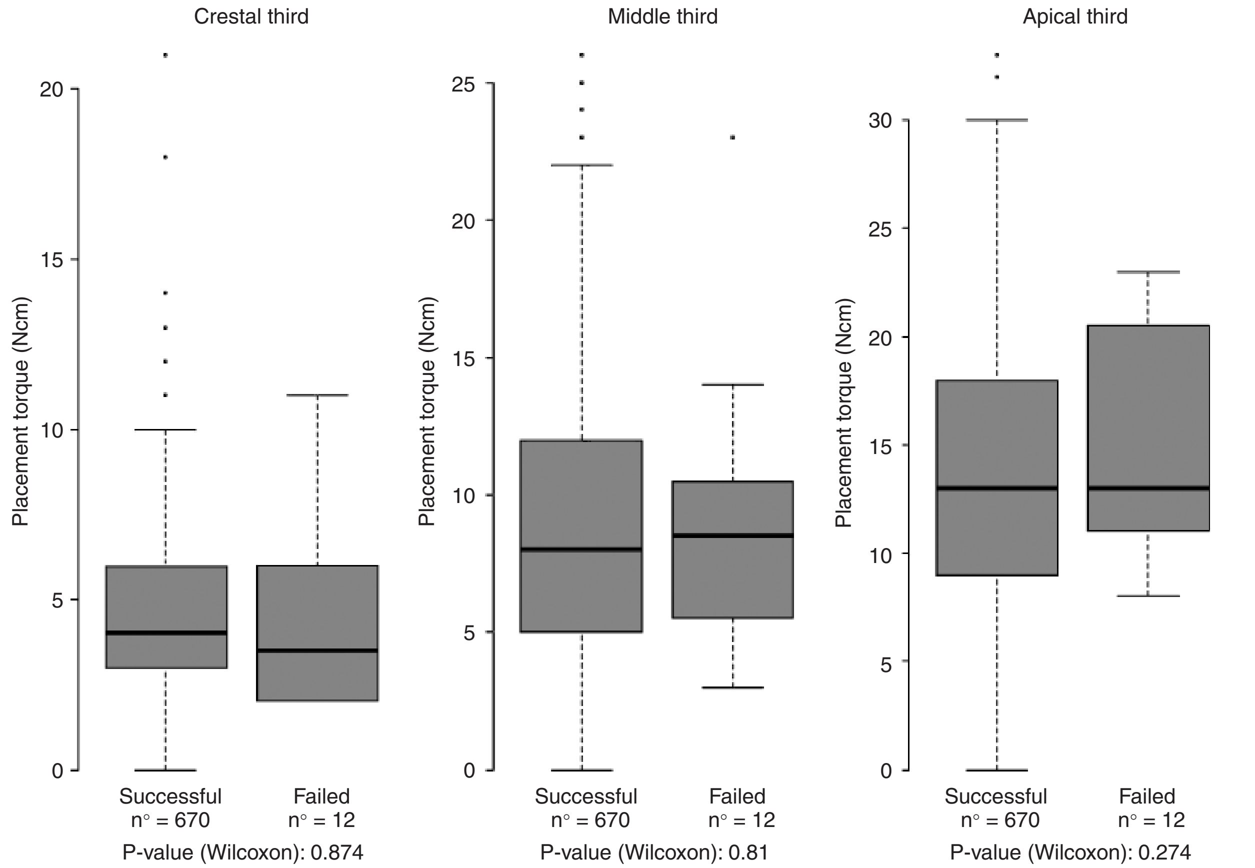

Fig. 1. Box-plots of the placement torque measurements (N cm) for the successful and failed implants, and results of the Wilcoxon rank-sum test in the crestal, middle and in apical thirds.

Table 13. Frequency and percentile distribution of the systemic diseases and therapies for patients with and without early failure, and the *p*-values of two different statistical analyses used

Factor	No		Yes		*p*-value	
	successful	failed	successful	failed	fisher	GEE
Hypertension	589 (98.00%)	12 (2.00%)	117 (98.32%)	2 (1.68%)	1.00	0.82
Cardiac problem	638 (97.85%)	14 (2.15%)	68 (100.00%)	0 (0.00%)	0.38	NA
Gastric problem	667 (98.38%)	11 (1.62%)	39 (92.86%)	3 (7.14%)	0.04*	0.01*
Osteoporosis	677 (97.97%)	14 (2.03%)	29 (100.00%)	0 (0.00%)	1.00	NA
Hypothyroid	685 (98.00%)	14 (2.00%)	21 (100.00%)	0 (0.00%)	1.00	NA
Hyperthyroid	702 (98.04%)	14 (1.96%)	4 (100.00%)	0 (0.00%)	1.00	NA
Chemotherapy	699 (98.04%)	14 (1.96%)	7 (100.00%)	0 (0.00%)	1.00	NA
Radiotherapy	703 (98.05%)	14 (1.95%)	3 (100.00%)	0 (0.00%)	1.00	NA
Crohn's disease	695 (98.16%)	13 (1.84%)	11 (91.67%)	1 (8.33%)	0.21	0.02*
Diabetes I	706 (98.19%)	13 (1.81%)	0 (0.00%)	1 (100.00%)	0.02*	NA
Diabetes II	682 (98.13%)	13 (1.87%)	24 (96.00%)	1 (4.00%)	0.39	0.36
Rheumatoid arthritis	693 (98.16%)	13 (1.84%)	13 (92.86%)	1 (7.14%)	0.24	0.22
Coagulation	649 (98.18%)	12 (1.82%)	57 (96.61%)	2 (3.39%)	0.32	0.42
Claustrophobia	694 (98.02%)	14 (1.98%)	12 (100.00%)	0 (0.00%)	1.00	NA
Antidepressant medication	647 (98.18%)	12 (1.82%)	59 (96.72%)	2 (3.28%)	0.34	0.31
Steroid medication	702 (98.04%)	14 (1.96%)	4 (100.00%)	0 (0.00%)	1.00	NA
Hypercholesterol	673 (97.14%)	14 (1.94)	33 (100.00%)	0 (0.00 %)	1.00	NA
Asthma	685 (98.74%)	13 (1.86%)	21 (95.45%)	1 (4.55%)	0.36	0.39
Radical hysterectomy	470 (98.74%)	6 (1.26%)	20 (90.91%)	2 (9.09%)	0.04*	0.04*

GEE, generalized estimating equations.
*Significant *p*-value <0.05.

outcome of osseointegration, as ascertained by the Fisher's test for osteoporosis and implant diameter. On the other hand, gastric problems, Crohn, diabetes type I and radical hysterectomy seem to increase the incidence of early failures. Thus, in the presence of such diseases, the choice of osseointegrated implants should eventually be made considering more classical prosthetic approaches.

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Clinical Relevance

Scientific rationale for the study: The incidence of early failures was so small when exclusively TiUnite implants were used that analysis of interfering factors became difficult.
Principal findings: It appears that poor bone quality did not influence the outcome of osseointegration, as ascertained for osteoporosis and implant diameter. On the other hand, gastric problems, Crohn, diabetes type I and radical hysterectomy seem to increase the incidence of early failures.
Practical implications: The small early failure rate of TiUnite implants is evident. More studies are needed to confirm the identification of the factors interfering with osseointegration when TiUnite implants are used.