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Prevalence of subjects with progressive bone loss at implants

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Abstract

Aim: The aim of the present study was to assess the prevalence of subjects with progressive bone loss at implants with a function time of at least 5 years.

Material and methods: Radiographs of 1346 patients who had attended annual follow-up visits at the Brånemark Clinic, Public Dental Services, Gothenburg, Sweden were retrieved. Six hundred and sixty-two subjects fulfilled the inclusion criteria. Thus, they all had been provided with implant-supported (Brånemark System[®] Nobel BioCare, Gothenburg, Sweden) fixed partial or complete dentures or single-tooth replacements with a documented function time in radiographs of at least 5 years. Implants that demonstrated progressive bone loss to a level of ≥ 3 threads of an implant were detected. The number of subjects who exhibited one or more implants with progressive bone loss to the threshold level was recorded.

Results: Twenty-eight percent of 662 included subjects had one or more implants with progressive bone loss. A logistic regression analysis revealed that the individuals in this group carried a significantly larger number of implants than the subjects in whom no implants with progressive loss were detected (6 vs. 4.8). Furthermore, $>30\%$ of the subjects in the group with progressive bone loss had ≥ 3 identified implants and that about 33% of all such implants in this group exhibited extensive bone loss. Out of the total 3413 implants included in the study, 423 implants (12.4%) demonstrated progressive bone loss.

Conclusion: It is suggested that the prevalence of progressive bone loss at implants assessed from subject-based data is higher than that evaluated from implant-based data.

In a consensus report on implant therapy from the Fourth European Workshop on Periodontology, it was concluded that conventional implant therapy using routine procedures appears to be safe and reliable with only a small number of biological and technical complications (Lang et al. 2002). This statement was based on findings presented in a systematic review on the incidence of biological and technical complications in implant therapy reported in prospective longitudinal studies of at least 5 years (Berglundh et al. 2002). The

types of biological complications evaluated in the review included implant loss, sensory disturbances, soft-tissue complications, peri-implantitis, bone loss ≥ 2.5 mm and implant fractures. From the 1310 titles and abstracts provided by the search in databases, 159 studies were selected for full-text analysis, out of which 51 studies were used for meta-analysis. Implant loss was the most frequently reported type of complication in the evaluated studies, while information regarding other categories, such as bone loss

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Table 1. Number of included and excluded subjects and distribution of patients in different exclusion categories

Total number of patients		1346
Number of included subjects		662
Number of excluded subjects		684
Reasons for exclusion	No.	Percentage of excluded subjects
Function time documented on radiographs <5 years	574	83.9
Overdentures	24	3.5
Bone augmentation procedures	23	3.4
Function time <5 years because of loss of implants	15	2.2
Various reasons, e.g. inadequate radiographs, initial therapy performed at other clinics	48	7

≥ 2.5 mm, was only provided in <40% of the studies. The limited available information regarding crestal bone loss in the studies analyzed by Berglundh et al. (2002) was in most cases presented as implant-based mean values, while frequency distribution data were less frequently reported. The ability to interpret the incidence of pronounced bone loss at implants was therefore regarded as limited.

Marginal bone loss over time assessed in intra-oral radiographs has in many long-term studies on implants been regarded as a critical examination variable (for review see Fourmousis & Brägger 1999; Wennström & Palmer 1999). It has also been suggested that a certain magnitude of annual bone loss could be acceptable for either implant systems or individual implants (Albrektsson et al. 1986; Albrektsson & Zarb 1993). A modification of radiographic criteria with regard to acceptable levels of bone loss at implants was proposed in a consensus report (Wennström & Palmer 1999). It was suggested that a maximal bone loss of 2 mm between baseline (prosthesis installation) and the 5-year examination could be accepted. Wennström & Palmer (1999) further stated that presentation of radiographic data on bone-level changes should include frequency distribution in addition to the mean values.

Because of the limited information of subject-based data in implant therapy in general, and the need to further elucidate the frequency of pronounced marginal bone loss at implants, the current investigation was initiated, the aim of which was to assess the prevalence of subjects with progressive bone loss at implants with a function time of at least 5 years.

Material and methods

Radiographs of 1346 patients who had attended annual follow-up visits at the Brånemark Clinic, Public Dental Services, Gothenburg, Sweden, during 1999 were retrieved. The subjects to be included in the study had been provided with implant-supported (Brånemark System[®] Nobel BioCare, Gothenburg, Sweden) fixed partial or complete dentures or single-tooth replacements, which all had a documented function time in radiographs of at least 5 years. Subjects restored with removable prosthesis, i.e. overdentures, or who had received implant therapy in conjunction with osseous grafting or other augmentation procedures, including the use of barrier membranes, were excluded. The number of individuals who fulfilled the inclusion criteria and the categories of individuals excluded for various reasons are described in Table 1. The main reason for exclusion of patients ($n = 684$) was the absence of a function time ≥ 5 years documented in radiographs (83.9%), while subjects representing overdentures, bone augmentation procedures and other reasons were less frequent (16.1%).

The intra-oral radiographs to be analyzed had been obtained using examination techniques described earlier (Hollender & Rockler 1980). Using a magnifying lupe ($\times 7$), the marginal bone level at implants being in function for 5 up to 20 years was assessed in the radiographs from the remaining 662 subjects. Sites that demonstrated a bone level corresponding to the position of, or apical to the 3rd marginal thread unit of an implant (threshold level: a position located about 3 mm apical to the

abutment–fixture junction) were detected. In such sites, the corresponding radiographic bone level at the time of the 1-year follow-up examination was determined in order to distinguish implants, which at this initial state had a bone level at the threshold of 3 threads. Thus, progressive bone loss at implants in the present study was defined as bone-level alterations occurring between the 1 year examination and the ≥ 5 years follow-up. The number of subjects who exhibited 1 or more implants with progressive bone loss to the threshold level was recorded. Full agreement was established between all four examiners regarding the selection of subjects with implants exhibiting progressive bone loss to the threshold level.

Data analyses

Subjects were grouped according to the presence (Group A) or absence (Group B) of implants exhibiting progressive bone loss to the threshold level. Differences between the groups regarding age, number of implants and function time were analyzed using Student's *t*-test for unpaired samples. The distribution of gender and construction types, i.e. fixed complete denture (FCD), fixed partial denture (FPD) and single-tooth replacements, as well as the jaw distribution assessed for each group, was compared using Fisher's exact test and chi-squared analysis. The variables included in the bivariate comparisons, i.e. age, gender distribution, number of implants and function time, were examined using logistic regression analysis. *P*-values < 0.05 were considered significant.

Results

Subject data

The number and percentage of subjects scored for each group are presented in Fig. 1. Group A (subjects exhibiting implant units with progressive bone loss to the threshold level) comprised 184 subjects (27.8%), while 478 (72.2%) subjects were allocated to Group B. Within the subjects in Group B, 40 patients revealed 1 or more implants with a marginal bone level corresponding to ≥ 3 threads at the function time ≥ 5 years. In these implant sites, however, no sign of progressive bone loss from 1-year examination was detected. Radiographs representing different follow-

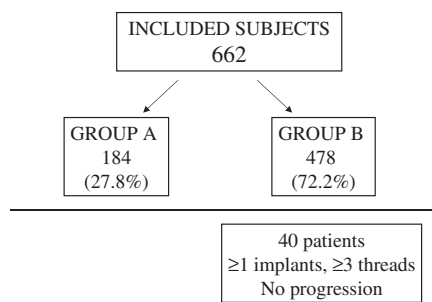


Fig. 1. Number and percentage of subjects in Group A (subjects with ≥ 1 implants with progressive bone loss ≥ 3 threads) and Group B (subjects with no implants with progressive bone loss ≥ 3 threads). Forty patients who exhibited ≥ 1 implants with bone loss ≥ 3 threads but no sign of progression from the 1 year examination are included in Group B.

up intervals from one subject in Group A are illustrated in Fig. 2.

Age and gender distribution of subjects were almost similar in Groups A and B (Table 2). Overt differences, however, were detected between the groups regarding the variables mean number of inserted implants and function time (Table 2). Thus, the subjects in Group A had on the average 6 implants, while the corresponding figure for the individuals in Group B was 4.8 implants. This difference was statistically significant. The mean function time for implants in Group A and Group B subjects was 9.1 and 8.4 years, respectively. Also, this difference in the bivariate analysis was statistically significant.

The histogram in Fig. 3 illustrates the frequency distribution of radiographic follow-up intervals in Groups A and B. In both groups, radiographic examinations at 5 and 10 years dominated.

Table 3 describes the distribution of construction types. The proportion of FCDs was significantly larger in Group A than in Group B (66.8% vs. 54.8%), while the opposite relation was found regarding single-tooth replacement. No differences were found with respect to the frequency of FPDs and different combinations of construction types.

The majority of the implant-supported constructions in both Groups A and B was located in the mandible (48.9–50.7%; Fig. 4). Subjects with prosthesis located in the maxilla varied between 37.5% and 41.8% and the proportion of subjects who had implant-supported constructions of any type in both jaws varied between 13.6%

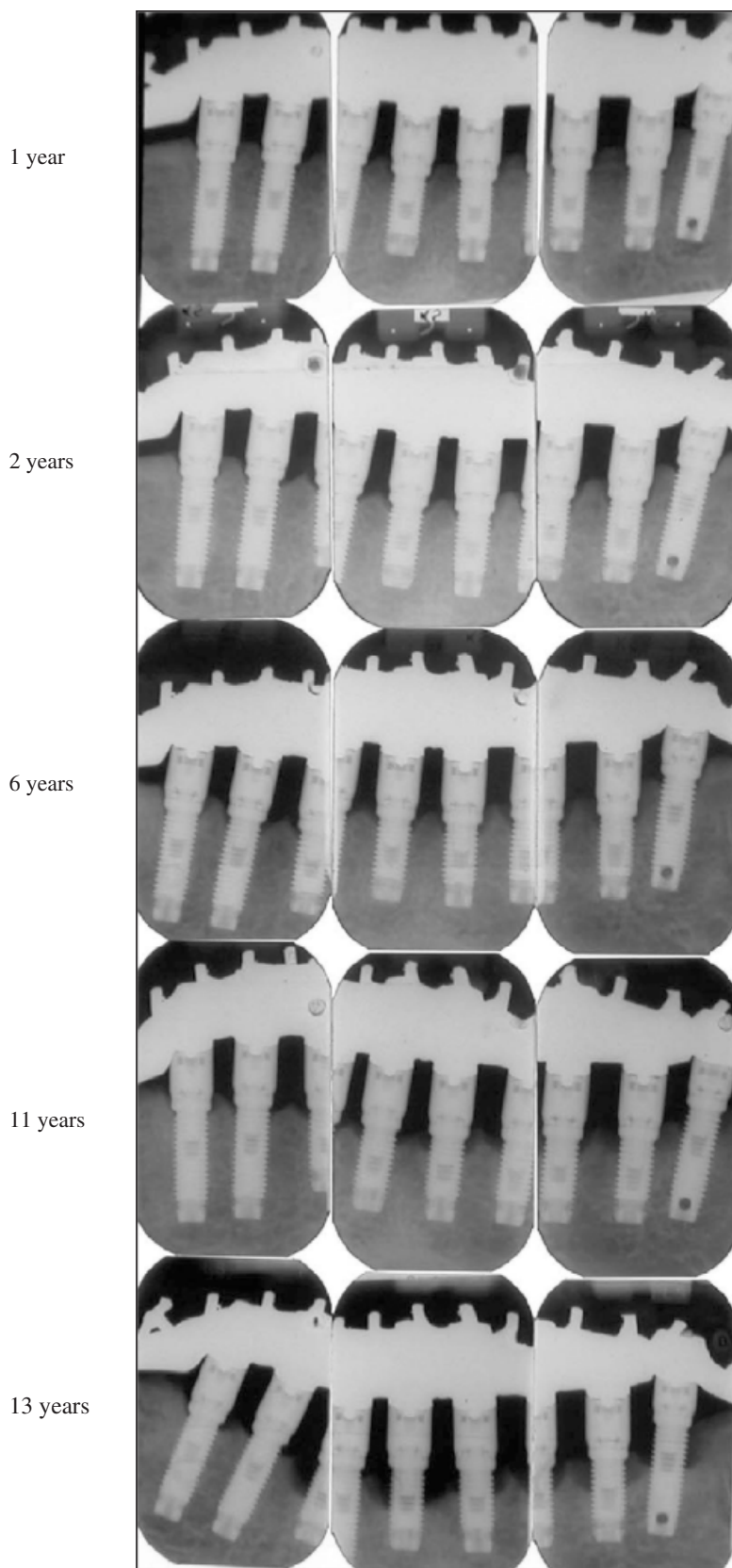


Fig. 2. Radiographs illustrating progressive bone loss in a 50-year-old female (Group A).

Table 2. Age, gender distribution, number of inserted implants and function time

	Group A (n = 184)	Group B (n = 478)
Age (mean) (years)	67.1	64.6
Range (years)	32–89	20–92
Gender	F/M	F/M
No.	106/78	291/187
Percentage	57.6/42.2	60.9/39.1
No. of implants; mean (SD)	6 (2.2)	* 4.8 (2.3)
Function time Years; mean (SD)	9.1 (3.3)	* 8.4 (2.9)

*P < 0.05.
M, male; F, female.

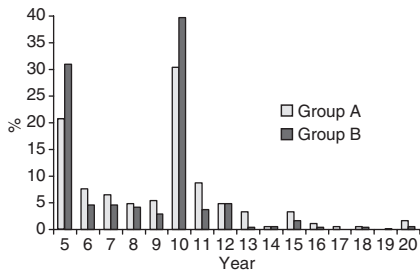


Fig. 3. Frequency distribution of radiographic follow-up intervals in Groups A and B.

and 7.5%. No differences regarding the distribution jaw location for the various constructions were found between Groups A and B.

The results from the logistic regression analysis are reported in Table 4. Subject age, years in function, jaw location and gender distribution, respectively, did not influence the probability for subjects to be scored into Group A. On the other hand, the number of implants per individual had a significant impact on the likelihood for subjects to exhibit implants with progressive bone loss to the threshold level.

The percentage distribution of subjects in Group A with respect to the number of affected implants is presented in Fig. 5. While most subjects demonstrated 1 or 2 affected implants (38.5% and 28.3%, respectively), the remaining 33% of the patients exhibited ≥ 3 implants with detectable progressive bone loss to the threshold level. Almost 10% of subjects in Group A had ≥ 5 affected implants.

Implant data

The total number of implants analyzed in the 184 subjects of Group A and in 478 subjects of Group B was 1098 and 2315,

Table 3. Distribution of subjects with fixed complete dentures (FCDs), fixed partial dentures (FPDs), single tooth replacements (STs) and combinations of different construction types

		FCD	FPD	ST	FPD FCD	FCD ST	FPD ST	FPD FCD ST
Group A (n = 184)	No.	123	52	1	6	0	2	0
	%	66.8	28.3	0.5	3.3	0	1.1	0
Group B (n = 478)	No.	262	163	41	7	2	1	2
	%	54.8	34.1	8.6	1.5	0.4	0.2	0.4

*P < 0.05.

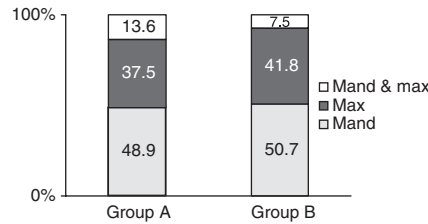


Fig. 4. Distribution of subjects with implant-supported constructions located in the mandible and the maxilla or in both.

respectively (Table 5). The number of implants that exhibited progressive bone loss to the threshold level in Group A was 423. Thus, the proportion of affected implants out of the total number of 3413 implants included in both groups was 12.4%.

A further analysis of the 423 implants with progressive bone loss found in Group A revealed a varying degree of bone loss. The percentage distribution of implants with regard to different bone loss categories is presented in Fig. 6. About 42% of affected implants had a bone level corresponding to 3 threads, 24% of the implants had lost bone support to the 4th thread and the remaining 33% of the identified implants exhibited bone loss levels from 5 threads or more.

Discussion

In the present study, the prevalence of subjects who exhibited progressive bone loss at implants was analyzed. For this purpose, intra-oral radiographs from 662 subjects who were all treated with implant-supported fixed reconstructions were collected. It was demonstrated that about 28% of subjects had one or more affected implant and that the individuals in this group carried a significantly larger number of implants than the subjects in

Table 4. Results from the logistic regression analysis

Factors	P-value
Age	0.8389
No. of implants	< 0.0001
Function time	0.1084
Jaw	0.3011
Gender	0.3039

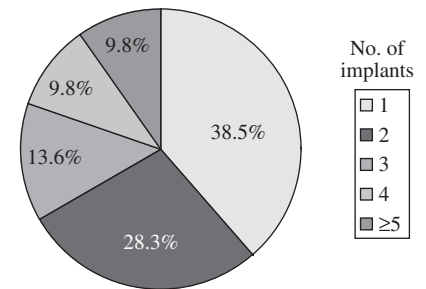


Fig. 5. Distribution of subjects in Group A (n = 184) with different number of implants with progressive bone loss ≥ 3 threads.

whom no implants with progressive loss were detected. The results furthermore revealed that > 30% of the subjects in the group with progressive bone loss had ≥ 3 identified implants and that about 33% of all such implants in this group exhibited extensive bone loss. It is suggested that the prevalence of progressive bone loss at implants assessed on subject-based data is higher than that evaluated from implant-based data.

The finding that progressive bone loss did not affect all implants to a similar extent is in agreement with data reported previously. Lekholm et al. (1999) in a 10-year prospective, multicenter study analyzed marginal bone resorption at implants in partially edentulous individuals. It was demonstrated that the average bone loss that occurred during the 10-year period amounted to 0.7 mm. A frequency distri-

Table 5. Implant data assessed from the 662 included subjects

	All (n = 662)	Group A (n = 184)	Group A (n = 478)
No. of implants	3413	1098	2315
No. of implants with progressive bone loss of ≥ 3 threads	423	423	0
Percentage of implants with progressive bone loss of ≥ 3 threads	12.4	38.5	0

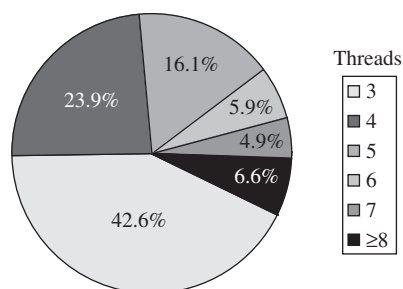


Fig. 6. Distribution of implants in Group A (n = 423) with regard to different bone loss categories (threads).

Analysis of different bone loss categories revealed that the majority (70%) of the implants showed small bone-level alterations (<1 mm), while 23% of the implants exhibited bone loss between 1.1 and 2 mm and about 7% of the implants had bone loss exceeding 2 mm. It is not clear, however, whether the implants with pronounced bone loss in the study by Lekholm et al. (1999) were confined to a certain category of patients, since no such information was available.

Ekelund et al. (2003) in a 20-year prospective study on implant therapy in the edentulous mandible reported on similar findings as referred to above. It was demonstrated that the average marginal bone level was 1.6 mm apical to a reference point of the implant and that 18% of all implants analyzed had a bone level >2 mm apical to this position. The bone loss that occurred between the 15- and 20-year examinations in the study by Ekelund et al. (2003), however, was only detected in 27% of the implants and was more pronounced at implants that exhibited a history of previous bone loss. It was furthermore reported that bone loss exceeding 0.5 mm between 15 and 20 years follow-up was only detected in two out of the 30 subjects examined. The observation by Ekelund et al. (2003) that marginal bone loss affects not only a distinct group of implants but also a certain group of subjects corroborates findings obtained in the present investigation.

Subject-based data with regard to differences in bone loss at implants were provided in a 5-year retrospective radiographic study (Hardt et al. 2002). In the study referred to, radiographs from 97 subjects who were restored with implant-supported FPDs in posterior segments of the maxilla were analyzed. Radiographs of the remaining natural dentition in the subjects were also analyzed and an age-related bone-loss (ArB) score was calculated for each subject in order to describe the experience of periodontal tissue destruction. Hardt et al. (2002) defined two groups of subjects ('Perio and Non-Perio') with regard to the ArB score and reported that the proportion of subjects who had >2 mm bone loss at implants during the study period was significantly larger in the 'Perio' group than in the 'Non-Perio' group. It was concluded that longitudinal bone loss at implants was correlated with previous experience of periodontal bone loss. Similar findings were also reported in a 10-year prospective study by Karoussis et al. (2004). They concluded that evidence exists for the association between periodontal and peri-implant conditions. The observation reported in the studies by Hardt et al. (2002) and by Karoussis et al. (2004) that a certain group of subjects exhibits an increased propensity to marginal bone loss at implants is consistent with data presented in the current study. The approach adopted in the two studies referred to and the current investigation was, however, apparently different. While Hardt et al. (2002) defined their subject groups with regard to an ArB loss score at teeth, the groups that were formed in the present study were confined to the presence of progressive bone loss at implants to a certain threshold level. Furthermore, both edentulous and partially edentulous subjects were included in the present study and no information was available regarding the experience of periodontal tissue destruction.

The types of implant-supported reconstructions included in the current study were fixed complete and FPDs. Removable prostheses, such as overdentures, were excluded because of the expected different outcome regarding implant complications as compared with fixed reconstructions. In the systematic review referred to above (Berglundh et al. 2002), it was demonstrated that implants supporting overdentures exhibited higher frequencies of biological and technical complications than implants used in fixed reconstructions. There are reasons to suggest that an inclusion of overdenture constructions in the present study might have resulted in a higher prevalence of subjects with progressive marginal bone loss at implants. It was furthermore disclosed in the present study that 41 out of 42 subjects restored with implant-supported single-tooth restorations had no signs of progressive bone loss. This observation is consistent with data reported in the systematic review by Berglundh et al. (2002) and indicates that such complications at single-tooth replacements occur in lower frequencies than those at fixed complete and partial dentures.

In the present study it was demonstrated that subjects in Group A (implants with progressive bone loss) had a significantly larger number of implants than the subjects in Group B. A logical interpretation of this finding could be that the likelihood for the subject to exhibit implants with progressive bone loss increases with the number of implants used in each individual. The number of years in function for the implants, however, appeared to have less influence on the complications studied in the present material as evaluated in the logistic regression analysis.

It was further demonstrated that the proportion of subjects who were restored with FCDs was also larger in Group A than in Group B. This observation indicates that progressive marginal bone loss at implants may not be related to the presence of remaining teeth and that implant therapy in partially edentulous individuals is to be expected to have a similar outcome as in edentulous subjects. This hypothesis is supported by findings reported in longitudinal studies (Lekholm et al. 1999; Hultin et al. 2000; Naert et al. 2002). Hultin et al. (2000) in a 10-year prospective study concluded that the long-term results with

implants in partially edentulous subjects were comparable with those presented for edentulous patients. Similar findings were also presented in a 1–16-year follow-up study on partially edentulous subjects by Naert et al. (2002).

The analysis of the number of affected implants within each subject in Group A of the present material revealed an even distribution of three categories of subjects: 1 affected implant, 2 affected implants and ≥ 3 affected implants (Fig. 5). Of particular interest is the fact that about 10% of the subjects in Group A had 4 affected implants and another 10% exhibited ≥ 5 implants with progressive bone loss. It is presently not known, however, whether the group of subjects with increased number of affected implants represents a category of individuals with a history of periodontal bone loss as indicated in the studies by Hardt et al. (2002) and Karoussis et al. (2004) referred to above.

In addition, the prevalence of implants with progressive bone loss with regard to the total amount of implants included in the current study was 12.4%, while the corresponding figure assessed on the subject level was more than twice as high (27.8%). This finding demonstrates the importance of applying subject-based data in clinical reports of implant therapy. Apparently, the prevalence calculated from implant-based data becomes diluted from the large number of implants included in the entire subject sample.

Résumé

Le but de l'étude présente a été d'estimer la fréquence globale de sujets avec une perte osseuse progressive au niveau des implants mis en fonction depuis au moins cinq années. Des radiographies de 1 346 patients qui avaient suivi les visites de maintenance à la clinique de Branemark®, service dentaire public de Göteborg, ont été revus. Six cent soixante-deux sujets rentraient dans les critères d'inclusion. Ils avaient tous reçu des prothèses fixes ou complètes ou des remplacements dentaires unitaires sur implants *ad modum* Branemark® avec un temps de mise en fonction visible à la radiographie d'au moins cinq années. Les implants qui avaient une perte osseuse progressive jusqu'au niveau ≥ 3 filetages d'un implant ont été détectés. Le nombre de sujets qui avaient un ou plusieurs implants avec une perte osseuse progressive jusqu'au niveau du seuil a été enregistré. Vingt-huit pour cent de 662 sujets avaient un ou plusieurs implants avec perte osseuse progressive. Une analyse de régression logistique a révélé que les individus dans ce groupe

portaient un nombre significativement plus important d'implants que les sujets chez lesquels aucun implant avec perte osseuse n'avait été détecté (6,0 vs 4,8). De plus > 30% des sujets dans le groupe avec perte osseuse progressive avaient ≥ 3 implants identifiés comme defectueux et environ 33% des implants dans ce groupe accusaient une perte osseuse importante. Des 3 413 implants inclus dans cette étude 423 (12,4%) accusaient une perte osseuse progressive. La fréquence normale de perte osseuse progressive au niveau des implants jugée à partir des données des patients est plus importante que lorsque le jugement est effectuée sur base des implants.

Zusammenfassung

Die Prävalenz von Subjekten mit progressivem Knochenverlust um Implantate

Ziel: Das Ziel der vorliegenden Studie war, die Prävalenz von Subjekten mit progressivem Knochenverlust um Implantate auszuwerten, wobei die Implantate mindestens 5 Jahre in Funktion waren.

Material und Methoden: Es wurden Röntgenbilder von 1346 Patienten, welche zu jährlichen Kontrolluntersuchungen an der Brånemark Klinik, Public Dental Services, Göteborg, Schweden, erschienen, durchgeschaut. 662 Subjekte erfüllten die Einschlusskriterien. Sie alle waren mit implantatgetragenen (Brånemark System, Nobel BioCare, Göteborg, Schweden) festsitzenden Brücken oder Prothesen oder mit Einzelkronen versorgt worden. Mit den Röntgenbildern konnte eine Belastungszeit von mindestens 5 Jahren dokumentiert werden. Es wurden Implantate, welche einen progressiven Knochenverlust von ≥ 3 Gewindegängen aufwiesen, identifiziert. Die Anzahl der Subjekte, welche ein oder mehrere Implantate mit progressivem Knochenverlust gemäss Schwellenwert aufwiesen, wurde aufgezeichnet.

Resultate: 28% der 662 untersuchten Subjekte wiesen ein oder mehrere Implantate mit progressivem Knochenverlust auf. Eine logistische Regressionsanalyse zeigte, dass die Individuen dieser Gruppe eine signifikant grössere Anzahl Implantate aufwiesen als die Subjekte, bei denen keine Implantate mit progressivem Knochenverlust entdeckt wurden (6 gegenüber 4,8). Zudem zeigten > 30% der Subjekte in der Gruppe mit progressivem Knochenverlust ≥ 3 befallene Implantate und ungefähr 33% dieser Implantate in dieser Gruppe zeigten einen ausge dehnten Knochenverlust. Von den insgesamt 3413 Implantaten, welche in die Studie einbezogen worden waren, zeigten 423 Implantate (12,4%) progressiven Knochenverlust.

Schlussfolgerung: Es wird die Vermutung aufgestellt, dass die Prävalenz von progressivem Knochenverlust bei Implantaten grösser ist, wenn Daten auf der Subjekt-Basis analysiert werden, als wenn die Daten auf der Implantat-Basis ausgewertet werden

Resumen

Intención: La intención del presente estudio fue valorar la prevalencia de sujetos con pérdida ósea

progressiva en implantes con un periodo en función de al menos 5 años.

Material y métodos: Se recuperaron las radiografías de 1346 pacientes que atendieron a visitas de seguimiento anual en la Clínica Brånemark, Servicios Dentales Públicos, Göteborg, Suecia. 662 sujetos coincidieron con los criterios de inclusión. De este modo, todos fueron dotados con dentaduras fijas totales o parciales o sustituciones de dientes unitarios implantosoportados (Sistema Brånemark® Nobel Biocare, Göteborg, Suecia) con un tiempo en función documentado en radiografías de 5 años. Se detectaron los implantes que demostraron pérdida ósea progresiva a un nivel de ≥ 3 roscas de un implante. Se registró el número de sujetos que exhibieron uno o más implantes con pérdida de ósea progresiva al nivel umbral.

Resultados: 28% de los 662 sujetos incluidos tuvieron uno o más implantes con pérdida ósea progresiva. Un análisis de regresión logística reveló que los individuos en este grupo llevaban un mayor número de implantes que los sujetos en los cuales no se detectaron implantes con pérdida ósea progresiva (6 vs. 4,8). Más aun, > 30% de los sujetos en el grupo con pérdida ósea progresiva tuvieron ≥ 3 implantes identificados y que alrededor del 33% de dichos implantes en este grupo exhibieron pérdida ósea extensiva. De los 3413 implantes incluidos en este estudio 423 implantes (12,4%) demostraron pérdida ósea.

Conclusión: Se sugiere que la prevalencia de pérdida ósea progresiva de implantes valorados de datos basados en sujetos, es mayor que aquellos evaluados de datos basados en implantes.

要旨

目的: 本研究は、少なくとも5年間機能しているインプラント部位で骨吸収が進行している患者の発生頻度を評価した。

材料と方法: スエーデン、イエテボリの公的歯科医療機関である Branemark クリニックにて年に1度の追跡検査のために来院した患者1346名のレントゲン像を検討した。そのうち662名が選択基準を満足していた。彼らは全てインプラント支持 (Branemark System®, Nobel BioCare, Göteborg, Sweden) の固定式部分義歯または総義歯あるいは単独歯修復物の治療を受けており、少なくとも5年間のX線像の記録に基づく機能期間があった。インプラントのねじ山3個以上の骨吸収の進行を示すインプラントを検出した。同閾値レベルまで骨吸収が進行しているインプラントが1本以上見つかった患者の数を記録した。

結果: 被験者662名の28%が、骨吸収が進行しているインプラントを1本以上持っていた。ロジスティック回帰分析は、同グループの被験者は進行性骨吸収を示すインプラントを持たない被験者よりも、有意にインプラントの本数が多いことを示した(6.0対4.8)。さらに進行性骨吸収を示す被験者グループの30%以上は、3本以上のインプラントを持っており、同グループのこのようなインプラントの33%は、広範囲の骨吸収を示した。同研究の対象となった合計3413本のインプラントのうち、423本(12.4%)が進行性骨吸収を示した。

結論: 患者ベースのデータから評価したインプラントの進行性骨吸収の発生頻度は、インプラント・ベースのデータから評価されるよりも高い事が示唆される。

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