

# Dental Implants in the Diabetic Patient: A Retrospective Study

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Diabetes mellitus is one of the world's major chronic health problems. In the United States alone, this metabolic disorder affects an estimated 15.7 million individuals, 5.9% of the population.<sup>1</sup> Among men and women over 65 years of age, where the rates of edentulism are highest, an estimated 18.4% of all individuals have some form of the disease.

A complex syndrome with more than one cause, diabetes is responsible for numerous complications affecting the whole body. In the oral environment, it has been associated with xerostomia, increased levels of salivary glucose, swelling of the parotid gland, and an increased incidence of caries.<sup>2</sup> Adult diabetics also experience a 2.8 to 3.4 times higher risk of developing periodontitis than nondiabetics.<sup>3</sup> Although there has been some conflicting evidence, diabetic patients seem to be more prone to infection.<sup>4-6</sup> Healing after surgery in the diabetic patient seems to occur more slowly, exposing the tissues to complications such as tissue necrosis.<sup>7</sup> Furthermore, animal studies indicate that streptozotocin-induced diabetes interferes with the process of osseointegration.<sup>8,9</sup>

Because of such considerations, diabetes has sometimes been considered a contraindication for the use of dental implants. The 1988 National Institutes of Health Consensus Development Conference Statement on Dental Implants<sup>10</sup> stopped short of

*It has become increasingly common for controlled diabetic patients to be considered as candidates for dental implants. This study reports on the results of placing implants in 34 patients with diabetes who were treated with 227 Brånemark implants. At the time of second-stage surgery, 214 of the implants had osseointegrated, a survival rate of 94.3%. Only one failure was identified among the 177 implants followed through final*

*restoration, a clinical survival rate of 99.9%. Screening for diabetes and trying to ensure that implant candidates are in metabolic control are recommended to increase the chances of successful osseointegration. Antibiotic protection and avoidance of smoking should also be considered. (Implant Dent 1999; 8:355-359)*

**Key Words:** dental implants, diabetes, osseointegration, implant prosthesis

explicitly stating this, but did include "debilitating or uncontrolled disease" and "conditions, diseases, or treatment that severely compromise healing" within its list of contraindications for dental implants.

Tempering concerns about the increased risk of implant failure in the diabetic patient, however, has been the growing awareness of the benefits provided by modern dental implants. First developed in the 1960s and commercially introduced 20 years later, implants represent a significantly better solution for tooth loss replacement than traditional dental appliances. Because they are anchored directly into bone, they provide complete stability, in contrast to traditional tooth-replacement alternatives such as dentures. They also minimize bone resorption and atrophy, conditions that can cause facial collapse and the resultant appearance of premature aging. Five-year survival rates of more than 95% in studies of implants supporting mandibular overdentures have become common,<sup>11,12</sup> and research has demonstrated improved masticatory func-

tion and overall satisfaction in implant patients.<sup>13,14</sup>

Since 1982, the worldwide market for dental implants has grown to approximately \$450 million. A 1998 trend survey in the trade journal Dental Products Report reported that >50% of oral surgeons and periodontists reported placing more implants in 1997 than in the prior year.

At the same time, as techniques for managing diabetes have evolved, evidence has accumulated that diabetic patients who effectively control their disease incur a lower risk of various health complications than uncontrolled patients. For example, it has been demonstrated that well-controlled diabetics respond well to periodontal therapy and have fewer systemic complications than poorly controlled diabetics.<sup>15</sup> Before exogenous insulin was widely available, the caries incidence in diabetics was high; but since insulin therapy has become commonplace, most studies have failed to demonstrate an increased caries incidence in treated patients.<sup>2</sup> Similarly, rates of infection

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**Table 1.** Demographic Data

Sex	No.	Age		Range	Smoker	Non-Smoker
		Average	Std. Dev.			
Male	17	59.1	12.7	34-75	2	15
Female	17	64.7	10.3	39-79	0	17
Total	34	62	11.7	34-79	2	32

Std. Dev., standard deviation.

seem to be worse in uncontrolled diabetics.<sup>5</sup>

Awareness of such distinctions has resulted in a greater degree of openness to the idea that diabetic patients may be good candidates for dental implants. A few studies have directly addressed this question in recent years and yielded promising preliminary data. In 1998, Kapur et al<sup>16</sup> compared 37 diabetic patients who received conventional removable mandibular overdentures versus 52 who were fitted with implant-supported ones and concluded that implants can be successfully used in diabetic patients with even low to moderate levels of metabolic control. A 1994 study found a 92.7% implant success rate for Type II diabetic patients under acceptable glucose control.<sup>17</sup> This article reports on results obtained by the authors after placing 227 implants in 34 diabetic patients.

## METHODS AND MATERIALS

The study population (Table 1) included 17 males and 17 females ranging in age from 34 to 79 years. The average age was 62.1 years (SD, 11.4). Two of the subjects, both male, were smokers. Diabetic status was generally determined from patient health histories or personal interviews. All patients were questioned about how their disease was being treated, and all were urged to strive for optimal metabolic control at the time of implant placement. In addition, a 10-day course of wide-spectrum antibiotics was begun for all subjects on the day of surgery.

Between April 1987 and May 1998, the study subjects were treated with a total of 227 implants, an average of 6.7 implants per person. Table 2 shows the anatomical distribution. Virtually all of the fixtures placed were Brånemark System implants.

Implant lengths ranged from 7.0 to 20.0 mm. Approximately 190 were between 10 and 18 mm long. Table 3 details the distribution of implants by length.

Of the 227 total implants, 91 were placed in fresh extraction sites. The remaining 136 implants were placed in osteotomies created by standard drilling techniques. Four of the 227 implants were loaded immediately after placement, all in the same patient. This individual was fitted simultaneously with 11 other implants that were not immediately loaded. Bone grafting was utilized at 31 of the 227 sites.

Thirty of the original 34 patients were followed through uncovering and the final restoration of 177 implants. The healing period between the first- and second-stage surgeries ranged from 0 to 15.5 months, with 5.9 months being the average healing period per implant.

## RESULTS

Upon uncovering, 214 of the 227 implants were found to have osseointegrated, a success rate of 94.3%. Of the thirteen failed implants, four occurred in each of two

**Table 2.** Anatomic Distribution of Implants Placed

Region	Total
Ant. Maxilla	45
Post. Maxilla	73
Maxilla	118
Ant. Mandible	46
Post. Mandible	63
Mandible	109
Total	227

Ant., anterior; Post., posterior.

patients (both nonsmokers), two occurred in one patient (also a nonsmoker), and one occurred in each of three patients. Of the latter, one was a smoker.

Of the four implants that were loaded immediately,<sup>18</sup> three failed. In the same patient, a second implant that was not immediately loaded also failed.

Six of the 13 surgical failures were located in the posterior mandible, four were in the posterior maxilla, two were in the anterior maxilla, and one was in the anterior mandible. Table 4 summarizes the location, diameter, length, and healing period of all the failed implants.

Of the 31 grafted sites, one (3.2%) failed. Autogenous bone, Grafton Gel (Musculoskeletal Transplant Foundation, Holmdel, NJ), and a membrane also were used at this site.

Of the 177 implants that were followed through final restoration, one failure was identified; a failure rate of only 0.06%. This implant, which was initially placed in a grafted site in the left maxilla and

**Table 3.** Lengths and Diameters of Implants Placed

Length			Diameter		
Length (mm)	Successful (No.)	Failures (No.)	Diameter (mm)	Successful (No.)	Failures (No.)
7	7		3	2	
8	3		3.75	164	7
8.5	2		4	24	7
10	54	6	5	13	
12	3		Unknown	10	
13	54	4	Total	213	14
15	54	1			
18	20	3			
20	6				
Unknown	10				
Total	213	14			

**Table 4.** Characterization of Failed Implants

Chart No.	Sex	Age	Position	Diameter (mm)	Length (mm)	Healing Period (mos.)	Cause and Status
2703	F	76	12	3.75	13	6	Surgical: Soft tissue grew in-between the implant & bone
4729	F	70	16	4	18	8	Surgical: Failed to integrate
5059	F	70	18	3.75	10	2.75	Surgical: Failed to integrate; immediate load
5059	F	70	27	3.75	15		Surgical: Failed to integrate; immediate load
5059	F	70	29	4	13		Surgical: Failed to integrate
5059	F	70	30	4	13	2.75	Surgical: Failed to integrate; immediate load
5752	M	66	5	4	18	12.75	Surgical: Failed to integrate
5752	M	66	8	4	10	12.75	Surgical: Failed to integrate
5752	M	66	9	4	10	12.75	Surgical: Failed to integrate
5752	M	66	14	4	18	12.75	Surgical: Failed to integrate
1712*	M	65	18	3.75	10	3.75	Surgical: Failed to integrate
1712**	M	65	19	3.75	10	3.75	Surgical: Failed to integrate
1315	M	53	29	3.75	10	2.5	Surgical: Failed to integrate
2305	M	75	4	3.75	13	4.75***	Post-Restoration failure: Bruxing & clenching

\* Removed 7.5 months after exposure; never loaded.

\*\* Removed 2 weeks after exposure; never loaded.

\*\*\* Months post-restoration at time of failure.

restored 5 months later, had a 3.75-mm diameter and a length of 10 mm. The cause of the failure seemed to be occlusal overload caused by bruxism. Table 5 summarizes the results achieved by the patients at each stage.

## DISCUSSION

Although the results of this study indicate that excellent results can be obtained when Brånemark implants are placed in diabetic patients, certain precautionary measures can increase the likelihood of a successful outcome. (1) Adequate screening is essential. A comprehensive health history should be obtained from every candidate for implant therapy, with attention given to fundamental systemic problems. If the patient has a history of diabetes, additional information should be gathered about his or her current

treatment. (2) If the diabetic patient's metabolic control seems to be clinically inadequate, it is best to delay implant therapy until better control is achieved. (3) The doctor should stress to the patient the importance of taking all diabetic medications on the days of surgery and maintaining an acceptable level of metabolic control throughout the healing period. (4) A 10-day regimen of broad-spectrum antibiotics should be started on the day of surgery to reduce the risk of infection. (5) The deleterious impact of smoking on osseointegration has been well documented.<sup>19</sup> Although the results of this study suggest that diabetics who smoke can experience success with dental implants, the authors believe that the combination of smoking and diabetes may substantially increase the risks of implant failure. For that reason, diabetic patients who smoke

should be urged to enter a smoking cessation program before implant surgery.

## CONCLUSION

Dental implants offer significant benefits that require that they be considered for the treatment of wide spectrum of patients, including the growing number of individuals with diabetes mellitus. Although uncontrolled diabetes has been shown to interfere with various aspects of the healing process, the results of this retrospective study indicate that a high success rate is achievable when dental implants are placed in diabetic patients whose disease is under control.

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**Table 5.** Patient's Results by Stage Achieved

Stage	Patients (No.)	Implants (No.)	Successful Implants	Failed Implants
Surgery	34	227		
Exposed, Failure	6*	13	0	13
Exposed, Successful, Not Attached	5	38	38	0
Attachment completed	29	176	175	1

\* One patient had failed implants at exposure and other implants that were successful at uncovering.

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## Abstract Translations [German, Spanish, Portuguese, Japanese]

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**ABSTRACT:** Es wird zunehmend zu einer Normalität, gut eingestellte Diabetiker als Kandidaten für Zahnimplantate anzusehen. Diese Studie berichtet über die Ergebnisse des Einsatzes von Implantaten bei 34 diabetischen Patienten, die insgesamt 227 Brånemark-Implantate erhielten. Zum Zeitpunkt des zweiten chirurgischen Behandlungsabschnitts waren 214 dieser Implantate in den Knochen integriert, was einer Überlebensrate von 94,3 Prozent entspricht. Unter den 177 bis zur endgültigen Wiederherstellung beobachteten Implantaten gab es nur einen einzigen Ausfall, was einer klinischen Überlebensrate von 99,9 Prozent entspricht. Zur Verbesserung der Aussichten auf eine erfolgreiche Knocheneinbindung werden bei potentiellen Implantatpatienten eine Untersuchung auf Diabetes sowie eine möglichst stabile Stoffwechseleinstellung empfohlen. Hilfreich sind außerdem der Schutz durch Antibiotika und die Aufgabe des Rauchens.

**SCHLÜSSELWÖRTE:** Zahnimplantate, Diabetes, Knocheneinbindung, Implantatprothese

**ABSTRACTO:** Se ha vuelto cada vez más común considerar a los pacientes con diabetes controladas como candidatos para recibir implantes dentales. Este estudio informa los resultados de colocar implantes en 34 pacientes con diabetes que fueron tratados con implantes 227 Brånemark. En el momento de la cirugía de segunda etapa, 214 de los implantes se habían oseointegrado, una tasa de supervivencia del 94,3 por ciento. Solamente se identificó una falla entre los 177 implantes seguidos hasta la restauración final, una tasa clínica de supervivencia del 99,9 por ciento. Los análisis para determinar la diabetes y tratar de que los candidatos al implante están en control metabólico se recomiendan para aumentar la posibilidad de una oseointegración exitosa. La protección con antibióticos y evitar el fumar también deberán considerarse.

**PALABRAS CLAVES:** implantes dentales, diabetes, oseointegración, prótesis de implantes

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**SINOPSE:** Está tornando-se muito comum pacientes com diabetes controlada serem considerados candidatos para implantes dentários. Este estudo relata os resultados da colocação de implantes em 34 pacientes com diabetes que foram tratados com 227 implantes Branemark. Na época da cirurgia de segundo estágio, 214 dos implantes tinham apresentado integração óssea, uma taxa de sobrevivência de 94,3 por cento. Somente um fracasso foi identificado entre os 177 implantes após a restauração final, uma taxa de sobrevivência clínica de 99,9 por cento. Para aumentar as chances de sucesso na integração óssea, recomenda-se a realização de exames para diabetes, além da tomada de medidas para assegurar que candidatos a implantes estejam em controle metabólico. Também deve-se considerar a proteção por meio de antibióticos e evitar o fumo.

**PALAVRAS-CHAVE:** implantes dentários, diabetes, integração óssea, prótese de implante.

#### 糖尿病患者とデンタルインプラント - 後向き研究

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#### 概要:

症状の抑えられた糖尿病患者をデンタルインプラントの適用対象に含める傾向は、拡がりつつある。この研究では糖尿病患者34人に、227 Branemarkインプラントが設置され、予後が報告される。第2段階手術時に、骨統合していたインプラントは214あり、生存率は94.3%だった。修復の最終段階まで追跡された177のインプラントの中には失敗例が1件あったが、これは臨床生存率99.9%に相当する。骨統合の成功率を上げるためには、糖尿病の有無を確認したうえで、代謝系統の症状抑制ができてきていることの確認が重要である。抗生物質の使用と禁煙も、治療の考慮対象となろう。

#### キーワード:

デンタルインプラント、糖尿病、骨統合、インプラント補綴

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