

## A CLINICAL AND RADIOGRAPHIC RETROSPECTIVE ASSESSMENT OF 109 IMPLANTS: A SHORT TERM STUDY

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ة قصيرة المدى باستخدام الزراعة السنوية لبرنامج لتقييم هذا النوع من العلاج التعويضي للأسنان إكلينيكية وإشعاعية، ومعرفة مدى تأثيره النفسي على المرضى. تم دراسة (١٠٩) زرعات سنوية، ٢٦ زرعة وضعت في الفك العلوي و ٨٣ زرعة وضعت في الفك السفلي. أظهرت نتائج هذه الدراسة فشل خمس زرعات سنوية، ثلاث في الفك السفلي بنسبة نجاح ٩٦,٤٪ واثنان في الفك السفلي بنسبة نجاح ٩٢٪. كذلك عند تقييم ٦٦ زرعة سنوية عملت لمدة تتراوح ما بين عام إلى عامين كان هناك زرعة سنوية واحدة فاشلة مما أعطى نسبة نجاح هي ٨٩,٥٪. وقد أظهرت نتائج هذه الدراسة أن هناك علاقة مباشرة ما بين وجود اللويحة السنوية والتهاب اللثة الحفافي الذي قد يكون مؤشراً ضعيفاً لتحديد مدى نجاح أو فشل العلاج بالزرعات السنوية. كذلك دلت الدراسة على أن المرضى الذين تم تعويض الأسنان المفقودة لديهم باستخدام الزراعة السنوية هم أكثر ارتياحاً نفسياً ووظيفياً من المرضى الذين تم تعويض فقد الأسنان لديهم بأجهزة الأسنان الاصطناعية (أطقم الأسنان)

A short-term clinical study using Branemark dental implants was carried out on 32 patients aged 23 to 77 years. A total of 109 implants were evaluated, 26 osseointegrated fixtures sighted in the maxilla and 83 fixtures in the mandible. Clinical and psychological effects of the treatment were assessed over a period of 4 years. Five implants have failed, three in the mandible and two in the maxilla giving an overall success rate of 96.4% and 92%, respectively. When the fixtures that have been functioning for 1-2 years were considered, out of 66 fixtures only one implant has failed; a success rate of 89.5%. The study indicated a direct relationship between the presence of plaque and the incidence of peri-implant gingivitis. Nevertheless, marginal inflammation may be a poor parameter for assessing implant success. In addition, patients were substantially more satisfied socially and physically with implant protheses than with conventional dentures.

### Introduction

The field of dental implants has been gaining attention in modern dentistry especially in the last 10 years. This interest has led to a dramatic increase in the

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number of implant systems available in the market.

However, Branemark's endosteal system has achieved worldwide acceptance as their basic experimental work dates back as far as the mid 1960's. Branemark's initial observations of vascular healing with a titanium growth chamber subsequently led to controlled clinical trials which established a systematic implant protocol that was accepted by the American Dental Association Council on dental materials, instruments and equipment.<sup>1</sup> As dental implantology is becoming an established and proven treatment modality, standard

criteria for success based on scientific investigations is essential to safeguard patients and give guidance to clinicians.<sup>2</sup> Several clinical studies claimed longitudinal success of the Branemark endosseous implants.<sup>3,5</sup> The success rate reported ranged from nearly 0% to almost 100% as a result of the diverse criteria used to quantify success and failure.

In 1986, the use of Nobelpharma implants commenced at the Eastman Dental Hospital, London University, United Kingdom where this study was carried out at the end of the year 1990. Thus, the implants had not completed five years in function. Data in this report is different from that reported by other workers which was based on a zero to five year analysis.<sup>4,6</sup> Further, it is the first retrospective report attempting to give preliminary data of the Branemark osseointegrated implants inserted by the Eastman Dental Hospital team. In addition, the psychological impact of implants on the patients through a questionnaire pertaining to eating, speaking, social life, aesthetics, and overall dental health was evaluated.

#### Material and Methods

All patients had been originally assessed by a prosthodontist. The inability of the patients to successfully adapt to optimally fabricated conventional prosthesis led to their referral to a joint surgical/prosthodontic clinic to be considered for implant placement. Full dental and medical histories were obtained and patients were examined to indicate if insertion of implant is a suitable treatment option, then a treatment plan was set-up. All surgical and prosthodontic treatment was performed according to the instruction Manual for Nobelpharma Implant System (Gotenborg, Sweden). Annual check-ups could not always be carried out but, as far as possible, patients were checked annually with or without radiographic examination.

Patients for this study were selected solely on their ability to attend for recall evaluation to carry out this study. Patients with at least a 6 months follow-up period of prosthesis function were included. The overall success rate of these implants were assessed. Moreover, implants have been followed up for more than one and two years. The majority of the implants evaluated in this study (66 implants) were checked one to two years after the construction of the suprastructures.

All evaluations were carried out by the principal investigator and a proforma was designed (Fig. 1) for data collection. All connecting bars between implants were removed for each implant to be evaluated individually.

For the clinical assessment, the parameters established by other investigators<sup>3,6</sup> were considered. It consisted of recording the following:

1. Complete immobility of the implant when tested clinically. Any discernable movement of the implant when rocking forces were applied by two instruments handles was recorded as failures.
2. Absence of peri-implant radiolucency as assessed on undistorted radiograph.
3. Mean vertical bone loss is less than 0.2 mm annually after first year of service.
4. No persistent pain, discomfort or infection attributable to the implant.
5. Gingival inflammation and plaque was recorded using the indices of Loe.<sup>7</sup> Pocket depth around each implant were recorded at four points (buccal, lingual, mesial and distal) using tines for Borodontic probe handles, all with conventional Williams markings at 1,2,3,5,7,8,9 and 10 mm, and a tip diameter of 0.5 mm. The tines were mounted in a previously calibrated pressure-sensitive handles adjusted to 0.2 N\*. In addition, the quality of the peri-implant tissues relating to the attached or unattached mucosa was evaluated.
6. Data reporting different complications including mucosal perforation, gingival hyperplasia formation, parasthesia/anaesthesia and any other complication were recorded.

A questionnaire developed by Akagawa et al<sup>8</sup> was presented to each patient to evaluate the psychological impact of their implants. It involved ten (10) questions which included reference to speech, stability of prosthesis, chewing ability, appearance and general satisfaction [Fig. 1].

Individual periapical film for each implant was secured using a modified film holder designed specifically for this study [Fig. 2]. The measuring technique of Mattson<sup>9</sup> using a scale at 0.1 mm intervals was used with the help of a constant light source X-ray viewing box and magnifying lens.

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EASTMAN DENTAL HOSPITAL

Surname:

ORAL MAXILLOFACIAL SURGERY DEPARTMENT  
ASSESSMENT FORM FOR IMPLANT PATIENT

Forename:  
Clinical Number:  
Date of Birth:  
Address  
Tel. No.

Date of first stage

Date of second stage

Fixation of titanium fixture  
Number, site and length of fixture

Titanium abutment placement

1. Stability

Mobile	Non-mobile	Sharp sound	Dull sound
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2. Soft Tissue

Gingival inflammation index

Adaptation of gingival margin around implant

- 0 = Normal gingiva
- 1 = Mild inflammation, change in colour, no bleeding.
- 2 = Moderate inflammation, redness, bleeding on probing.
- 3 = Severe inflammation, marked edema, spontaneous bleeding.

Well adapted                      Unadapted

Labial                                      Lingual

Mesial                                      Distal

Pocket depth

Plaque index

Mesial Labial  
Distal Lingual

- 0 = No plaque around implant
- 1 = Film of plaque adhere to implant
- 2 = Moderate accumulation of soft debris
- 3 = Abundance of soft material

Presence of Calculus

Supragingiva                                      Subgingiva

3. Radiographic Examination

O.P.G. Presence of radiolucent area

Absence of radiolucent area

Periapical Film

Number of uncovered threads

Mesial                                      Distal

Length of uncovered implant

Mesial                                      Distal

Figure 1. Proforma for data collection.

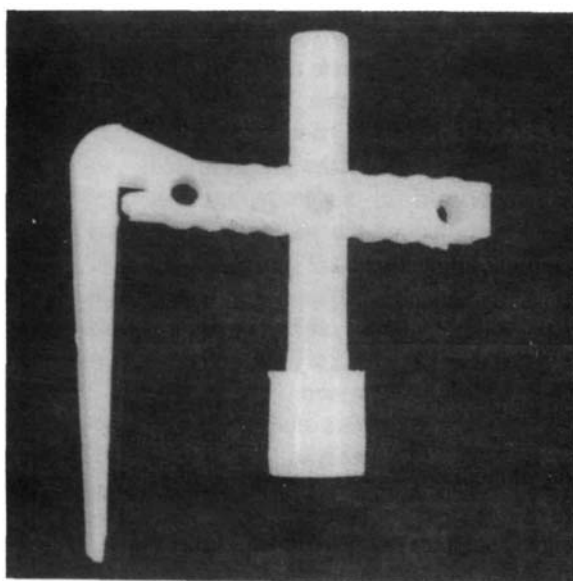


Figure 2. Modified periapical film holder.

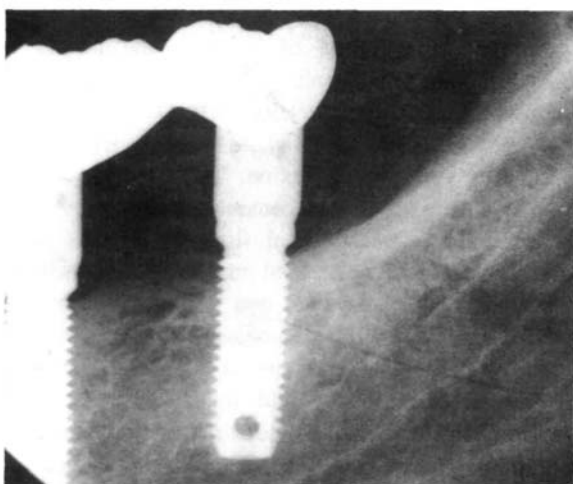


Figure 3. A sample radiograph to show the clarity of fixture threads in the radiographs used in the study.

Using the radiographs obtained at the time of abutment connection as baseline data, record of crestal bone height was made on the mesial and distal surfaces of the implants and measured to the fixture-abutment junction. Only radiographs demonstrating clarity of fixture threads were used [Fig. 3].

**Results**

Thirty two (32) patients with a total of 109 implants were evaluated. Twenty six (26)

osseointegrated fixtures were placed in the maxilla and 83 fixtures in the mandible. Twenty one (21) of these patients were females and eleven (11) were males. The age range was 23-77 years.

**Success rates in mandible/maxilla**

Five implants in five separate patients demonstrated mobility and required removal. Four of these implants showed peri-implant radiolucencies. The fifth implant was lost before a radiograph could be obtained. Of the five recorded failures, three implants failed very shortly after the second surgical phase, a failure rate in this study of 3%. One implant failed two and the other, three years after function. Three of the failures involved the mandible and two involved the maxilla which gives an overall success rate of 96.4% and 92%, respectively. However, when the fixtures which have been functionally restored 1-2 years only were considered, 66 fixtures, one implant has failed giving a success rate of 89.5%.

**Periodontal Assessment**

Among the 32 patients, 15 (47%) demonstrated clinical signs of marginal inflammation of the transmucosal tissues. Observable plaque and calculus deposits were recorded in 12 (37.5%) and 4 (12.5%) patients, respectively. Among the 109 implants, 15 (14%) were surrounded by unattached alveolar mucosa which demonstrated a higher degree of plaque accumulation and associated inflammation. A mean probing depth of 2.7 mm. was recorded in this study.

Table 1. Marginal bone resorption around the implants in different groups.

Patients	Duration of Implants (months)	No. of Implant in Mandible	No. of Implant in Maxilla	* Mean Distance
Group A	6-11	38	15	1.5
Group B	12-22	28	6	1.5
Group C	24-35	11	2	1.5
Group D.	36-47	-	3	2.5
Group E	48*	3	2	2.5

\*Mean distance in millimeter between bone crest and fixture abutment connection at the mesial and distal sides.

### Radiographic Assessment

Patients were divided into five groups according to the duration after prosthetic reconstruction. The change in bone height, expressed as the distance in millimeters measured from the bone crest to the fixture-abutment junction is shown in Table 1. The mean values for both the mesial and distal sides are indicated. The maximum distance reached was 2.5 mm.

### Complications

Two implants involving two patients demonstrated perforations of the inferior mandibular border. Moreover, one implant in another patient showed perforation of the nasal floor and subsequently failed.

Dental and medical histories revealed that two patients had lost teeth/tissue as a consequence of trauma with mandibular fractures. Open immobilization had involved stainless steel wiring in one patient and a titanium plate in the other. Two patients had medical problems, the first patient was diabetic, effectively controlled by oral hypoglycemic medication. The second patient was suffering from systemic lupus erythematosus and was on steroid medication.

### Psychological Assessment

Twenty-seven (84%) patients were more socially satisfied and confident with their implant retained prostheses compared with their previous conventional dentures. Thirty-one (97%) patients were aware of an improvement in chewing following insertion of the implant retained prostheses. Twenty-eight (88%) patients reported improved prosthesis stability, 20 (62%) patients felt there had been an improvement with respect to speech.

### Discussion

The successful application of osseointegrated implants for the rehabilitation of edentulous patients has been documented through multiple long-term results as presented by several centers world wide.<sup>4,5,10,11</sup> However, the use of the Branemark system to provide support for the restorative treatment of partially edentulous patients was an inevitable treatment option that has recently evolved. This study involving 109 fixtures demonstrated a 1-4-year-overall success rate of

95.4%. The mandibular success rate was 96.4% and the maxillary success rate of 92.0%. This compares well with results of other workers.<sup>35</sup> Regrettably, the present' data do not represent the same observation periods as the previous studies to allow for comparison. In this study, however, successful osseointegration of the implants which have been functionally restored 1-2 years was 98.5%. The failure rate for this group of implants was low and coincided well with other short-term results for partially as well as completely edentulous patients.<sup>4,12,14</sup> Furthermore, feasible reasons for the few failures seen in this study were also possible to identify. In general, failure of implant osseointegration may reflect many parameters. These parameters include bone quality and quantity, host response, infective elements, traumatic elements (surgical and prosthodontic) and others.<sup>16</sup> The greatest failures, three implants (3%), occurred before the prosthetic rehabilitation. This result is similar to that obtained by Vansteenbergh et al<sup>15</sup> who reported a failure of 3.4% of the installed implants during the healing period or the stage 2 abutment connection operation. Of the three failed implants, one fixture was associated with pus discharge suggesting infection. The need for strict sterility during implant placement is necessary.<sup>16</sup>

One fixture caused nasal floor perforation and subsequently failed. The third implant was inserted in a very thin alveolus which was not apparent at the time of initial pre-surgical assessment using conventional radiographs. At the time of implant placement, perforation of the buccal and lingual cortical plates occurred, as the implant diameter was greater than the width of the alveolus. As a result, it was planned to use reformatted CT scans before attempting a replacement of the lost implant to establish further details of the bone morphology.<sup>17</sup> However, Newman and Fleming<sup>18</sup> suggested a selective guided tissue regenerative technique in the field of periodontology which may offer opportunities to encourage bone regeneration in similar sites in the future.

Among the other two implants that failed, one was due to over tightening of a loosened transmucosal element without stabilizing the collar effectively. The bone threads were subsequently stripped. The other implant was lost shortly after abutment connection without adequate adjustment to the existing prosthesis. It was felt that occlusal forces overloaded the implant with resulting mobility.

A point that is worth mentioning is that most of the reported studies have used the Branemark osseointegration procedure to treat totally edentulous patients.<sup>4,5,10</sup> As a considerable number of the patients assessed in this study were partially edentulous patients, one must be cautious with assuming a similar outcome in the longer term. Nevertheless, some short-term studies of a limited number of partially edentulous patients have been reported.<sup>15,19,20</sup> The first study that showed the long-term fate of these implants was presented by Jemt et al.<sup>14</sup> In general, Jemt and his co-workers, with the other short-term reports, showed that the outcome of the Branemark technique in the treatment of partially edentulous patient is similar to what has been described for complete edentulism.

The study of the gingival status confirmed a direct relationship between the presence of plaque and the incidence of marginal gingivitis, a relationship which was proposed by several other studies.<sup>21</sup> In contrast to the work of Cox and Zarb,<sup>11</sup> this study could not demonstrate a relationship between marginal inflammation and the changes in crestal bone levels. Such a relation would emphasize the need for patient's cooperation as well as careful selection of the patients. Furthermore, although the presence of marginal inflammation should be considered undesirable, its presence in the absence of pain, appears to be irrelevant.<sup>16</sup> The difference in the reported figures of the mean probing depth in several studies may be attributed to the fact that some investigators were not using a constant pressure probe used in this study. However, it is perhaps unwise to assume that conventional periodontal indices bear any relevance to the implant situation which is quite different from that of a tooth. This criteria, therefore, requires further scrutiny.

It has been proposed by Branemark and other long-term studies that following an initial mean loss of the crestal bone of 1.5 mm in the first year, loss of crestal bone should not be greater than 0.2 mm/year. Nevertheless, it must be recognized that serial reproducible periapical radiographs should be a pre-requisite for accurate evaluation. As patients attendance for review visits was poor, quantifiable radiographic data were not available for the present study. It was not possible, therefore, to compare results with previous investigations. However, with the few available periapical radiographs, the

maximum bone loss reached was 2-5 mm. In this study, high quality periapical radiographs (Fig.3) were produced using the modified film holders which will offer an opportunity for future study.

It was suggested that certain medical conditions may jeopardize successful osseointegration and therefore contra-indicate implant placement.<sup>22</sup> Neither the patient under steroid medication, nor the diabetic patient has demonstrated any implant failure 2-3 years after implant placement and dental rehabilitation. To be reliable, however, such a claim would have to be more documented if enough medically compromised patients were included in the study.

The two patients with mandibular fractures caused some initial concern at the pre-operative assessment. It is known that galvanic activity and subsequent corrosion products could compromise osseointegration.<sup>23</sup> Both stainless steel transosseous wiring and the titanium alloy plate, potentially, could have caused complications. Neither of the patients has demonstrated implant failure to date.

The implant with nasal perforation subsequently failed. This maybe anticipated in view of the success rate of 72% of fixture with nasal/antral perforations reported by Smith and Zarb.<sup>2</sup> Perforation of the inferior mandibular border, seen in one of the patients, was not associated with apparent problems. It was felt that such a complication possess very little increased risk to failure due to the considerable soft tissue coverage at this location.

Considerable numbers of elderly patients are unable to adapt to conventional prosthesis for tooth replacement due to psychological or functional reasons. Patient emotional and psychological attitude and satisfaction was considered one of the consistent parameter that should be included when judging the acceptability of an implant system.<sup>6</sup> In this study, an improvement in confidence was recorded in 84% of the patients which compares with 88% in the results of Gregono.<sup>24</sup> Most patients included in the study reported improvement in chewing ability and improved retention of their implant prostheses with increased stability. Both of these parameters may be attributed to the retention and stability enhanced by the abutment connectors established with prosthodontic rehabilitation. These findings are consistent with previous studies.<sup>25,26</sup>

### Conclusions

This report is limited to a small number of patients over a short observation period to allow for a reliable conclusion as to the fate of the inserted implants. However, these preliminary results endorse the favorable results of the Branemark system implants reported by others.

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### References

- American Dental Association. Council on Dental Materials Instruments and Equipment. Provisionally acceptable endosseous implant for use in selected cases. Wozniak, W.T. in lilt, 1985.
- Smith DE, Zarb GA. Criteria for success of osseointegrated endosseous implants. *J Prosthet Dent* 1989;62(5):567-72.
- Alberktsson T, Zarb GA, Worthington P, Eriksson AR. The long-term efficacy of currently used dental implants: A review and proposed criteria of success. *Int J Oral Maxillofac Implants* 1986;1(1):11-25.
- Adell R, Lekholm U, Rockier B, Branemark PI. A 15-year study of osseointegrated implants in the treatment of the edentulous jaw. *Int J Oral Surg* 1981;10:387-416.
- Alberktsson T. A multicenter report on osseointegrated oral implants. *J Prosthet Dent* 1988;60(1):75-84.
- McKinney R, Koth DL, Steflik DE. Clinical standards for dental implants. In: Clark JW, ed. *Clinical dentistry*. Harperstown: Harper and Row, 1984:1-11.
- Loe H. The gingival index, the plaque index and the retention index systems. *J Periodontol* 1964;38:610.
- Akagawa Y, Rachi Y, Matsumoto T, Tsuru H. Attitudes of removable denture patients toward dental implants. *J Prosthet Dent* 1988;60(3):362-63.
- Mattson O. A magnifying viewer for photo fluorographic films. *Acta Radiol* 1953;39:412-417.
- Branemark PI, Hansson B, Adell R, et al. Osseointegrated implants in the treatment of the edentulous jaw. Experience from a 10-year period. *Scand J Plast Reconstr Surg Suppl* 1977;16:1-132.
- Cox JF, Zarb GA. The longitudinal clinical efficacy of osseointegrated dental implants. A 3-year report. *Int J Oral Maxillofac Surg* 1987;2:91-160.
- Gregory M, Murphy WM, Scott I, Watson CJ, Reeve PE. A clinical study of the Branemark dental implant system. *Br Dent J* 1990;168:18-23.
- Henry PJ, Adler EA, Wall CD. Osseointegrated dental implants: 2-year follow-up replication study. *Aust Dent J* 1986;31(4):247-56.
- Jemt T, Lekholm U, Adell R. Osseointegrated implants in the treatment of partially edentulous patients: A preliminary study on 876 consecutively placed fixture. *Int J Oral Maxillofac Implants* 1989;4(3):211-17.
- van Steenberghe D, Lekholm U, Bolender CL, et al. Applicability of osseo-integrated oral implants in the rehabilitation of partial edentulism: A prospective multicenter study of 558 fixtures. *Int J Oral Maxillofac Implants* 1990;5:272-81.
- Branemark PI, Zarb GA, Albrektsson T. *Tissue-integrated prostheses: Osseointegration in clinical dentistry*. Chicago: Quintessence Publishing Co, 1985:199-209.
- Schwarz MS, Rothman SL, Chafetz M, Rhodes M. Computed tomography in dental implantation surgery. *Dent Clin North Am* 1989;33(4):555-97.
- Newman MG, Fleming TF. Periodontal considerations of implants and implant associated microbiota. *J Dent Educ* 1988;52(12):737-44.
- Jemt T, Laney WR, Harris D, et al. Osseointegrated implants for single tooth replacement: A 1-year report from a multicenter prospective study. *Int J Oral Maxillofac Implants* 1991;6:29-36.
- Jemt T, Lekholm U, Grondahl K. A three year follow-up study of early single implant restorations ad modum Branemark. *Int J Periodontics Restorative Dent* 1990; 5:341-49.
- Lekholm U, Adell R, Lindhe J, et al. Marginal tissue reactions at osseointegrated titanium fixtures.(II) A cross-sectional retrospective study. *Int J Oral Maxillofac Surg* 1986;15:53-61.
- Matukas VJ. Medical risks associated with dental implants. *J Dent Educ* 1988; 52(12):745-47.
- Ravenholt G. Corrosion current and pH rise around titanium coupled to dental alloys. *Scand J Dent Res* 1988;96:466-72.
- Grogono AL, Lancaster DM, Finger IM. Dental Implants: A survey of patients attitudes. *J Prosthet Dent* 1989;62 (5):573-76.
- Blomberg S, Lindquist LW. Psychological reactions to edentulousness and treatment with jawbone-anchored bridges. *Acta Psychiatr Scand* 1983;68:251-62.
- Hoogstraten J, Lamers LM. Patient satisfaction after insertion of an osseointegrated implant bridge. *J Oral Rehabil* 1987;14:481-87.