A COMPARISON OF THREE DIFFERENT IMPLANT SYSTEMS IN THE SAME PATIENT

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Abstract

Objectives. The goal of this study was designed to test three different implant design systems in the same patient, under similar conditions, for their longevity and functionality. Various intraoral endosseous implant systems have been introduced over the years to equip practitioners in helping to restore partially- and fully edentulous jaws to functionality. To date many different makes of implant systems are available on the market. Many of these are based on the Brånemark submergible endosseous implant. The various implants come in different designs and coatings. The coating materials include hydroxyapatite, ceramics or titanium (plasma sprayed/pure/alloy). Most of the implants are two-stage submergible units, requiring two surgical procedures for placement. Recently there has been a move towards single stage implants with the added advantage of one surgical procedure for the patient. The question as to which implant system is the better one, is still open to speculation.

Materials and methods. Six titanium implants, three pairs of different design, were placed in the mandibles of 14 patients and evaluated over one to five years. The six implants included: two cylindrical units (GMI, Southern Implants), two Brånemark-like implants (IBS, Southern Implants), and two compression implants (OCSI [LIBB], Southern Implants). The cylindrical and Brånemark-like units are two-stage implant components while the OCSI (LIBB) units are single-stage units. All the implants were manufactured from the exactly the same grade IV titanium and supplied by Southern Implants of South Africa (Pty) Ltd.

Results. The retention rate of the implants over the observation period was 97.2%, comparing favourably with the retention rate as published in the literature.

Conclusion. The success of the study proves the hypothesis, that different designs of implant systems have no bearing on the longevity or functional success of the units used, and lends credence to the assumption that the design of the implant does not influence its functionality.

Clinical Significance. Different designs of implant systems have no bearing on the longevity or functional success of the units used, and lends credence to the assumption that the design of the implant does not influence its functionality in the anterior mandible.

Key words: dental implant, implant designs, edentulous mandible, survival

The study was designed to compare three different implant systems in the same host and under similar conditions, for their medium longevity and functionality in the anterior region of the mandible. Various intraoral endosseous implant systems have been introduced over the years to equip practitioners in helping to restore partially- and fully edentulous jaws to functionality. To date there are many different implant materials available on the market. A number of these are based on the design of the Brånemark submergible endosseous implant. The major differences among the various implants are found in their design, whether screw type or non-screw type, and the material used to coat them. These materials include titanium (plasma sprayed/pure/alloy), ceramics and hydroxyapatite. Most of the implants are two-stage submergible units comprising an endosseous element and a transmucosal unit onto which a superstructure can be fitted. These implants require two surgical procedures for placement - one for the initial endosseous placement and a second surgical procedure for the exposure of the implant and fitting of the superstructure. The success of these numerous systems has been reported in the literature by various authors[1-3]. Recently, some authors have reported on the

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osseointegrated compression screw implant (OCSI) as another addition to the field of implants[4,5]. This system differs from the Brånemark (Nobel Biocare) and the Brånemark-like (Southern Implants) systems in that it is placed directly as a one-stage procedure and requires no flap surgery. These implants employ the principle that bone should be compressed upon insertion, providing both stability and rigidity. The authors reporting on their experience with the OCSI implants, claim "that failure rates are similar to those of the Brånemark submergible implant systems"[4,5].

A comprehensive search of the health science literature on intra-oral implants revealed no reported studies that tested different implants systems in the human host. Tillmanns et al.[6,7] reported on peri-implant breakdown of three different dental implants placed in Beagle dogs. The implants tested were: hydroxyapatite coated, titanium plasma-sprayed and titanium alloy units. The authors concluded that all implants were equally susceptible to peri-implantitis. d'Hoedt et al.[2] compared four different endosseous implant systems in different patients. The type of implants compared were: Tübingen (Frialit®, Friedrichsfeld Ltd) of aluminium oxide ceramic; TPS (Straumann Ltd), titanium plasma sprayed, self tapping screw; IMZ (Friedrichsfeld Ltd) an intramobile cylinder used both as titanium plasma sprayed and hydroxyapatite ceramic coated units; Brånemark (Austenal-Dental Ltd, Nobel Biocare) of pure titanium and ITI (Straumann Ltd) titanium plasma sprayed system. This study assessed the survival time of these different implants over various time periods and the follow up results for the different systems varied in different patients. The implants utilised were two cylindrical units (GMI, Southern Implants), two compression implants (single stage OCSI [LIBB], Southern Implants) and two Brånemark-like implants (IBS, Southern Implants). No definitive conclusions were drawn from the data because of major differences in distribution within the groups.

The question of which implant system is the best to use in trying to restore edentulous cases to functionality, is still open to speculation. The working hypothesis was formulated as follows: the different designs of implant systems have no bearing on the longevity or functional success of the units used.

Material and Methods

Patient selection

Selection criteria included: completely edentulous patients, reasonable to good general health with no anaesthetic complications, bone height in the mandibular anterior region that would accommodate placement of 13 to 18 mm length implants, bone width that would accommodate implants of 3.75 mm in diameter, no history of previous radiation therapy for malignancies in the head and neck region. Patients were randomly drawn from the Pre-prosthodontic Surgical Clinic. Twelve completely edentulous patients, two males and ten females, aged between 33 and 73 years (mean, 53 years), were included in the study. Treatment was performed in all cases by the same surgeon, assistant surgeon and prosthodontist.

Ethical considerations

The Research Ethics Committee approved the study. All the patients signed an informed consent document before participating in the study.

Surgical Procedure

Six implants, two non-submergible and four submergible units, were placed between the mental foramina of the mandible. The implants were all grade IV titanium units. The cases were done under general anaesthesia. A free gingival graft was transplanted onto the anterior lower jaw in 10 cases at least two months prior to placement of the implants. In two cases sufficient keratinised epithelium was present. The cylindrical (GMI) and Brånemark-like units were placed in two stages. The first components were placed into the bone and allowed to heal for four months. Thereafter, the transmucosal ball head abutments (GMI and IBS) were placed as a second procedure under local anaesthesia. The OCSI (LIBB) ball head units were placed at the same time as the first procedure of the two stage implants as a single stage final procedure. The implants were placed in a 3:2:1 permutation, hence with every sixth patient the same implant placement position was achieved.

The surgical procedure for the four two-stage submergible implants had a crestal incision, raising a full thickness mucoperiostium flap, exposing the bone and followed by

Table 1: Mobility

0	No mobility
1	Slight mobility with firm pressure
2	Mobility with minimal pressure

Table 2: Probing depth1

0	0 to 3 mm
1	>3 to 5 mm
2	>5 mm

Table 3: Bone height, average of mesial and distal sites

0	baseline value
1	0 to 3 mm
2	> 3 mm

placement of the implant units under copious water irrigation. The mucosal incisions were sutured using resorbable materials and allowed to heal until the second stage procedure three to four months later. The two non-submergible implants OCSI (LIBB) were placed without any gingival incisions directly into the bone using tactile guidance. The alveolar process was flattened when indicated for the submergible implants. Patients received antibiotics (Amoxicillin 500mg), from the day of operation three times daily, for five days postoperatively and were requested to rinse with a 0.2% chlorhexidine solution four times per day for five days.

Prosthetic Procedure

The Department of Prosthetics and Dental Mechanics did the prosthetic rehabilitation. Patients refrained from wearing their lower denture for a period of one to two weeks immediately post implant placement. The old denture was then relined with a soft liner before reinsertion. After three to four months, ball-abutments were placed on the submergible implant units, under local anaesthesia. Final impressions were made and a

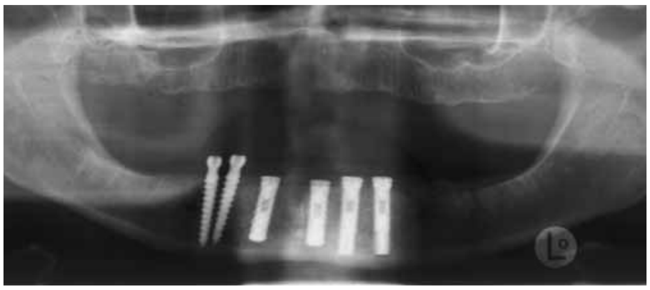

Figure 1a: Radiograph of implants at one month follow up visit.

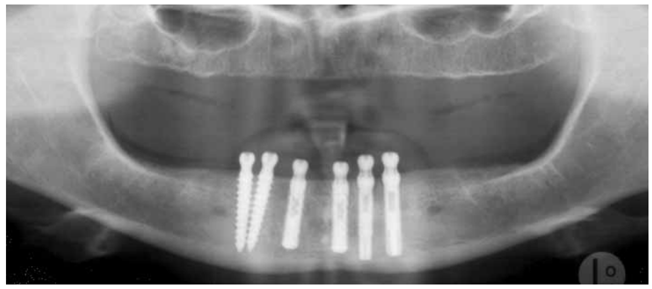

Figure 1b: Radiograph of the same patient as in 1a at three year follow up.

Figure 1c: Clinical appearance of patient in fig 1b at three year follow up.

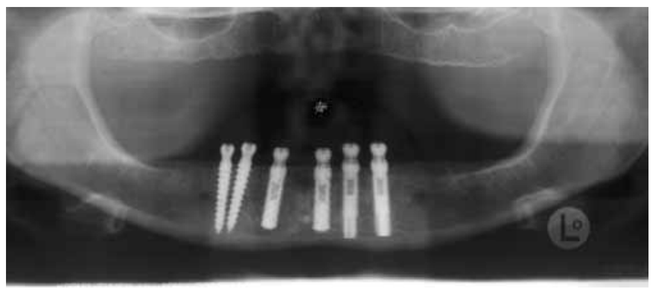

Figure 1d: Radiograph of the same patient as in 1a at five year follow up.

Figure 1e: Clinical appearance of patient in fig 1b and 1c at five year follow up.

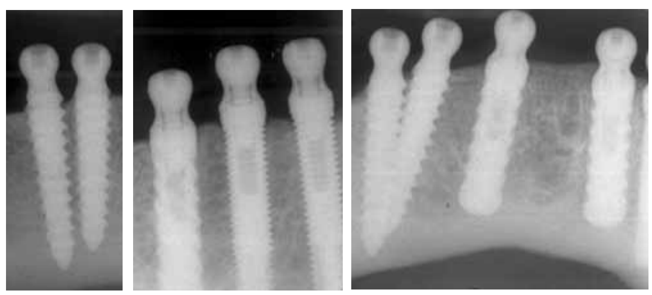

Figure 1f: Figure 1g: Figure 1h:

Periapical radiographs of patient in 1e at five year follow up.

Figure 1i: Denture in situ.

new upper and lower acrylic resin denture was constructed on the ball abutment. Fabrication of the denture usually required three treatment sessions, after which follow-up care with relieving of pressure spots was performed. In all the cases, a conventional denture in the maxilla opposed the overdenture in the mandible. Patients were seen after one week, four weeks, three months, six months and subsequently every year for the duration of their follow up period.

Table 4 Illustrating the number of implants placed and the follow up time

	Patient	Follow up time (in months)	Number of implants placed	Remaining implants at time of follow up (%)
1	CH	66	6	6 (100)
2	JP	66	6	6 (100)
3	AE	66	6	6 (100)
4	DR	60	6	6 (100)
5	MDB	40	6	6 (100)
6	JM	40	6	6 (100)
7	AB	36	6	6 (100)
8	CB	36	6	6 (100)
9	PS	36	6	6 (100)
10	MF	12	6	4 (67)
11	HB	12	6	6 (100)
12	HO	12	6	6 (100)
			72 (total)	**70 (total)**

Data collection, clinical and radiographical parameters

Extensive clinical and radiological examinations were done postoperatively (Tables 1-3,5-7). Two weeks after prosthesis insertion, clinical and radiological baseline data were gathered with respect to the bone quality for implant survival and evaluation of the attachments. These included mobility, probing (sulcus) depth, attachment level and radiographical bone height. All measurements were repeated after one month, six months, one-year and then annually for the duration of the follow up period.

The assessment of mobility, scored 0 – 2 (Table 1), was done using two dental mirror handles and applying firm pressure in a mesial and distal direction. The values were expressed as a mean number.

The assessment of probing depth (sulcus depth), scored 0 – 2 (Table 2), was done using gentle probing with a Hu-Friedy periodontal probe (Hu-Friedy, Chicago, USA) to measure the distance from the marginal peri-implant mucosa to the deepest point of the peri-implant sulcus (at four locations per implant). The values were expressed as a mean number.

The marginal radiographic bone height measurements, scored 0 – 2 (Table 3), were assessed on periapical intraoral radiographs. The distance from the edge of the implant to the most coronal point of implant bone contact was determined by means of a calliper. The marginal bone level is expressed as a mean value for the mesial and distal sites.

Immobile implants without signs of peri-implant radiolucency on the radiograph were considered successful.

Results

Twelve edentulous patients were treated with six mandibular implants between the mental foramina (example Fig 1a, 1b and Fig 2a, 2b). A total of 72 implants were placed in 12 patients (Table 4). One of 12 patients lost two of the six implants initially placed. These implants (OCSI [LIBB]) were lost three months after placement due to gingival infection. These two OCSI (LIBB) implants were replaced after the bone was healed. All implants were located in keratinised mucosa.

Clinical measurements for the different patients reflect the mean values obtained for the different scoring parameters. Plaque indexes were not individually accessed, as other parameters, as bone height, mobility and probing depth were considered more consistent assessment tools8 (Table 5, 6 and 7).

The clinical and radiographic data showed no mobility of the implants apart from the two OCSI (LIBB) units that were lost (Fig 1a to 1i and Fig 2a to 2d). Marginal bone levels hardly decreased from baseline over one year as post-operative remodelling and stabilized. The three and five year follow up results showed no further loss of bone height as indicated by the cumulative scores (Tables 6 and 7). Oral hygiene was adequate to excellent in all cases, resulting in healthy peri-implant soft tissues. Surgical complications, with the exception of the aforementioned loss of two implants, did not occur within the observation period.

Excluding the two OCSI (LIBB) implants, the cumulative chance on implant survival is 88.9% after 1-year [three

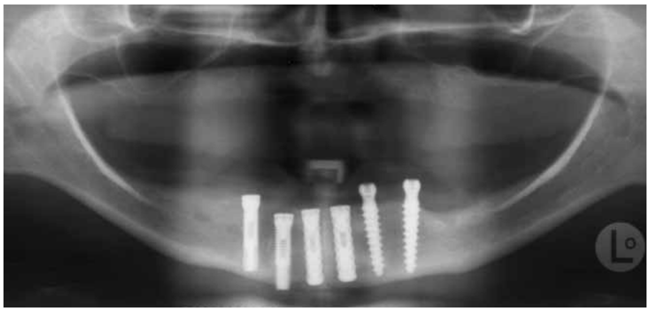

Figure 2a: Radiograph of another patient at two week follow up.

Figure 2b: Clinical appearance of patient in fig 2a at one year (fig 2b) follow up.

Figure 2c: Clinical appearance of patient in fig 2a at three year (fig 2c) follow up.

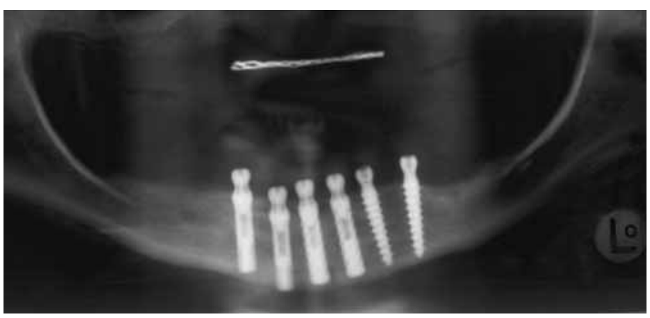

Figure 2d: Radiograph of patient in 2c at three year follow up.

patients] (Table 5), 95.7% after 3 years [eight patients] (Table 5 and 6) and 97.2% after 5 years [twelve patients] (Table 4, 5, 6 and 7).

Discussion

This study reports on the clinical performance of three different implant systems used in the same oral environment and under similar conditions over a period from one to five years. In general, favourable results were obtained for all the implants

Table 6: Results of five patients after three year follow up

Patient	Mobility	Bone height	Probing depth
MDB	0	0	0
JM	0	1	0
AB	0	0	0
CB	0	0	0
PS	0	1	0

Table 7: Results of four patients after five year follow up

Patient	Mobility	Bone height	Probing depth
CH	0	0	0
JP	0	0	0
AE	0	0	0
DR	0	0	0

Table 5: Results of three patients after one year follow up

Patient	Mobility	Bone height	Probing depth
MF	2	0	0
HB	0	0	0
HO	0	0	0

used in this study, both from an objective and from a subjective perspective. In all cases, the surgeon was able to place implants of the planned implant length and diameter at the predetermined sites. Early implant loss, as an exponent of surgical or other complications, occurred in one patient. We can only speculate about the reasons for these losses[9,10]. One patient lost two of her OCSI (LIBB) implants (non-submergible type) due to gingival infection and although these units were removed they were replaced later in the same area as the lost units.

The implant survival rate of 97.2% after five years is acceptable and comparable with observations by other authors. Healthy soft tissues were seen in conjunction with even reasonable oral hygiene. Hardly any bone loss between baseline and one-, three- and five-year observations occurred for any of the different implants. Probing depths (Hu-Friedy periodontal probe) and marginal bone levels did not change much between baseline and 60 months post-operative observations. Minor hypertrophy of the peri-implant mucosa did occur in some cases but was never severe enough to warrant surgical intervention. The expectation was that the probing depth measurements will increase as a consequence of the slight hypertrophy seen in some cases[11]. The fact that this does not seem to be the case, may indicate that assessment of probing depth in the presence of hypertrophy may reflect its inaccuracy as a measure of evaluation in implant dentistry[12]. Different views with respect to the ability to detect small marginal bone changes by means of periodical probing are expressed in the literature[8,13-15].

Consideration was given to the fact that the OCSI (LIBB) implants were minimal loaded early (after two weeks) following their placement. This was not considered significant as the denture was adjusted to avoid full direct contact with the implant in the first four months.

Conclusion

The results of this study indicate that the tested hypothesis holds true for all the implants tested under similar oral conditions and that the design of the implant does not affect its medium longevity or functional success.

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