OSSEOINTEGRATED TITANIUM PLASMA COATED IMPLANTS IN RECONSTRUCTION OF EDENTULOUS MANDIBLE

Brig PN AWASTHI^{*}, vsm, Lt Col PARAMJIT SINGH⁺

(Department of Dental Surgery, Armed Forces Medical College)

ABSTRACT

Fifteen patients underwent surgical insertion of titanium plasma sprayed screws in the mandible ridge over the symphysis region. In 3 patients, along with the screws in the symphysis region, hollow basket implant type 'H', one each in the mandible first/second molar region were inserted. Implants were fixed only in those patients who had retention and stability problems of mandibular artificial denture. Indication, technique and biocompatibility of titanium implants and tissue supported over denture have been discussed.

MJAFI 1997; 53 : 202-206

KEYWORDS: Mandibular artificial denture; Plasma coated titanium implants; Stability.

Introduction

Over the past several decades an astonishing number of shapes and ideas have been created in the field of oral implants [1]. In May 1982, at a conference held in Toronto, the North American dental profession was introduced to bone implant interface, which was called "osseointegration" [2,3]. This new concept included the use of biocompatible materials, precisely adapting the implant to the prepared bony site, atraumatic surgical procedure, an immobile and undisturbed healing phase and delayed loading and a two-stage surgical protocol with submerged implants which are unloaded during the healing phase of 3 to 6 months. This necessitated a second surgical procedure for uncovering the implants at a later date. The knowledge gained from the experience of the Swedish team was also utilized in the development of other systems currently available in the market.

The International Team for Implantology (ITI) dental implant system developed by Schroeder and co-workers [4-6] is a single-stage, nonsubmerged system and has proved that osseointegration can be predictably achieved without the need to bury the implant, thus eliminating the need for a second surgery. Titanium and titanium-aluminium-vanadium alloy systems have emerged as the materials

perceived to have the best biofunctionality. Patients treated with the ITI system of implants are discussed in this paper.

Material and Methods

The primary consideration of selecting patients for the implantation procedures in our study was the insufficient retention of the lower denture which in general was due to resorption of the alveolar crest following tooth extraction.

The study was carried out in three phases -- the implantation procedure, prosthetic construction, and rehabilitation and follow-up.

In the first phase 15 patients were selected for the insertion of titanium plasma sprayed (TPS) implants in the mandibular symphysis region and 3 patients were selected for the insertion of hollow basket implants in mandibular first and second molar region (3 mm posterior to mental foramen) along with TPS implants in symphysis region. Thus a total of 18 cases were studied. In the second phase only 15 of these patients were provided prosthesis as in 3 cases the implants were rejected before the patients could be given any prosthesis. In one patient the implants were rejected after insertion of complete lower denture. In all the 4 patients where implants failed, no trial was given for its reinsertion as the patients showed

^{*}Professor & Head, Dept of Dental Surgery, Armed Forces Medical College, Pune - 411040; ⁺Classified Specialist (Prosthetic Dentistry), 2 Corps Dental Unit, C/o 56 APO.

unwillingness.

Before selecting the patient for this study all the factors leading to impairment of bone and soft tissue healing were ruled out. Radiological examination was carried out and only those patients having more than 12 mm vertical symphyseal height was selected for TPS implants. For hollow basket cylinder implants only the 'H' type implants were used and the ridge height above inferior alveolar canal selected for this study was 9 mm with 5 mm width and 10-12 mm mesiodistal length just posterior to mental foramina. All the pre-operative, operative and follow-up findings were recorded in a specially designed proforma. Upper and lower arch study casts were made and template prepared to assess the problem of retention and stability and for proper placement of implant in the mandibular ridge. TPS screw implants of 11, 14 and 17 mm sizes and hollow basket type 'H' implants were used in this study.

Prosthetic rehabilitation

Doldar bar with onlay denture was given in 11 patients who were fitted only with TPS screws. After the implants were surgically seated in the mandible and before the surgical flap was sutured impression were made in irreversible hydrocolloid impression material (Zelgan). The surgical area was sutured and packs given. Master casts were made in stone plaster. Wax copings were prepared on the model which were joined by a wax bar. The pattern was cast and finished in NP₂ alloy by standard techniques. The copings along with the doldar bar was cemented with a glass ionomer cement within 24 hours of the implantation. This had the advantage of providing stability to the implants. After 12-14 weeks upper and lower dentures were made using standard techniques.

The lower denture was relined by soft liner for better fit over the bar attachment. In 4 cases a metal clip attachment was placed in the denture over the doldar bar to prevent wear-out of acrylic by the metallic bar copings.

Results

Out of 3 patients with TPS screws and hollow basket implants, a complete lower 14-teeth bridge was given to one and full lower onlay dentures were given to the remaining 2 patients.

Fig 1 and 2 show a patient where complete lower 14-teeth bridge was fitted on 2 TPS screws and 2 hollow basket implant type 'H'. In another

Fig. 1: Radiograph of mandible showing one titanium plasma sprayed screw, one hollow cylinder type 'C' implant and 2 type 'H' hollow basket implants *in situ* with doldar bar.

Fig. 2: Photograph showing full lower arch 14-teeth bridge on the implants as shown in Fig 1.

Fig. 3: Radiograph showing 3 titanium plasma sprayed screw implants with chromium cobalt framework *in situ*.

TABLE 1

Showing subjective condition of the patient

Clinical parameter	Group A		Group B		Chi square	df	P-value
	Yes	No	Yes	No			
Is the implant doing well?	12 (80%)	3 (20%)	2 (66.7%)	1 (33.3%)	0.26	1	0.55 (exact)
Are you having pain on eating?	0 (0%)	12 (100%)	1 (33.3%)	2 (66.7%)	4.29	1	< 0.05
Is your bite okay?	12 (100%)	0 (0%)	2 (66.7%)	1 (33.3%)	4.29	1	< 0.05

TABLE 2

Showing the condition on examination

Clinical parameter	Group A		Group B		Chi square	df	P-value
	Yes	No	Yes	No			
Redness or tenderness of gingiva on palpation	3 (20%)	12 (80%)	1 (33.3%)	2 (66.7%)	0.26	1 (exact)	0.55
Tenderness on percussion	0 (0%)	12 (100%)	1 (33.3%)	2 (66.7%)	4.29	1	< 0.05

Fig. 4: Photograph showing anterior 6 teeth bridge with bilateral free end saddle denture.

patient an anterior fixed partial denture (6 teeth) with cast bilateral free end saddle removable partial denture was made over the 3 anterior implants (Figs 3,4).

Patients in whom dental implants were inserted in symphysis region only were grouped as 'A' and

TABLE 3

Showing gingival mobility on clinical examination

Gingival mobility	Group A	Group B	Stratum odds ratio
None	8 (53.4%)	1 (33.3%)	1.00
Slight	4 (26.7%)	1 (33.3%)	0.50
Moderate	1 (6.66%)	0	0.38
Severe	2 (13.33%)	1 (33.3%)	

Note: Rows 3 and 4 have been clubbed for statistical analysis; chi square for linear trend = 0.41; exact p value = 0.52

those cases where implants were used in symphysis and molar region were termed as group 'B' for the purpose of this study.

Parameters used to evaluate each implant inserted in our study are given in Tables 1-3. The post-operative follow-up period varied between 6-40 months. The successful implants were relatively firm, generally comfortable without any progressive bone loss and capable of effectively supporting the prosthesis during the entire period of our study [7]. Table 4 shows the condition of the prostheses on clinical examination whereas Table 5 gives the comparison of the radiographic bone loss in the two groups.

TABLE 4

Showing condition of prostheses on clinical examination

Clinical condition of prostheses (occlusion) or on probing	Group A		Group B		Chi square	df	P-value
	Yes	No	Yes	No			
Central prematurities	0 (0%)	10 (100%)	0 (0%)	1 (100%)	*	*	*
Interferences lateral excursion	0 (0%)	8 (100%)	0 (0%)	1 (100%)			
Midbuccal pocket on probing	0 (0%)	8 (100%)	0 (0%)	1 (100%)			

* Data in the above table was not amenable to statistical analysis since the results were similar in both groups (0% versus 100% for all clinical parameters)

TABLE 5

Comparison of the radiographic bone loss in the two groups

Extent of radiographic bone loss	Group A	Group B	Stratum odds ratio
Upto neck	8 (53.4%)	1 (33.3%)	1.00
Upto shoulder	2 (13.3%)	1 (33.3%)	0.25
Below shoulder	2 (13.3%)	Nil	0.63
Circumferential	3 (20.0%)	1 (33.3%)	
Total	15 (100%)	3 (100%)	

Note: Rows 3 and 4 have been clubbed for statistical analysis; chi square for linear trend = 0.12; exact p value = 0.73

Discussion

At a meeting of the ITI in Switzerland, a joint reporting of cases was carried out [8]. The presentation was representative of data from the United State, Switzerland, Sweden and Germany. This meeting reviewed 1739 screw implants in 484 patients. They were in place up to 96 months (8 years) with average of 32.6 months. The absolute percent age of implants remaining in function was 94.1 per cent. In our study 42 TPS screw implants in 15 patients were given. They were in place up to 40 months with a range between 6-40 months. The absolute percent of implants remaining in function was 76.2 per cent. The other type of implants used were TPS screws with endosteal hollow basket implants with fixed bridge in one patient and onlay denture in the other two. Although the endosteal blade-vent implant has the advantage of being

adaptable to a relatively thin and shallow alveolar ridge from biomechanical stand point it does not have an ideal design. Peak pressures tend to develop at the neck of the implant under function and result in bone resorption in most vulnerable region. A more ideal design would feature an anchoring surface with the greatest possible area to distribute the occlusal forces and minimize the specific pressure. Under such circumstances favourable conditions in the bone, can be achieved with a bone metal interface rather than an interposed connective tissue layer. Both screw and cylinder design fulfil these objectives.

Treatment with hollow basket implant has been well documented for over 10 years and has been used in the United States since 1981. This proves the efficacy of this implant. In a series of cases reported from Switzerland, Sweden, Germany and the United States, 580 hollow cylinder implants were used for up to 10 years with an overall rate of success at 95.3 per cent [8]. In our series only 6 hollow basket implants were used with 66.6 per cent success rate.

As per the literature and the manufacturer's instructions prefabricated gold codings are used over the implants which are joined by a gold bar. However, seeing the financial constraints and with the objective of providing this mode of treatment for the poor, gold coping's and gold bar were not used in this study. Codings and bar attachments were cast in our laboratory with NP2 alloy. This reduced the cost tremendously.

A recent study by Weber et al [9] has shown radiographically that crestal bone levels adjacent to nonsubmerged ITI implants are comparable to

the Branemark type implant at 1- and 2-year follow-up visits. The simplicity of the restorative phase is also an advantage of the ITI system.

REFERENCES

1. Meshram S, Lalla R. Dental implants: An over view. *Journal of Indian Dental Association* 1995; 66: 108-11.
2. McGlumphy CA, Laisen PE. *Contemporary Oral and Maxillofacial Surgery*. 2nd ed. St Louis: Mosby 1993; 370-2.
3. Adell R, Lekholm V, Rockler B, et al. A 15-year study of osseointegrated implants in the treatment of edentulous jaw. *Int J Oral Surg* 1981; 10: 387-416.
4. Schroeder A, Vander Zypen E, Stich H, et al. The reaction of bone, connective tissue and epithelium to endosteal implants with sprayed titanium surfaces. *J Maxillofac Surg* 1981; 9: 15-25.
5. Sutter F, Schroeder A, Buser D. The new concept of ITI hollow-cylinder and hollow-screw implants. Part I Engineering and design. *Int J Oral Maxillofac Implants* 1988; 3: 151-2.
6. Buser D, Schroeder A, Sutter F, et al. The new concept of ITI hollow-cylinder and hollow-screw implants. Part 2. Clinical aspects, indications and early clinical results. *Int J Oral Maxillofac Implants* 1988; 3: 173-81.
7. Smith D, Zarb GA. Criteria for success for osseointegrated endosseous implants. *J Prosthet Dent* 1989; 62: 567-72.
8. Babbush CA. Titanium plasma screw implant system and endosteal hollow cylinder implant system. *Dent Clin North Am* 1986; 30: 133-49.
9. Weber HP, Buser D, Fiorellini JP, et al. Radiographic evaluation of crestal bone levels adjacent to non-submerged titanium implants. *Clin Oral Implant Res* 1992; 3: 181-8.