EVALUATION OF SPLINTING ON IMMEDIATELY LOADED IMPLANTS IN MANDIBULAR OVERDENTURE PATIENTS

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INTRODUCTION

Since the advent of dental implants, trials were done to ensure its success and decrease the susceptibility of failure. Success of implants denotes its proper osseointegration, which is affected by many factors, biological, mechanical, local or even general. Stability of the dental implants in the early stage following its placement is very important for the process of bone formation.

Stability of implants becomes mandatory when immediate loading is proposed for. To satisfy this requirement several authors tried to use bars to splint the implants. The bar connecting the implants helps to stabilize the implants, antagonize lateral stresses, distributes the load widely avoids its concentration. But, still the use of bars is an extra-work needs precision and well trained technicians.

The use of free standing implants with attachments on the other hand can be used with immediate loading, but under some precautions to avoid bone resorption resulting in implant failure especially under immediate loading.

This means that under immediate loading the two implant treatment modalities bar splinting and free-standing can be applied but which of the two treatment modalities is more safe from the view point of bone changes?

AIM OF THE STUDY

The aim of this study is to evaluate the effect of splinting on immediately loaded implants coated by calcium phosphate (FBR)[7] in mandibular overdentures.

Methods of evaluation:

1. Clinical evaluation:
   - Mobility using periotest.
   - Gingival Index.
   - Probing depth.
2. Radiographic evaluation:
   - Marginal bone height changes.
   - Marginal bone density changes.

INTRODUCTION

The use of dental implants has increased tremendously in recent years and is expected to increase even more in the future (Worthington B, 1988).

The use of implant retained and supported removable prosthesis especially in edentulous mandibles can greatly improve the quality of life for patients who have not been able to function effectively with conventional complete dentures (Beumer III et al, 1989).

Implant retained overdentures have been found to offer a highly effective means of oral rehabilitation for the atrophic mandible, restoring both oral and facial form (Chan MF, 1995).

Osseointegration of dental implants is essentially a close apposition between living bone and the surface of the functioning implant. Achieving such a state depends upon a healing period, after implant placement, of 3 to 6 months before fabrication of the final prosthesis. It was postulated that during this stage the implants are to be left totally unloaded to attain Osseointegration (Adell E et al, 1981; Branemark PI, 1983; Branemark PI, 1985).

The healing period is often psychologically and socially unacceptable for many patients (Salama H et al, 1995; Schnitman P et al, 1997).

With the introduction of self tapping and self threading implant designs; the primary stabilization of implant fixtures (an important factor for achieving osseointegration) (Piatelli A et al, 1993) opened the door for decreasing or even eliminating the healing period.

Efforts were made to overcome the drawbacks of the conventional two stage submerged or non submerged implant treatment modalities as well as those of the provisional immediate implant treatment modality. These efforts has led some authors and clinicians to advocate the trend of immediate loading of implants with the prosthetic appliance rather than waiting for the standard recommended period for osseointegration to occur.

The immediate loading principle was recommended by many authors (Salama H. et al, 1995; Schnitman P.A. et al, 1997; Piatelli A. et al, 1993; Tarnow D.P. et al, 1997; Andre Gomes D. et al, 1998; Shararah E. et al., 2000).

Several authors have indicated that splinting was a mandatory factor for the success of immediate loaded implants. These experiences have exclusively utilized several splinted implants through bar structures and/or fixed provisional prosthesis (Salama H. et al, 1995; Balshi T.J. et al, 1997; Gatti C. et al, 2000; Jaffin R.A. et al, 2000). The success of these techniques seems to be dependent on the ability to control implant micromotion through splinting during the healing period (Andre Gomes D. et al, 1998).

A recent case report also confirms the validity of the applied treatment concept to immediately loaded titanium implants with a plasma. Sprayed surface in the anterior region of the mandible provided the ability of inserting four implants that are splinted with a bar (Lederman P.D. et al, 1998).

However, others have achieved success with immediately loaded freestanding implants (Andre Gomes D., 1998; Piatelli A., 1997; Shararah E. et al, 2000).

Moreover, a study was undertaken to evaluate the predictability of four unsplinted free standing self-tapping screw implants; with a ball and socket abutment design. The conclusion was that immediate loading od such a case is a safe and reliable method for management of the completely edentulous mandible (Shararah E. et al, 2000).

Additionally, many manufacturers have introduced new fixture surfaces indicating their ability to achieve faster bone regeneration, thus allowing immediate implant loading (S. Szmukler-Moncler D. et al, 2000; Zegger P., 2000).

Many coating materials were tried and recently newly developed calcium phosphate coating was introduced and showed promising results (Lozada J., 1993; S. Szmukler-Moncler D. et al, 2000; Zeggel P., 2000; Eser Tufekci et al, 1999).

This study is concerning with establishing evidence based data on the necessity of splinting for long term success of immediate loaded implants in cases of mandibular implant retained overdenture, both utilizing and evaluating the newly

introduced surface of calcium phosphate coating on achieving short term osseointegration.

Literature Review

I. IMMEDIATE LOADING

To minimize the risk of implant failure, osseointegrated oral implants are conventionally kept load-free during the healing period. During healing the removable prosthesis are used, however many patients find these temporary prosthesis rather than uncomfortable and it would be beneficial if the healing period could be shortened without jeopardizing implant success. The immediate restoration of loading of dental implants has therefore became an intense area of clinical trial and research in the field of dental implantology over the last several years (Petrungaro P.S., 2002). Many studies were conducted to find out whether there is a difference in success rates between immediately or early loaded implants compared with conventionally loaded implants. Although most of the studies were related to fixed prosthesis, some still addressed removable implant retained overdentures, that showed favorable results with immediate loading (Gatti C. et al, 2000; Chiapasco M. et al, 1997).

Esposito et al (2003), conducted an extensive review of studies reporting immediate, early and delayed loading of osseointegrated implants. The authors concluded that while it is possible to successfully load oral implants immediately after their placement in mandibles of adequate bone density and height in carefully selected patients, it is yet unknown how predictable this approach is. They recommended further well designed studies to understand how predictable immediate and early loading are.

Immediate loading of a dental implant not only includes a nonsubmerged one-stage surgery but actually loads the implant with a provisional restoration at the same appointment or shortly thereafter. Immediate loading was the initial protocol suggested with dental implants. These implants yielded a wide range of clinical survival (Strock A.C. et al, 1939; Linkow L.I., 1968; Cranin A.N. et al, 1977; Smithloff M. et al, 1976; Kapur K.K., 1987). On the occasion, a direct bone interface could be developed and maintained for more than 20 years (Biglani M. et al, 1996).

Initial studies of immediate loading, with a primary goal of a direct bone implant contact, have been proposed in completely edentulous patients for overdentures. These studies have been encouraging results. Babush et al described completely edentulous patients with overdentures in 1986. Four threaded implants were inserted in the anterior mandible and splinted together with a bar and clip system 2 months after implant insertion. The authors reported an 88% implant survival over an 8-year period with 1,739 implants. Chiapasco et al. (1997) reported 226 consecutive mandibular overdenture patients with 904 implants inserted between the mental foramina and an average of 6.4 years of function with 96.9% implant survival. More recent reports about the use of overdentures by Gatti et al. (2000) and Chiapasco et al. (2001)continued to demonstrate implant survival rate above 96%.

Immediate loading for completely edentulous mandibles was reported by Schintman et al. in 1990 using 28 screw-shaped implants to support a fixed prosthesis in 10 patients.() Later, Henry and Rosenberg (1994) evaluated immediately loading for mandibular completely edentulous patients with a prospective clinical trial. In 1995, Salama et al. described two cases, and in 1996, Biglani and Lozada did a retrospective

report of four completely edentulous patients after 3 to 6 years of function, and both articles found a 100% implant survival. In 1997, Tarnow et al. presented 10 edentulous patients in both the maxilla and mandible over a 1- to 5-year period with a 97% survival of implants, which were immediately loaded and splinted together to support a full arch prosthesis.

Horiuchi et al (2000), reported that immediate loading of implant is as predictable as delayed loading in both mandibular and maxillary arches. However, the number of implants placed, their distribution and the type of rigid connection are critical considerations for immediate loading. Tarnow et al (1997) reported that when multiple implants were placed and splinted into a full arch form and immediately loaded, favorable results were obtained. concerning implant overdentures, Henry and Rosenberg (1994) suggested that controlled immediate loading of adequately installed, non-submerged implants, by re-insertion of a modified denture, does not appear to jeopardize the process of osseointegration in the anterior mandible.

The peri-implant tissue response to immediately loaded implants was evaluated by Rungcharassaeng et al. (2002) Five patients (3 men, 2 women; mean age 61 years) each received 4 HA-coated endosseous root-form implants in the interforaminal region in the mandible supporting mandibular bar overdentures with opposing conventional maxillary complete dentures. Within the limitations of the study, the peri-implant tissue response of immediately loaded, HA-coated implants was favorable and comparable to that of conventional, delayed implants after 1 year.

Early implant loading has also been reported successful through many studies. Kronstrom et al (2003) described a 12-month evaluation of 17 consecutive patients with 68 conical Branemark implants placed between the mental foramina (4 implants per patient) according to a 1-stage surgical procedure. Fixed mandibular prostheses were connected to the implants on average of 33 days after implant placement. Clinical and radiographic examinations were performed at the time of placement of the fixed prosthesis and at a 12-month examination. Five implants were lost during the observation period, 3 before loading and 2 after prosthesis connection rendering an implant survival rate of 93%. One patient lost her prosthesis because of a failing implant. The average marginal bone loss was 0.24 mm.

Branemark (1999) reported excellent results with a clinical system developed specifically for an immediately loaded definitive fixed prosthesis using only 3 mandibular implants. This 3-year study documented survival rates of 98% for both the prosthesis and individual implants.

All implants used in these reports were a screw-type design with rough surfaces. Chiapasco et al. (2001) compared the results of immediate and delayed loading of implants with implant-retained mandibular overdentures. No significant differences were found between the two groups. The cumulative success rate of implants was 97.5% in both groups. Results from this study showed that immediate loading of endosseous implants rigidly connected with a U-shaped bar does not seem to have any detrimental effect on osseointegration. Conversely, this method significantly shortens the duration of treatment with relevant satisfaction for the patients.

As with implant-supported fixed prostheses, a waiting period of 3 to 6 months is usually indicated to obtain osseointegration, both for submerged and non-submerged implants. It is possible that this healing period may prove inconvenient to the patient, thereby discouraging pursuit of such treatment. As demonstrated by Ledermann (1983), and Gerber and Besimo (1991) rigid connection of 3 to 4 intraforaminal implants with a U-shaped bar can reduce micromovements, as in the situation of a 3 months delayed loading with an overdenture. the chiapasco et al. study (2001), showed that the percentage of direct bone-implant contact of immediately loaded implants was significantly greater than that of the non-loaded ones.

Reported results demonstrated that success rates may be correlated to the implant system used (Bergendal T. et al, 1998; Naret I. et al, 1994). The number of implants placed, their distribution, and the type of rigid connection used, appear to be critical in the immediate loading situation. The choice of 4 implants and a U-shaped bar to rigidly connect them is based on the assumption that this number can grant stability and avoid movement that may compromise osseointegration. A rigid bar is able to minimize rotational movements and transfer loads to the implants mostly in a vertical direction. This may reduce the risk of micromovement, with a subsequent lower risk of compromising osseointegration.

It is also important to observe the overdenture technique bar has been applied only in the intraforaminal area of the mandible and in cases of good bone quality (class I, II, or III). Whenever these conditions are not achieved, and where there is any doubt concerning primary stability of the placed implants, the standard 2-stage

technique is recommended. However, it seems important that the whole surface of the implant can be covered by bone and no statistically or clinically relevant differences could be detected between the test and control groups. The biologic knowledge is consistent with this conclusion (Chiapasco M. et al, 2001).

Preliminary results on immediate loading seem to indicate that immediately loaded implants, when rigidly splinted and used to support an overdenture prosthesis, performed no differently than implants placed and restored using the standard healing period (Testori et al, 2001).

A prospective study of Romero et al. (2002) designed to compare the results of immediate and delayed loading of implant retained mandibular overdentures after a 2-year follow-up. Twenty patients were randomly divided into two groups. Group I patients (test group) received four ITI implants in the intraforaminal area of the mandible. Two days after surgery, Octa abutments were immediately screwed on implants, the implants were rigidly connected with a U-shaped Dolder gold bar and loaded with an overdenture. Group 2 patients (control group) received, in the same area, the same type of number of implants, which were left to heal according to the standard protocol. At 3-4 months, Octa abutments were screwed on the implants and the same prosthetic procedure of the test group was applied. The minute follow up period lasted 2 years, with recall appointments at 2 weeks, 1, 2, 6 months, 1 year and every following year postoperatively. Only one implant out of the 40 of group 2 failed, whereas none failed in group 1. No statistical difference of the clinical parameters evaluated was noted in the two groups. Therefore, immediate loading of implant, if connected with U-shaped bar, can provide the same results as the

traditional technique as far as osseointegration and short-term survival rates of implants are concerned. Moreover, this method significantly shortens the treatment period, thus increasing patient satisfaction.

More recently, Misch et al. (2003) reported on a 5-year prospective study with Bi Horizon Maestro implant for completely edentulous patients. The transitional restoration was delivered at surgery or within 2 weeks for 31 patients. 244 implants were used in maxillae and mandibles. After 5 years, 100% implant survival and prosthesis survival was reported. The first year bone loss was 0.7 mm and the bone los up to 5 years later was 0.07 mm. The results are similar to those using a two-stage approach using the same system as reported by Kline et al. (2002) in a 5-year prospective study.

Also, other authors achieved success with immediately loaded free-standing implants.

A Piatelli et al. (1997) reported findings of two immediately loaded free standing titanium plasma-sprayed (TPS) implants, retrieved for a fracture of the abutment and for psychological results, after 8 and 9 months of loading, respectively. The microscopical analysis showed that mature, compact, cortical bone was present around both implants, with the bone implant contact percentage about 60 to 70%. No fibrous tissue or gap were present at the interface. No resorption was present in the peri-implant bone. On both implants a few osteoblasts were found positive at the interface for alkaline phosphatase (ALP); while no cells positive for acid phosphatase (ACP) were present. Immediate loading can,perhaps, be used in very selected cases of