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Evaluation of Immediate Functional Loading with Single Piece Implants

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ABSTRACT

Introduction: In recent years, implantology has increasingly advocated the concept of immediate loading, even with single implants. It is defined as the placement of a prosthetic restoration within 48-72 hours after implant placement. Among the other advantages of immediate loading like overall treatment reduction in timing, with function, cosmetic and psychological benefits for the patient. This case described a new surgical concept and a technique to fabricate screw-retained provisional crowns for immediate loading of free-standing single tooth implants. Hence the aim of this study is to evaluate immediate functional loading with single piece implants

Materials and Methods: For rehabilitation with basal implants in sites after immediate extraction, a 2-mm twist drill, the first cortex (alveolar) was drilled and then drilling was continued till the basal cortex (nasal floor/sinus floor/lingual cortex/pterygoid bone), which was perceived as a dip. For rehabilitation with compressive screw implants in healed edentulous sites, the compression screw implants in the upper and lower jaw were inserted with the primary aim of achieving stability through compression of trabecular bone along the vertical (endosseous) axis of the implant. Frequency tables and chi square tests were used to analyze the data.

Results: There were 30 patients with 76 implants present and assessed for this study. The mean age of the participants was 47.43±16.93. In the study participants, 30% of the participants had hypertension, 20% had diabetes mellitus and 20% had smoking habit. BCS and Compressive type of implants were both used in the study. In 51.32% sites, BCS implants were used and 48.68% sites Compressive type implants were used depending on the clinical situation. For the success of the implant, many criteria were assessed such as Implant stability quotient, mid-buccal gingival level and inter proximal gingival papilla, absence of complications (pain, discomfort, infection, bone loss and mobility).

Results showed that there was a significant association found between diabetes mellitus with mobility, bone loss and discomfort. Contrastingly there was no association between smoking habit and any of the complications affecting the success of the implant. This showed that systemic disease plays a major role in the success of the implants.

Conclusion: The high cumulative implant survival rate for the devices and the technology of the Strategic Implant® indicates (within the limitations of this study) that the immediate functional loading concept with cortically anchored implants or implants providing corticalization of spongious bone for the rehabilitation of partially edentulous segments and for single-tooth replacement in maxilla and mandible can be a viable concept even in cases where extractions of teeth were done simultaneously.

Keywords: Single implants, immediate loading, Compressive implants, implants, BCS implants

INTRODUCTION

Branemark and colleagues showed the osseous wound healing using the titanium chamber gave rise to the concept of osseointegration. He demonstrated the ability of natural bone to accept implanted titanium during its remodelling stages leading to osseointegration [1]. It implies a film, direct and lasting connection between vital bone and screw-shaped titanium implants of defined finish and geometry - fixtures. Thus, there is no interposed tissue between fixture and bone[2].

Osseointegration can only be achieved and maintained by a gentle surgical installation technique, a long healing time and a proper stress distribution during in function[3]. The successful outcome of any implant procedure is mainly dependent on the interrelationship of the various components of an equation that includes the Biocompatibility of the implant material, Macroscopic and microscopic nature of the implant surface & designs, surgical technique etc. Branemark's original protocol recommends complete healing of the alveolar bone prior to placing a dental implant after tooth extraction and this process requires a minimum period of 6 to 12 months. [1,4]

This obvious disadvantage of the procedure leaves the patient with no teeth or with a removable temporary prosthesis, and hence, many patients, at times, do not choose this option at all [5,6]. Dental implants, when placed in the basal bone, can be immediately loaded with teeth, as this bone is very strong, never gets resorbed throughout the life, and forms the stress-bearing part of our skeleton[7]. Since the cortical walls around the extraction site are stable at the time of extraction, placement of implants into fresh extraction sockets is more successful than placement after few months[8]. There are two different approaches for immediate loading of dental implants. First one is on the principle of compression screw, whereas the other is on the cortical anchorage of thin screw implants (bicortical screw [BCS])[9].

The first approach relies on the compression screw principle. Screw implants of this type can result in lateral condensation of spongy areas. Implant stability is greatly increased by a mechanism that could be regarded as "corticalization" of the spongy bone (KOS)[10]. The second approach is to establish cortical anchorage of thin screw implants [bicortical screw (BCS)] or basal implants. Excellent primary stability can be obtained along the vertical surfaces of these implants with no need for corticalization. Implants of this type are, therefore, well suited not only for immediate loading but also for immediate placement[11].

In BCS implant, the implant is anchored to the basal/cortical bone which is useful in cases of severe alveolar ridge resorption, when bone grafting is prohibited due to the patient's general medical condition and when a more conservative treatment with lower cost is needed[12].

BCS® implant is a special type of basal implant, consisting of one piece that is inserted through a crestal approach, just like the other endo-osseous implants and then anchored deeply inside the basal bone. Lazarov revealed in a prospective cohort study that the use of Strategic Implant® prosthesis (BECES/BCS, KOS, KOS Plus, and BOI) is a safe and efficient procedure with a high success rate and without peri-implantitis. He followed up 1019 BECES/BCS cases for more than 48 and up to 57 months and reported a cumulative survival rate of 97.5% [13,14]

In recent years, implantology has increasingly advocated the concept of immediate loading, even with single implants. It is defined as the placement of a prosthetic restoration within 48-72 hours after implant placement[15,16]. Among the other advantages of immediate loading like overall treatment reduction in timing, with function, cosmetic and psychological benefits for the patient[17,18]. Gomez et al.

published in 1998 the first case report of immediate loading on single tooth. Specifically, authors analyzed the clinical aspects of the immediate loading of a single hydroxyapatite-coated threaded root form implant[19]. This case described a new surgical concept and a technique to fabricate screw-retained provisional crowns for immediate loading of free-standing single tooth implants. Authors concluded that further clinical studies were necessary in order to promote routine clinical application of this technique[20]. Hence the aim of this study is to evaluate immediate functional loading with single piece implants

MATERIALS AND METHOD

Patients who visited the outpatient section of Department of Oral and Maxillofacial Surgery in Thai Moogambigai Dental College were enrolled in the study after prior consent. Ethical clearance was obtained prior to study from the Institutional ethical committee. The patients were enrolled in supportive treatment including recall visits once every month.

Inclusion criteria:

- Patients with the age between 18-80 were included in the study
- Patients who were willing for implants and reluctant to wear removable prosthesis
- Patients with fair oral hygiene
- Patients who do not have any major systemic disease/limiting condition in which surgery is contraindicated

Exclusion criteria:

- Incompliant patients with poor oral hygiene, psychoses, parafunctional habits, TMJ disorder and substance abuse
- Insufficient vertical inter arch space to accommodate the prosthodontic components available

Surgical technique:

For rehabilitation with basal implants in sites after immediate extraction, a 2-mm twist drill, the first cortex (alveolar) was drilled and then drilling was continued till the basal cortex (nasal floor/sinus floor/lingual cortex/pterygoid bone), which was perceived as a dip. The 2nd or 3rd cortex to be involved was decided on the basis of site involvement in the jaw. For placing implants at the site of maxillary central incisors, lateral incisors, and canines, nasal floor / palatal bone was engaged. In the region of maxillary premolars, nasomaxillary buttress was engaged and in the maxillary molars region, pterygoid plates of the sphenoid bone was engaged. In both the jaws, the implants were placed with the primary aim of cortical anchorage of the load transmitting thread at least in the second/third cortex

For rehabilitation with compressive screw implants in healed edentulous sites, the compression screw implants in the upper and lower jaw were inserted with the primary aim of achieving stability through compression of trabecular bone along the vertical (endosseous) axis of the implant. When compression screw implants were planned, sequential bone expansion was done with bone expansion screws depending on tactile sensitivity of the nature of bone. The expansion of bone was done with expenders of 1mm to 1.5mm shorter than the actual diameter if the implant to be placed.

It was left fully to the decision of the treatment provider, which implant type would be used in the individual patient and at which individual site. Treatment was provided on the basis of panoramic pictures or computed tomography data.

Tilting was done in the necessary directions to accommodate the restoration in proper occlusal scheme. After the placement of implant, the implant neck was bent if required to give proper alignment for optimal prosthetic rehabilitation.

On 3rd day, the completed metal ceramic veneered prosthesis was fixed using GIC luting cement and occlusal adjustments if required were adjusted. In all cases, the implants were splinted/fixed within

maximum of 72h. Segment bridges and individual crowns in both the jaws were installed in full functional loading.

In all the cases primary stability in compressive and bicortical screw implants was achieved initially and confirmed with the implant torque wrench. Percussion test was done as another confirmatory test, depending on the resonance heard by the thud made with the metallic instrument on the implant we confirmed that the implant is "in the cortical" or placed with adequate corticalization of spongy bone in cases of compressive screw implants. Primary stability is obtained due to its self tapping property.

Periodic follow up was done to check the stability of the implant, rate of osteointegration, gingival changes, esthetics. Post operative radiographs were taken as routine investigation on 1 month, 3 and 6 months and results were tabulated. Frequency tables and chi square tests were used to analyze the data.

RESULT

There were 30 patients with 76 implants present and assessed for this study. The mean age of the participants was 47.43±16.93. There were 10% participants in 18-25 years, 46.67% in the 26-50 years and 43.33% in the 51-80 years age group respectively (figure1). There were 80% males and 20% females present in the study.

In the study participants, 30% of the participants had hypertension, 20% had diabetes mellitus and 20% had smoking habit.

Out of 76 implants that were assessed, 92.11% implants had bending done, 76.32% implants had splinting done (figure 2,3). Also extraction was performed in 56.58% sites and abutment was trimmed in 56.58% of the implants.

BCS and Compressive type of implants were both used in the study. In 51.32% sites, BCS implants were used and 48.68% sites Compressive type implants were used depending on the clinical situation.(figure 4).

For anchorage, in 48.68% sites alveolar bone corticalization was used for compressive implants, 23.68% sites nasal cortex and in 15.78% palatal cortex was used for support for BCS implants. (table 1)

For the success of the implant, many criteria were assessed such as Implant stability quotient, mid-buccal gingival level and inter proximal gingival papilla, absence of complications (pain, discomfort, infection, bone loss and mobility).

The implant stability quotient was measured immediately and 6 months post operatively the implant placement (table 2,3).

Midbuccal gingival level was assessed clinically post operatively after 6 months and it was observed that in 86% sites there was no difference in the gingival level, in 5% sites there were less than 1 mm difference in the gingival level and 9% had unsatisfactory results respectively. Similarly in interproximal gingival papilla assessment, 83% sites had complete closure, 8% sites were at the level of gingival papilla and 9% sites had unsatisfactory results.

All the complications were analysed after 6 months and some were reviewed and treated appropriately. Positively none of the cases had pain or local tissue infection. But 3.95% sites had mobility. Vertical and crater bone loss was observed radio graphically in 7.89% sites each. Those implants which had mobility and bone loss were replaced with new implants successfully with adequate cortical anchorage. 19.74% sites had slight discomfort 6 months after implant placement. The occlusal loading forces were adjusted/modified with Bausch articulating paper with progressive colour transfer until till there were no complications.

Results showed that there was a significant association between the type of implant placed and the anchorage which was done (table 4).

Under the category of presence of systemic diseases, there was no association found between hypertension with pain or mobility or local tissue infection. But there was a statistically significant association

between hypertension with bone loss and discomfort (table 5,6)

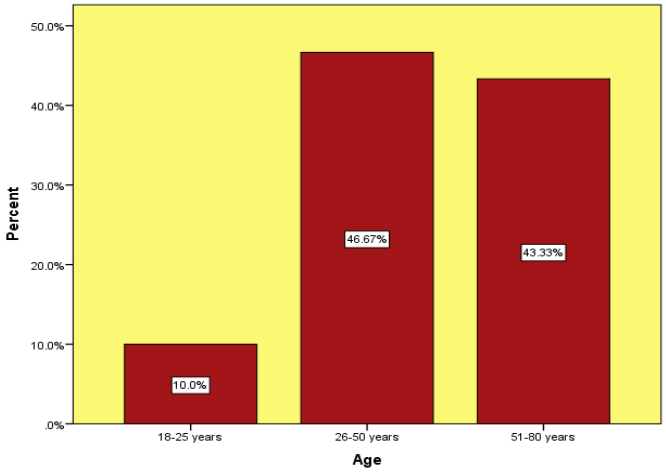

Figure 1 : Age groups of the study participants

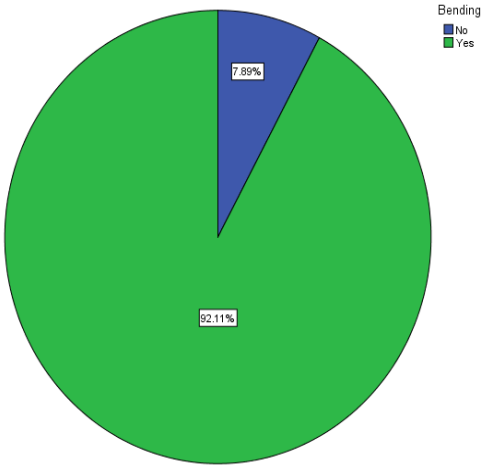

Figure 2: Bending status of the implants

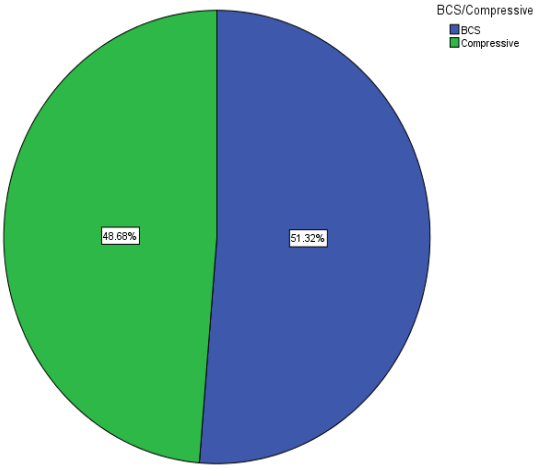

Figure 4: Type of the implants used in the study

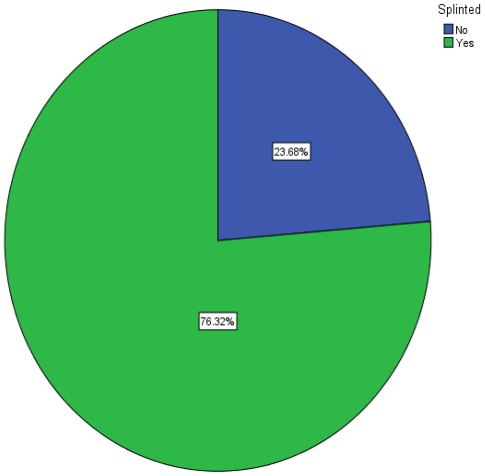

Figure 3: Splinting status of the implants

Table 1: Anchorage sites used in the study

Anchorage	Frequency	Percent
Alveolar bone corticalisation	37	48.68
Cortical Engagement Distal Mandible	3	3.94
Mandible InterForaminal Anchorage	6	7.89
Nasal cortex	18	23.68
palatal cortex	12	15.78
Total	76	100.0

Table 2: Frequency Table – Immediate Implant stability quotient

ISQ	Frequency	Percentage
48	6	7.89
54	8	10.52
55	10	13.15
56	15	19.73
58	11	14.47
60	13	17.1
62	6	7.89
64	7	9.21
Total	76	100

Results showed that there was a significant association found between diabetes mellitus with mobility, bone loss and discomfort (table 7-9). Contrastingly

there was no association between smoking habit and any of the complications affecting the success of the implant. This showed that systemic disease plays a major role in the success of the implants.

Table 3: Frequency Table – Post operative Implant stability quotient (after 6 months)

ISQ	Frequency	Percentage
68	7	9.21
70	10	13.15
72	9	11.84
74	11	14.47
75	15	19.73
76	11	14.47
78	13	17.1
Total	76	100

Table 4: Chi square tests between the type of implant placed and the anchorage

Type of implant and anchorage	Alveolar bone corticalisation	Cortical Engagement Distal Mandible	Mandible Inter Foraminal Anchorage	Nasal cortex	palatal cortex	Total	Chi square value	P value
BCS	0	3	6	18	12	39	76.000[a]	0.000
Compressive	37	0	0	0	0	37		
Total	37	3	6	18	12	76		

Table 5: Chi square tests between the hypertension and bone loss among study participants

Hypertension	Bone loss			Total	Chi square value	P value
	Crater	No	Vertical			
Absent	6	39	6	51	6.985[a]	0.03
Present	0	25	0	25		
Total	6	64	6	76		

Table 6: Chi square tests between the hypertension and discomfort among study participants

Hypertension	Discomfort		Total	Chi square value	P value
	No	Yes			
Absent	36	15	51	9.161[a]	0.002
Present	25	0	25		
Total	61	15	76		

Table 7: Chi square tests between the diabetes and mobility among study participants

Diabetes mellitus	Mobility		Total	Chi square value	P value
	No	Yes			
Absent	67	0	67	23.251[a]	0.001
Present	6	3	9		
Total	73	3	76		

Table 8: Chi square tests between the diabetes and bone loss among study participants

Diabetes mellitus	Bone loss			Total	Chi square value	P value
	Crater	No	Vertical			
Absent	3	64	0	67	61.632[a]	0.000
Present	3	0	6	9		
Total	6	64	6	76		

Table 9: Chi square tests between the diabetes and discomfort among study participants

Diabetes melitus	Discomfort		Total	Chi square value	P value
	No	Yes			
Absent	61	6	67	41.516[a]	0.000
Present	0	9	9		
Total	61	15	76		

DISCUSSION

Dental implant also called as fixture or endosseous implant is a surgical component which is known to interface with bone of the jaw or the skull through osseointegration[21]. The success rate of the implant is determined based on the health of the oral tissues and also health of the individual.

Recent reports have demonstrated the successful placement of dental implants into the fresh extraction socket in the anterior as well as in molar regions. The technique was made possible due to developments in implant surface[22].

The main aim of this study is to evaluate single piece implants in immediate functional loading. Many authors concluded that placement of single piece implants in immediate functional loading is a predictable treatment and can be indicated. (Lindeboom et al)[23]

In our study we rehabilitated 30 partially edentulous patients with single piece implants under immediate functional loading protocol. In all the cases primary stability in compressive and bicortical screw implants was achieved initially and confirmed with the implant torque wrench. Percussion test was done as another confirmatory test, depending on the resonance heard by the thud made by the metallic instrument on the implant we confirmed that the implant is in the corticals or placed with adequate corticalization of spongy bone. Primary stability is obtained due to its self tapping property.

Due to planned tilting, the implant's thread can be anchored in dense bone structures (especially in the lingual cortical of the distal mandible, the nasal floor, and the pterygoid plate of the sphenoid bone) and well spread anteriorly-posteriorly, giving an effective supporting polygon[24] marked by four strategic positions. No published clinical studies have investigated immediate loading multiple screwable cortical implants, fixated in the second and third cortical as support for fixed complete arch restorations in the maxilla. This concept of using highly mineralized bone which is far away from the location of the later teeth is best visible on tuberopterygoid implants[25].

In our study all patients were administrated pre and post operative antibiotic doses during the implant therapy. The above protocols have permitted obtaining a correct osseointegration between titanium structures and bone, regardless of whether its placed in healed/extraction site, the existence of previous infections. Fabrication of functional and aesthetically pleasing restoration is a vital part in the rehabilitation of our all patient. After cementation of the permanent crown, the soft tissue contours were healed in harmony with the adjacent teeth. 6 months follow-up revealed stable, healthy peri-implant soft tissue and a satisfied patient.

CONCLUSION

Within the limits of the study, the following conclusions can be drawn:

1. Immediate functional loading using multiple, cortically anchored screw implants as well as when using compression screw implants, as a support for fixed segmental and single tooth prosthesis in the upper and lower jaw demonstrated a high implant survival rate
2. When implants where tilted and the necks of the implants were subsequently bent, it did not affect the high survival rate and caused no clinically relevant bone fractures in that region.
3. BCS implant placement can be considered as a safe, effective and predictable treatment option for the restoration of fresh post extraction infected sockets when appropriate pre operative procedures are taken to clean and decontaminate the surgical sites.

The high cumulative implant survival rate for the devices and the technology of the Strategic Implant® indicates (within the limitations of this study) that the immediate functional loading concept with cortically anchored implants or implants providing corticalization of spongious bone for the rehabilitation of partially edentulous segments and for single-tooth replacement in maxilla and mandible can be a viable concept even in cases where extractions of teeth were done simultaneously.

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Conflict of Interest: None

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