EVALUATION OF BASAL DENTAL IMPLANTS IN POSTERIOR MANDIBLE

Mostafa M. Omar[1]* BDS, Riham M. Eldibany[2] PhD, Lydia N. Melek[3] PhD

ABSTRACT

INTRODUCTION: Dental implants provide a unique treatment modality for the replacement of a lost dentition.
OBJECTIVES: The aim of this study was to evaluate the placement of newly designed basal dental implant in the posterior mandible.
MATERIALS AND METHODS: This clinical study was conducted on 15 basal dental implants placed in 8 patients having missing lower posterior teeth. The patients were followed up clinically daily for the first week then weekly for the first month postoperatively regarding pain, edema and any post-operative complications. Radiographic evaluation was performed by cone beam computed tomography (CBCT) preoperatively, immediately and 3 months postoperatively. Periotest was used to determine implant stability immediately and 3 months postoperatively.
RESULTS: All the results were evaluated clinically, radioghraphically and statistically. Clinically, mild pain and edema occurred and subside 1 to 4 days post-operatively without post-operative complication. Radiographically bone density has shown significant increase immediately post-operatively.
CONCLUSIONS: The sharp threads of Roott basal dental implants allowed good bone anchorage and high primary stability which is one of the main factors of implants success.
KEYWORDS: Basal dental implant, periotest, osseointegration.

1- BDS, MS, Alexandria University, Faculty of Dentistry, Alexandria University.
2- Professor of Oral and Maxillofacial surgery, Faculty of Dentistry, Alexandria University.
3- Lecturer of Oral and Maxillofacial surgery, Faculty of Dentistry, Alexandria University.

   *Corresponding author:
E-mail: mostomar90@gmail.com

INTRODUCTION

Dental implants provide a unique treatment modality for the replacement of a lost dentition. This is accomplished by the insertion of a relatively inert material (a Biomaterial) into the soft and hard tissues of the jaws, providing support and retention for dental prosthesis (1).

The advantage of single tooth implant over other treatment modalities can be summarized as preservation of alveolar bone width and height and avoiding preparation of adjacent natural teeth (2).

For implant success and survival, there had to be an effective biological adaptability between the implant material and the bone, which is termed osseointegration. Osseointegration is achieved by direct bone to implant interface without intervening fibrous tissues (3,4).

Immediate loading of dental implants was initiated in 1980 with mandibular over dentures by Babbush in 1986 (5). The greatest amount of literature to support this treatment modality lies with mandibular full-arch fixed restorations. Initially, Salama et al (6) and Satio et al (7) demonstrated treatment of fully edentulous mandibles where multiple implants were placed in dense bone, particularly in the symphyseal region. By nature, these implants supported or retained restorations replacing the complete arch of the dentition and therefore, they were automatically considered to be loaded, as occlusal forces were transmitted directly to the implants from contact with the opposing dentition (8,9).

Consensus reports and systematic reviewers have attempted to define the term immediate loading from both the context of timing of the prosthesis and amount of occlusal loading it receives. Immediate loading is often defined in terms of timing as at the same clinical visit as implant placement. With the single implant scenario this is often achievable and may be advantageous in supporting soft tissue contour (10).

Immediate loading can lead to another potential pitfall phenomenon known as "overloading" where the forces on the implant can potentially disrupt the bone fusion process, can lead to premature implant failure or rejection (11).

Basal dental implants were invented and developed in many stages, by French and German dentists primarily. Single piece dental implant was introduced and used by Dr. Jean Marc in 1972. His design was available in two sizes (12). In 1980 a French dentist presented an improved basal implant with matching cutting tools. Lateral basal implants were introduced in 1997. In 2002 the base plate design was invented and fracture proof. In 2005 the experiences with lateral basal implants were transformed to screw designs (13).

Roott basal dental implants are single-component implants used for multiple unit restorations. They can be placed in extraction sockets and also in healed bone. The structural characteristics allow placement in the bone that is deficient in height and width. They can be placed with flap or flapless technique. Most of these implants take support from the basal bone which is a lot more resistant to resorption. Their long polished surface protects from accumulation of bacteria at the cervical part of the implant (14).

Therefore, this study was conducted to evaluate the new design of the basal implants in posterior mandible and immediate loading.

MATERIALS AND METHODS

Appropriate ethical clearance was obtained from Faculty of Dentistry, Alexandria University, and an informed consent was taken from all patients.

I. Criteria of Patient Selection

This was a prospective clinical trial. It was conducted on 15 basal dental implants placed in 8 Patients presented with missing mandibular posterior teeth. All patients were selected from the Outpatient Clinic of Oral and Maxillofacial Surgery Department, Faculty of Dentistry, Alexandria University.

Inclusion criteria:
- Patients of both sexes, with age of 20-40 years.
- Patients with missing posterior mandibular teeth (premolars and molars).
- Good oral hygiene.
- Adequate bone height above the inferior alveolar nerve and mental nerve at least 10 mm.

Exclusion criteria:
- Presence of infection or advanced periodontal disease.
- Inadequate interocclusal space.
- Patients with local factors or medically compromising diseases who are contraindicated to implant placement affecting the clinical procedure or result (uncontrolled diabetes, osteoporosis).
- Current chemotherapy or radiotherapy.
- Heavy smokers.
- Parafuctional habits as bruxism and clenching.

II. Materials

1. Basal dental implant (Roott Implant system, Trate Company, Switzerland)

    Newly designed one piece Roott basal dental implants with wide sharp threads. (Fig.1)

2. Microdent bone expanders (Microdent Implant system, Spain)

    These are surgical autoclavable manual threaded bone expanders, which are tapered and self-screwed. (Fig.2)

3. Periotest M (Medizintechnik Gulden e.k. Germany)

    A dental measuring instrument that help in assessment of stability of dental implants. (Fig. 3)

Figure (1): Basal dental implant.

Figure (2): Microdent bone expander.

Figure (3): Periotest M.

III. Methods

1. Pre-operative phase

a. Personal history

The preoperative data was collected and recorded in full details including name, age, gender, occupation, address, telephone number.

b. Past medical and dental history

A chart including past medical history, family history, drug history and past dental history was filled out.

c. Clinical examination
- Clinical examination of the entire oral and para-oral tissues, to ensure right patient selection.
- Evaluation of the implant site and the interocclusal space.
- Oral hygiene instructions were given to all patients.

d. Radiographic examination

Was obtained by cone beam computed tomography to evaluate bone height, width and approximation to inferior alveolar nerve or mental nerve (Fig. 4).
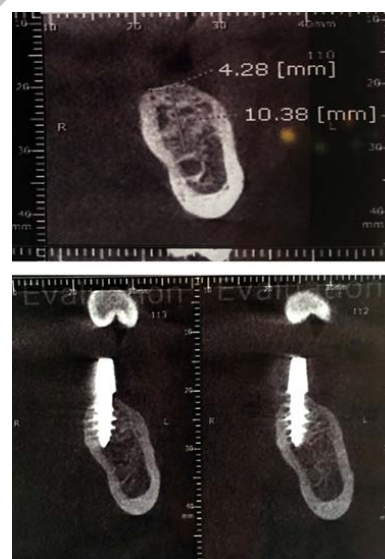

Figure (4): Pre and immediate post-operative CBCT.

e. Study cast

Was obtained by alginate impression to evaluate mesiodistal width and inter-occlusal space.

2. Operative phase (Fig.5)

All Patients were operated under local anesthesia mepivacaine HCL 2% with levonordefrin 1:20000 (Mepecain-L, 1.8ml carpule. Alexandria co. Egypt). Patients were asked to rinse their mouth with 0.12% chlorhexidine (Hexitol: Arabic drug company, ADCO, Egypt) for 30 seconds. Crestal incision was done using no. 15 scalpel and elevation of muccoperiosteal flap using periosteal elevator to expose bone. Pilot drill was used for creating initial osteotomy. Expanders were then placed inside osteotomy site and screwed till reaching the full length. The expander was left in position for 5-10 sec to enable the bone to relax. The expander was then turned in a reverse direction and pulled out of the osteotomy site. The basal dental implant was carried into the osteotomy site and threaded in a clockwise direction with a slight apical pressure using the plastic cap. The ratchet wrench was introduced on top of the implant holder, the implant was then self-threaded to the full length of osteotomy site. Periotest was used to determine implant stability. The flap was sutured in position.

Figure (5): Surgical phase.

3. Post-operative phase

a) Early postoperative care
- No rinsing or hot drinks for 24 hours.
- Oral hygiene instructions.
- Sutures were removed 7 days post-operatively.

b) Postoperative medication
- Amoxicillin 857mg clavulanate 125mg (Augmentin: GlaxoSmithKline, UK.) 1 gm every 12 hours for 5 days.
- Metronidazole 500mg (Flagyl: GlaxoSmithKline, UK.) every eight hours for 5 days.
- Diclofinac potassium 50mg (Cataflam: Diclofenac Novartis-Switzerland.) every eight hours for 5 days.
- All patients were instructed to rinse their mouth using chlorhexidine (Hexitol: Arabic drug company, ADCO, Egypt) antiseptic mouth wash 0.12%.

c) Provisional restoration
Alginate impression was taken 3 days post-operatively and provisional restorations were fabricated by CAD\CAM machine using polymethyl methacrylate cubes. All provisional restorations were out of occlusion.

4. Follow up phase

a) Clinical evaluation
All Patients were evaluated daily for the first week then weekly for the first month regarding post-operative pain, edema and any complications. Implant stability was measured three months post-operatively using periotest.

b) Radiographic evaluation
A CBCT was done immediately and three months post-operatively to assess bone density (Fig.5).

5. Prosthetic phase

Definitive restorations (porcelain fused to metal) were done three months post-operatively.

6. Statistics

All of the obtained data were statistically analyzed and presented in the form of tables, graphs and charts using the IBM Statistical Package for Social Science (SPSS) software version 22.0

RESULTS

A total of 15 implants were placed in 8 patients presented with missing mandibular posterior teeth and they were indicated for implant placement. The selected patients were 5 males and 3 females with age range from 21 to 40 years with mean of 32.8 years. The missing teeth were 4 mandibular first premolars, 3 mandibular second premolars, 6 mandibular first molar and 2 mandibular second molars

Implants sizes were 1 implant was 4*8mm, 3 implants were 3.5*10mm, 4 implants were 4.5*12mm and 7 implants were 4.5*10mm.

1. Pain

After surgery, nine patients experienced mild pain (VAS=1) and three patients experienced moderate pain (VAS=2) and one patient experienced pain between annoying and uncomfortable (VAS=3) and two experienced uncomfortable pain (VAS=4) at surgical site for 1-3 days duration.

2. Edema

All patients suffered from trace edema, which subsided totally by the 4th post-operative day.

3. Post-operative complications

No post-operative complications were recorded regarding infection in the early follow up period.

Two failed implants have been recorded in this study.

4. Periotest (Table 1)

Periotest readings immediately and 3 months postoperatively

Table (1): Periotest reading immediately and 3 months postoperatively.

	Immediate post-operative	3months post-operative	Z	P
Perio test Range	-6.10 : 1.50	-8.0 : 2.0		
Mean ± SD.	-3.36 ± 1.93	-3.49 ± 2.69	0.175	0.861
Median	-3.50	-3.30		

5. Radiographic results to assess bone density (Table 2)

Bone density around osseointegrated implants have shown increased bone density around implant surface.

In the pre-operative phase, the mean peri-implant bone density value was 1424.9 ± 394.7 HU with a minimum recorded value 921.0 HU and a maximum recorded value of 2120.0 HU.

In the immediate post-operative phase, the mean peri-implant bone density was 1615.88±407.84 HU with a minimum recorded value of 1021.5 HU and a maximum recorded value of 2303.5 HU.

In the third month, the mean peri-implant bone density was 1670.7 ± 561.9 HU with a minimum recorded value of 668.0 HU and a maximum recorded value of 2457.5HU. The differences between bone density pre and immediately post-operatively were statistically significant (p <0.001).

The differences between bone density immediately and 3 months post-operatively were not statistically significant.

Table (2): Radiographic results showing bone density pre-operatively, immediately and 3 months post-operatively

Bone density	Pre-operative	Immediate post-operative	3months post-operative	F	p
Average Range	921.0 – 2120.0	1021.5 – 2303.5	668.0 – 2457.5		
Mean ± SD.	1424.9 ± 394.7	1615.88±407.84	1670.7 ± 561.9	4.107*	0.029*
Median	1295.0	1495.50	1871.50		
Sig. bet. Grps	$p_1 < 0.001^*$, $p_2 = 0.115$, $p_3 = 1.000$				

F: F test (ANOVA) with repeated measures, Sig. bet. periods was done using **Post Hoc Test (Bonferroni)**

p_1: p value for comparing between **Pre-operative** and **Immediate post-operative**

p_2: p value for comparing between **Pre-operative** and **3months post-operative**

p_3: p value for comparing between **Immediate post-operative** and **3months post-operative**

*: Statistically significant at $p \leq 0.05$

DISCUSSION

In this study fifteen implants were placed in 8 patients in the posterior mandible. All patients were selected from the Outpatient Clinic of the Oral Maxillofacial Surgery Department, Faculty of Dentistry, Alexandria University. Their ages ranged between 21 and 40 years.

Patients were selected free from systemic diseases because that may complicate the surgical procedure or the healing process of the implant procedure, patients were also selected free from parafunctional habits such as bruxism and clenching, because the magnitude of the forces are high, the duration of the forces are extensive and the direction of the forces are more horizontal than axial to the implants (15,16).

Heavy smokers were also excluded from this study. Exposure to smoking has a harmful effect on the peri-implant bone loss that eventually leads to implant failure (17).

In this study basal dental implants with wide sharp threads were used. Their ability to engage with cortical bone gives high primary stability which is the key for implant success. Long polished neck prevents bacterial accumulation around the implants and their bending ability facilitates restoration in unfavorable implant position. The implants lengths varied from 8.0 to 12 and the diameter varied from 3.5 to 4.5mm. Throughout the evaluation period, two failed implants have been recorded without obvious reason. Regarding pain and edema, all patients suffered from mild to moderate pain with trace edema that subsided from 2 to 4 days post-operatively.

As basal implants are anchored in high quality basal bone, the biomechanical loads (masticatory forces etc.) are distributed to the cortical bone regions which are highly resistant to resorption and have very high repairing capacity. The force distribution is away from the bone areas surrounding the implant which are prone to bacterial invasion and hence these implants survive very well even in very unfavorable conditions. This sort of force distribution also helps in the prevention of "facial collapse" owing to bone resorption in the areas where there is no masticatory stimulation (18).

Many studies have shown the effect of threads shape on dental implant success. Threads shapes have a direct effect on stress distribution. Implants with wider threads, because of the increased contact surface of the implant with the bone, caused more stability, implants with smaller threads and shorter pitch length causes more stress to the bone (19).

Threads are used to maximize initial contact, improve initial stability, enlarge implant surface area, and improve the dissipation of stresses at the interface. Thread depth, thread thickness, thread face angle, thread pitch, and thread helix angle are some of the geometric variations that determine the functional thread surface and affect the biomechanical load distribution around the implant. The greater the number of threads is as influential as depth of the threads, as they result in more functional surface area (20).

Periotest was used to measure implant stability immediately and 3 months postoperatively. It was chosen as the implant used in this study was a one-piece implant (21).

Both Osstel and Periotest systems proved to be sensitive in measuring dental implant stability in hard and in soft interfaces (22).

Despite manufacturers recommendations to use the pilot drill then followed by larger drills (sequential drilling) in this study only the pilot drill was used then followed by Microdent screw expanders in order to increase the primary stability and bone density around implant surface.

Periotest reading immediately post-operatively ranged from +1.5 to -6.1 with mean -3.97. The readings 3 months post-operatively ranged from +2 to -8 with mean -3.49. The results were statistically non-significant. These readings show high primary stability of the newly designed basal dental implants and good bone implant contact immediately post-operatively.

Radiographic results have shown bone density pre-operatively range from 921.0 HU to 2120.0 HU with mean 1424.9 ± 394.7 HU. Immediately post-operatively bone density ranged from 1021.5 HU to 2303.5 HU with mean 1615.88±407.84. 3 HU months post-operatively bone density ranged from 668.0 HU to 2457.5 HU with mean 1670.7 ± 561.9 HU. The result was statistically significant between pre and immediate post-operative bone density which then proves the efficacy of screw expanders in increasing bone density and bone condensation.

CONCLUSION

From the results of this study, the following was concluded:

Newly designed basal dental implant with sharp threads allows getting high primary stability and immediate loading.

CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

REFERENCES

1. Spiekermann H. Implantology. Stuttgart; New York; New York: G. Thieme Verlag ; Thieme Medical Publishers; 1995.

2. Palmer RM, Smith BJ, Palmer PJ, Floyd PD. A prospective study of Astra single tooth implants. Clin Oral Implants Res.1997;8:173-9.

3. McMillan PJ, Riggs ML, Bogle GC, Crigger M. Variables that influence the relationship between osseointegration and bone adjacent to an implant. Int J Oral Maxillofac Implants. 2000;15:654-61.

4. Koutsonikos A. Implants: success and failure--a literature review. Ann R Australas Coll Dent Surg. 1998;14:75-80.

5. Babbush CA, Kent JN, Misiek DJ. Titanium plasma-sprayed screw implants for the reconstruction of edentulous mandible. J Oral Maxillofac Surg. 1986;44:274-82.

6. Salama H, Rose LF, Salama M, Betts NJ. Immediate loading of bilaterally splinted titanium root-form implants in fixed prosthodontics--a technique reexamined: two case reports. Int J Periodontics Restorative Dent. 1995;15:344-61.

7. Saito H, Chu SJ, Reynolds MA, Tarnow DP. Provisional Restorations Used in Immediate Implant Placement Provide a Platform to Promote Peri-implant Soft Tissue Healing: A Pilot Study. Int J Periodontics Restorative Dent. 2016;36:47-52.

8. Norkin FJ, Ganeles J, Sekler J, Zfaz S. Immediate loading of endosseous dental implants: A review of the evidence. Inside Dentistry. 2008;4:6-7.

9. Testori T, Del Fabbro M, Szmukler-Moncler S, Francetti L, Weinstein RL. Immediate occlusal loading of Osseotite implants in the completely edentulous mandible. Int J Oral Maxillofac Implants. 2003;18:544-51.

10. Nkenke E, Fenner M. Indications for immediate loading of implants and implant success. Clin Oral Implants Res. 2006;17(Suppl 2):19-34.

11. Schropp L, Isidor F. Timing of implant placement relative to tooth extraction. J Oral Rehabil. 2008;35(Suppl 1):33-43.

12. Nair C, Bharathi S, Jawade R, Jain M. Basal implants - a panacea for atrophic ridges. J Dent Sci Oral Rehabil 2013;1-4.

13. Sharma R, Anand D, Prakash J, Hasti A. Basal implants – an alternate treatment modality for atrophied ridges. IJCMPR. 2017;3:1186-90.

14. Implants. Available at: https://trate.com/en/implants/basal.

15. Donos N, Calciolari E. Dental implants in patients affected by systemic diseases. Br Dent J. 2014;217:425-30.

16. Chrcanovic BR, Kisch J, Albrektsson T, Wennerberg A. Bruxism and dental implant treatment complications: a retrospective comparative study of 98 bruxer patients and a matched group. Clin Oral Implants Res. 2017;28:e1-e9.

17. Takamiya AS, Goiato MC, Gennari Filho H. Effect of smoking on the survival of dental implants. Biomed Pap Med Fac Univ Palacky Olomouc Czech Repub. 2014;158:650-3.

18. Advantages of the Immediate Load Basal Dental Implants Available at: https://www.dentalimplantskerala.com/options/advantages-of-the-immediate-load-basal-implants/.

19. Geramizadeh M, Katoozian H, Amid R, kadkhodazadeh M. Three dimensional optimization and sensitivity analysis of dental implant thread parameters using finite element analysis. J Korean Assoc Oral Maxillofac surg. 2018;2:59-65.

20. Mosavar A, Ziaei A, Kadkhodaei M. The effect of implant thread design on stress distribution in anisotropic bone with different osseointegration conditions: a finite element analysis. Int J oral Maxillofac Implants. 2015;6:1317-26.

21. Teerlinck J, Quirynen M, Darius P, van Steenberghe D. Periotest: an objective clinical diagnosis of bone apposition toward implants. Int J Oral Maxillofac Implants 1991;6:55-61.

22. Samer AJ, Abdullah AA. Assessment of Osstell™ and Periotest® systems in measuring dental implant stability (in vitro study). Saudi Dent J. 2011;23:17-21.