

## **RADIOGRAPHIC EVALUATION OF THE EFFICACY OF WIDE DIAMETER IMPLANTS IN THE IMMEDIATE REPLACEMENT OF MANDIBULAR MOLARS**

Rania Farouk Abdulmaguid\* and Ziad A. Rabie\*\*

### **ABSTRACT**

**Background:** Immediate implant placement to simultaneously replace mono-radicular teeth at the time of extraction has gained wide acceptance as a reliable and predictable treatment option. Application of this option in replacement of molars has presented a difficult challenge both surgically and prosthetically.

**Aim of the study:** The current study aimed to investigate the efficacy of wide diameter implants in the immediate replacement of mandibular molars over a period of 24 months.

**Methods:** Thirty implants were utilized in the immediate replacement of mandibular molars in a one stage surgical procedure following the atraumatic extraction of the teeth. The implants were restored after three months and followed-up at 12 and 24 months to evaluate the crestal bone loss around them.

**Results:** A survival rate of 96.6% was evident at the end of the study period (24 months) with a mean crestal bone loss of 0.33-mm at 12 months and 0.19-mm at 24 months with a total mean crestal bone loss of 0.52-mm during the study period.

**Conclusion:** Wide diameter implants are a reliable and predictable means to immediately replace mandibular molars with stable long-term prognosis with the consideration of proper extraction procedures and maintenance of the socket architecture.

**KEY WORDS:** Wide diameter implants, Immediate molar replacement, Immediate implant placement.

### **INTRODUCTION**

The original protocol proposed by Brånemark for the healing of extraction sites before implant placement ranged between 6 to 8 months to

avoid infection and provide primary stability of the implant at placement <sup>(1)</sup>. The increased use of dental implants and the advancement of research led to the introduction of immediate placement of

\* Lecturer at Oral Medicine and Periodontology Department, Faculty of Dentistry, MSA University.

\*\* MSc Prosthodontics, Fellow ICOI, Private Practice, Cairo, Egypt.

dental implants at the time of tooth extraction. This technique presented several advantages over the original protocol which include reduction of the overall treatment duration with reduced number of surgical interventions <sup>(2, 3)</sup>. The most important advantage of immediate placement lies in the preservation of the bone and gingival architecture at the extraction site <sup>(4, 5)</sup>, as bone remodeling post extraction may result in 50% bone reduction horizontally and 2.4 to 4.5 mm vertically which is even more pronounced in the molar region <sup>(6)</sup>. Several survival rate studies found out that there was no significant difference in the outcome when comparing immediate and delayed implant placement <sup>(7-10)</sup>.

Most of the research on immediate implant placement has been conducted on monoradicular teeth. This may be attributed to the difficulty associated with the immediate placement of implants and positioning in molar sockets due to the challenging residual inter-radicular bony architecture <sup>(11)</sup>. The use of a regular diameter implant in one of the root sockets compromises the emergence profile with the creation of marked off-axis loading and a resultant cantilever effect <sup>(12)</sup>. Therefore, the use of a wide diameter implant may improve the stability of the implant through bicortical stabilization, increases the surface area available for osseointegration and lead to placement in a more prosthetically oriented position with a resultant axial loading <sup>(13, 14)</sup>.

Therefore, this study was designed to evaluate the efficacy and clinical outcome of wide diameter implants in the immediate replacement of mandibular molars.

## **MATERIALS AND METHODS:**

### **Patient selection and inclusion criteria:**

This study was conducted on thirty mandibular molar sites utilizing thirty wide diameter implants

(Dentium Superline implant, diameter 7mm, South Korea), placed in 25 patients. There was no age or gender restriction. The inclusion criteria were as follows:

- Mandibular molars diagnosed as non-restorable (molars with fused roots were excluded).
- No presence of peri-radicular pathology or radiolucency.
- Thick periodontal biotype as assessed following De Rouck et al <sup>(15)</sup> periodontal probe technique.
- Intact buccal plate of bone.
- The distance from the furcation to the inferior alveolar canal should be more than 10 mm in length.
- No history of periodontal disease.
- Nonsmoker patients.

All patients received cone beam computed tomography (CBCT) analysis for diagnosis and inclusion processes and for planning the implant installation.

### **Surgical Procedures:**

On the day of the surgery, following administration of the appropriate local anesthetic, there was no attempt made to remove the tooth using conventional extraction forceps. As the proposed treatment and study parameters were highly dependent on the preservation of the surrounding bony walls of the socket, the extraction was carried out by careful sectioning of the tooth to avoid damage to the inter-radicular bone to allow removal of the roots individually with periostomes, thus avoiding any potential damage to the bony elements of the socket. Following the removal of the roots, the socket was evaluated to ensure the presence of four intact outer walls and undamaged inter-radicular bone with absence of any pathology or fenestration.

The osteotomy preparation was then commenced in the inter-radicular bone using a special 1.3 mm lance drill from 3i Biomet. The starting position was always slightly off-center towards the lingual thus allowing for preparation of the implant placement site in a centrally located position but away from the buccal bone plate. Preparation was then continued using the manufacturer's drills and instructions for the 7-mm diameter implant. It should be noted that as a compensation for natural bone resorption following tooth extraction, the implant was positioned 2-mm below the margin of the intact buccal bony wall, therefore the osteotomy preparation was 2-mm deeper as compared to delayed implant placement<sup>(16)</sup>.

Implant insertion was performed using the surgical motor until being primarily seated at a torque of 35 Ncm, and the final seating was done by hand with an implant insertion wrench until the implant platform ended 2-mm subcrestally. The ideal implant seating should be away from the buccal plate of bone with the buccal strut of the inter-radicular bony septum still intact and butting up against the implant. With the correct positioning of the implant in the extraction socket, the residual socket space was usually less than 2-mm wide in any direction around the implant therefore not requiring any bone graft to fill it. A healing abutment was then connected and tightened with soft tissue adaptation around it been done using Vicryl 4.0 sutures.

All patients received a course of antibiotics (3x Amoxicillin 500 mg/day for 7 days) and analgesics (2x Ibuprofen 600 mg/day for 3 days). Follow-up for all cases was done within 10 – 14 days after surgery for suture removal and postoperative evaluation.

Second stage procedures were performed after 3 months from the surgery following standard prosthetic techniques and restoration delivery.

### **Radiographic evaluation:**

Radiographic evaluation was conducted using CBCT. The base line measurements were obtained following the delivery of the prosthetic restoration, while the examination periods were scheduled at 12 months and 24 months at which intervals CBCTs were made for each patient.

### **RESULTS:**

This study utilized 30 implants to immediately replace 30 mandibular molars. Out of these, one implant failed after 6 weeks of placement due to excessive parafunctional habits from the patient and inability to follow the postoperative instructions. The remaining implants survived the study duration with uneventful healing, thus giving a survival rate of 96.6%.

The evaluation periods were set at 12 months and 24 months (tables 1, 2 and figure 1). The mean crestal bone loss at the first evaluation period was 0.33-mm ( $\pm 0.26$ ) with a range between 0.9-mm to 1.24-mm. Out of the 29 implant sites, only two had bone loss over 1-mm after one year that may be attributed to the fact that during the surgery the implant encroached on the buccal plate of bone. While the remaining implants showed bone loss within a similar range.

The mean crestal bone loss at the second evaluation period was 0.19-mm ( $\pm 0.09$ ) with a range between 0.1-mm to 0.4-mm. The previously mentioned implant sites did not show any further progression in bone loss outside the range of the remaining implant sites.

The total amount of crestal bone loss after the study period was 0.52-mm ( $\pm 0.32$ ).

TABLE (1) Crestal bone loss readings at the evaluation periods and at the end of the study

No.	12 Months	24 Months	Total
1	0.29	0.3	0.59
2	0.22	0.2	0.42
3	0.09	0.1	0.19
4	0.28	0.3	0.58
5	0.19	0.1	0.29
6	1.05	0.3	1.35
7	0.3	0.2	0.5
8	0.37	0.2	0.57
9	0.26	0.1	0.36
10	0.2	0.1	0.3
11	1.24	0.3	1.54
12	0.52	0.2	0.72

13	0.35	0.4	0.75
14	0.48	0.2	0.68
15	0.4	0.1	0.5
16	0.57	0.4	0.97
17	0.29	0.3	0.59
18	0.22	0.2	0.42
19	0.09	0.1	0.19
20	0.28	0.3	0.58
21	0.19	0.1	0.29
22	0.3	0.2	0.5
23	0.37	0.2	0.57
24	0.26	0.1	0.36
25	0.2	0.1	0.3
26	0.22	0.2	0.42
27	0.09	0.1	0.19
28	0.1	0.1	0.2
29	0.1	0.1	0.2

TABLE (2) Statistical analysis of the results using paired t-test

Group	N	Mean	CI 95% <sup>2</sup>	Standard Deviation <sup>3</sup>	Min	Max
12 Months	29	0.328	0.234 - 0.423	0.259	0.09	1.24
24 Months	29	0.193	0.158 - 0.228	0.096	0.1	0.4
p value: 2.839e-3 <sup>1</sup>						

<sup>1</sup> p value more than 0.01 is non-significant statistically.

<sup>2</sup> There is a 95% chance the population mean is within the confidence interval calculated for this sample

<sup>3</sup> Standard Deviation measures the spread of values.

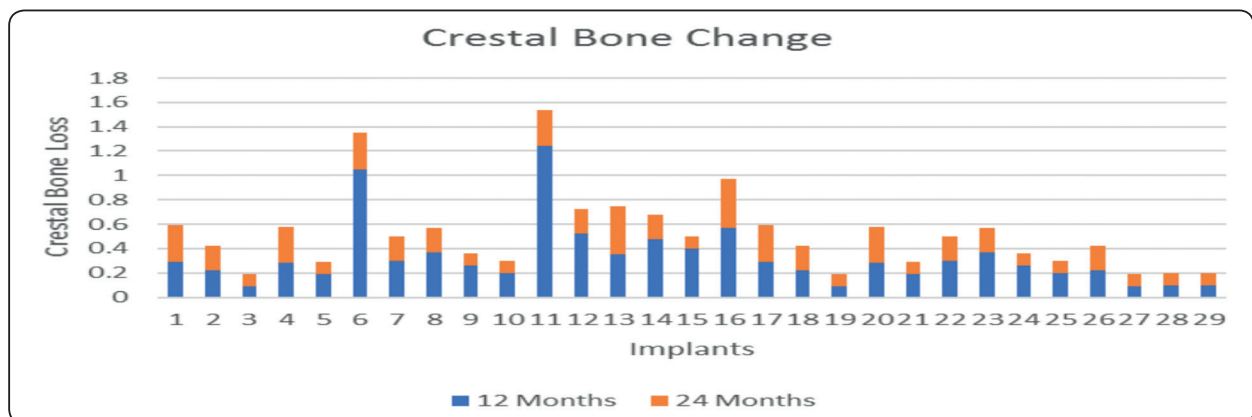


Fig. (1) Crestal bone loss during the evaluation periods

## DISCUSSION

The implant survival rate of 96.6% is in accordance with other studies on immediate placement reporting survival rates over 92% after 1 year follow-up<sup>(12,17-27)</sup>. Additionally, the survival rate of this study is in accordance to that of a multicenter study on wide diameter implants replacing molars in an immediate placement fashion, which reported 95.7% implant survival rate<sup>(28)</sup>.

Some authors have reported bone loss associated with wide diameter implants as compared to regular diameter implants<sup>(29)</sup>, but the mean bone loss after one year in this study is similar to several studies and far within the criteria of success<sup>(30-34)</sup>.

It should be noted that very few studies have reported on bone loss around immediately placed implants in molar extraction sockets. Among these are the study by Bianchi and Sanfilippo<sup>(35)</sup> that reported 0.75-mm bone loss after 72 months follow-up, and Penarrocha et al<sup>(7)</sup> who reported 0.83-mm bone loss after 1 year and Prosper et al<sup>(36)</sup> who reported bone loss of 0.17-mm after one year and 1.01-mm after 5 years. In conclusion, these results indicate that immediate placement in molar sockets produces limited bone loss which is stable over time.

Finally, wide diameter implants have reported increased failure rates mainly due to the operator's learning curve, poor bone density, implant design and site preparation, and its use when primary stability had not been achieved with a standard diameter implant<sup>(37)</sup>.

## CONCLUSION

Immediate molar replacement with wide diameter implants presents a viable treatment option due to the good primary stability achieved within the extraction socket and the limited bone loss over time. However, success is dependent on the careful execution of the extraction procedure and the accurate drilling process during the osteotomy preparation.

## REFERENCES

1. Brånemark PI, Hansson BO, Adell R, Breine U, Lindström J, Hallén O, Ohman A. Osseointegrated implants in the treatment of the edentulous jaw. Experience from a 10-year period. *Scand J Plast Reconstr Surg Suppl.* 1977; 16: 1-132.
2. Becker BE, Becker W, Ricci A, Geurs N. A prospective clinical trial of endosseous screw-shaped implants placed at the time of tooth extraction without augmentation. *J Periodontol.* 1998; 69: 920-6.
3. Schwartz-Arad D, Chaushu G. The ways and wherefores of immediate placement of implants into fresh extraction sites: a literature review. *J Periodontol.* 1997; 68: 915-23.
4. Lazzara RJ. Immediate implant placement into extraction sites: surgical and restorative advantages. *Int J Periodontics Restorative Dent.* 1989; 9: 332-43.
5. Watzek G, Haider R, Mensdorff-Pouilly N, Haas R. Immediate and delayed implantation for complete restoration of the jaw following extraction of all residual teeth: a retrospective study comparing different types of serial immediate implantation. *Int J Oral Maxillofac Implants.* 1995; 10: 561-7.
6. Schropp L, Wenzel A, Kostopoulos L, Karring T. Bone healing and soft tissue contour changes following single-tooth extraction: a clinical and radiographic 12-month prospective study. *Int J Periodontics Restorative Dent.* 2003; 23: 313-23.
7. Peñarrocha-Diago M, Carrillo-García C, Boronat-Lopez A, García-Mira B. Comparative study of wide-diameter implants placed after dental extraction and implants positioned in mature bone for molar replacement. *Int J Oral Maxillofac Implants.* 2008; 23: 497-501.
8. Polizzi G, Grunder U, Goené R, Hatano N, Henry P, Jackson WJ, Kawamura K, Renouard F, Rosenberg R, Triplett G, Werbit M, Lithner B. Immediate and delayed implant placement into extraction sockets: a 5-year report. *Clin Implant Dent Relat Res.* 2000; 2: 93-9.
9. Ribeiro FS, Pontes AE, Marcantonio E, Piattelli A, Neto RJ, Marcantonio E Jr. Success rate of immediate nonfunctional loaded single-tooth implants: immediate versus delayed implantation. *Implant Dent.* 2008; 17: 109-17.
10. Paolantonio M, Dolci M, Scarano A, d'Archivio D, di Placido G, Tumini V, Piattelli A. Immediate implantation in fresh extraction sockets. A controlled clinical and histological study in man. *J Periodontol.* 2001; 72: 1560-71.

11. Fugazzotto PA. Sinus floor augmentation at the time of maxillary molar extraction: technique and report of preliminary results. *Int J Oral Maxillofac Implants*. 1999 Jul-Aug;14(4):536-42. Erratum in: *Int J Oral Maxillofac Implants* 1999; 14: 902.
12. Acocella A, Bertolai R, Sacco R. Modified insertion technique for immediate implant placement into fresh extraction socket in the first maxillary molar sites: a 3-year prospective study. *Implant Dent*. 2010; 19: 220-8.
13. Peñarrocha M, Uribe R, Balaguer J. Immediate implants after extraction. A review of the current situation. *Med Oral*. 2004; 9: 234-42.
14. Shin SW, Bryant SR, Zarb GA. A retrospective study on the treatment outcome of wide-bodied implants. *Int J Prosthodont*. 2004; 17: 52-8.
15. Evans CD, Chen ST. Esthetic outcomes of immediate implant placements. *Clin Oral Implants Res*. 2008; 19: 73-80.
16. Araujo MG, Sukekava F, Wennstrom JL, Lindhe J. Ridge alterations following implant placement in fresh extraction sockets: an experimental study in the dog. *J Clin Periodontol* 2005; 32: 645-52.
17. Ashman A. An immediate tooth root replacement: an implant cylinder and synthetic bone combination. *J Oral Implantol*. 1990; 16: 28-38.
18. Becker W, Dahlin C, Becker BE, Lekholm U, van Steenberghe D, Higuchi K, Kultje C. The use of e-PTFE barrier membranes for bone promotion around titanium implants placed into extraction sockets: a prospective multicenter study. *Int J Oral Maxillofac Implants*. 1994; 9: 31-40.
19. Brägger U, Hämmerle CH, Lang NP. Immediate transmucosal implants using the principle of guided tissue regeneration (II). A cross-sectional study comparing the clinical outcome 1 year after immediate to standard implant placement. *Clin Oral Implants Res*. 1996; 7: 268-76.
20. Cosci F, Cosci B. A 7-year retrospective study of 423 immediate implants. *Compend Contin Educ Dent*. 1997; 18: 940-2.
21. Goldstein M, Boyan BD, Schwartz Z. The palatal advanced flap: a pedicle flap for primary coverage of immediately placed implants. *Clin Oral Implants Res*. 2002; 13: 644-50.
22. Gomez-Roman G, Kruppenbacher M, Weber H, Schulte W. Immediate postextraction implant placement with root-analog stepped implants: surgical procedure and statistical outcome after 6 years. *Int J Oral Maxillofac Implants*. 2001; 16: 503-13.
23. Gomez-Roman G, Schulte W, d'Hoedt B, Axman-Kremar D. The Frialit-2 implant system: five-year clinical experience in single-tooth and immediately postextraction applications. *Int J Oral Maxillofac Implants*. 1997; 12: 299-309.
24. Lang NP, Brägger U, Hämmerle CH, Sutter F. Immediate transmucosal implants using the principle of guided tissue regeneration. I. Rationale, clinical procedures and 30-month results. *Clin Oral Implants Res*. 1994; 5: 154-63.
25. Nir-Hadar O, Palmer M, Soskolne WA. Delayed immediate implants: alveolar bone changes during the healing period. *Clin Oral Implants Res*. 1998; 9: 26-33.
26. Rosenquist B, Grenthe B. Immediate placement of implants into extraction sockets: implant survival. *Int J Oral Maxillofac Implants*. 1996; 11: 205-9.
27. Yukna RA. Clinical comparison of hydroxyapatite-coated titanium dental implants placed in fresh extraction sockets and healed sites. *J Periodontol*. 1991; 62: 468-72.
28. Vandeweghe S, Ackermann A, Bronner J, Hattingh A, Tschakaloff A, De Bruyn H. A Retrospective, Multicenter Study on a Novo Wide-Body Implant for Posterior Regions. *Clin Implant Dent Relat Res*. 2012; 14: 281-92.
29. Ivanoff CJ, Gröndahl K, Sennerby L, Bergström C, Lekholm U. Influence of variations in implant diameters: a 3- to 5-year retrospective clinical report. *Int J Oral Maxillofac Implants*. 1999; 14: 173-80.
30. Bischof M, Nedir R, Abi Najm S, Szmukler-Moncler S, Samson J. A five-year life-table analysis on wide neck ITI implants with prosthetic evaluation and radiographic analysis: results from a private practice. *Clin Oral Implants Res*. 2006; 17: 512-20.
31. Bornstein MM, Harnisch H, Lussi A, Buser D. Clinical performance of wide-body implants with a sandblasted and acidetched (SLA) surface: results of a 3-year follow-up study in a referral clinic. *Int J Oral Maxillofac Implants*. 2007; 22: 631-8.
32. Krennmair G, Waldenberger O. Clinical analysis of wide-diameter frialit-2 implants. *Int J Oral Maxillofac Implants*. 2004; 19: 710-5.
33. Mordenfeld MH, Johansson A, Hedin M, Billström C, Fyrberg KA. A retrospective clinical study of wide-diameter implants used in posterior edentulous areas. *Int J Oral Maxillofac Implants*. 2004; 19: 387-92.

34. Tawil G, Mawla M, Gottlow J. Clinical and radiographic evaluation of the 5-mm diameter regular-platform Brånemark fixture: 2- to 5-year follow-up. *Clin Implant Dent Relat Res.* 2002; 4: 16-26.
35. Bianchi AE, Sanfilippo F. Single-tooth replacement by immediate implant and connective tissue graft: a 1-9-year clinical evaluation. *Clin Oral Implants Res.* 2004; 15: 269-77.
36. Prosper L, Crespi R, Valenti E, Capparé P, Gherlone E. Five-year follow-up of wide-diameter implants placed in fresh molar extraction sockets in the mandible: immediate versus delayed loading. *Int J Oral Maxillofac Implants.* 2010; 25: 607-12.
37. Renouard F, Nisand D. Impact of implant length and diameter on survival rates. *Clin Oral Implants Res.* 2006; 17 Suppl 2: 35-51.