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CASE REPORT

Case Series of Single Stage Immediate Implant Placements into Fresh Extraction Sockets of Mandibular Molars

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ABSTRACT

Immediate implant placement into fresh extraction sockets of mandibular molars requires good case selection, detailed clinical and radiographic examination as well as adequate clinical experience and judgement. This paper describes a standard protocol adopted by a single Oral and Maxillofacial Surgeon from the Department of Oral and Maxillofacial Surgery, National Dental Centre Singapore, as applied to a series of four cases.

Keywords: Extraction sockets, Immediate implant, Lower molar

INTRODUCTION

The original implant surgical protocol proposed by Brånemark[1] involved open flap access, stepwise osteotomy of the bony ridge, and implant placement followed by good primary closure. If the patient presents with a failing tooth, extraction must be performed and the socket allowed to heal for three to six months before replacement with a dental implant can be considered. After complete socket healing has taken place, bony ridge and soft tissues deficiencies that render the site unsuitable for implant placement need to be addressed first. A variety of hard and soft tissue ridge augmentation may be used but overall treatment time is prolonged.

Though a lengthy procedure, this had been a reliable protocol adopted by surgeons worldwide due to its predictable and systematic nature, allowing complications that may arise from each step to be dealt with appropriately[1].

However, with technological advances and new surgical innovations, various radical modifications to this original protocol had been introduced that showed promising and predictable outcomes. One such treatment protocol is the placement of implants into fresh extraction sockets, otherwise commonly known as immediate implant placement.

Immediate implant placement may be defined as implant placement immediately following tooth extraction and as part of the same surgical procedure[2], or as implant placement immediately following extraction of a tooth which must be combined, in most cases, with bone-grafting the peri-implant socket defects[3].

This technique has a number of proposed advantages[4,5]such as minimising hard and soft tissue loss, decreased total treatment time, reduced number of surgical procedures, reduced overall cost and better patient acceptance.

However, discrepancies between the size of the implant and sockets, poorly vascularised infected bone at the implant site and difficulty controlling three-dimensional implant position and primary stability of the implants placed are some of the surgical challenges that operators face[4]. Therefore, this procedure is generally not recommended for

Table 1. Patient Data, Teeth for Extractions and Reasons for Extractions.

Patient No.	Age	Sex	Extracted Tooth and Implant Replacement Site	Reason for Extraction
1	28	M	Mandibular Right First Molar	Unrestorable tooth structure secondary to caries
2	49	M	Mandibular Left First Molar	Unrestorable tooth structure secondary to caries
3	51	F	Mandibular Right First Molar	Unrestorable tooth structure secondary to vertical tooth fracture
4	42	M	Mandibular Left First Molar	Unrestorable tooth structure secondary to caries

Table 2. Data of Implants and Healing Abutments Used.

Patient No.	Implant Site	Implant Morphology	Implant Length (mm)	Implant Body Diameter (mm)	Healing Abutment Height x Diameter (mm)
1	Mandibular Right First Molar	TE	10	4.8	4.5 x 6.5
2	Mandibular Left First Molar	TE	12	4.8	4.5 x 6.5
3	Mandibular Right First Molar	TE	10	4.8	4.5 x 6.5
4	Mandibular Left First Molar	TE	12	4.8	4.5 x 6.5

the novice surgeon.

This article presented a case series of single stage immediate dental implant placements into fresh extraction sockets of mandibular molars. The case selection, treatment planning, surgical protocol, restorative outcomes and complications encountered were presented and discussed.

MATERIALS AND METHODS

Patients

This series reported four subjects treated with the same protocol, by a single Oral and Maxillofacial Surgeon from the Department of Oral and Maxillofacial Surgery, National Dental Centre, Singapore between December 2008 and April 2011 (Table 1).

Clinical Evaluation and Patient Preparation

Standard clinical assessment was carried out for all four patients. Significant past medical history, general health and smoking habits were documented. All patients did not present with significant medical or systemic issues that will compromise dental implant success. Clinical assessment included an extra-oral examination followed by an intra-oral examination. This was carried out jointly with a prosthodontist.

All four patients required single mandibular molar teeth extraction. The teeth were free of acute infection and had adequate apical bone for primary implant stability.

Cases that were immediate placements of implants in the anterior zone as well as those lost on follow-up were not included in this case series.

Preoperative Radiographic Assessment

All the patients in this series underwent routine panoramic radiographic investigations to assess the amount of vertical bone thickness between the apices of the tooth and the superior cortical line of the inferior alveolar nerve.

Implants

The implants used in this case series were described in Table 2. All the implants were non-submerged,

Table 3. Post-extraction Socket Findings, GraftingDdata, Primary Stability and Healing Period before Final Restoration.

Patient No.	State of Socket after Extraction	Labial Peri-implant Socket Gap Distance (mm)	Primary Stability	Peri-implant Socket Grafting Performed (Yes/No)	Graft Material Used	Healing Period before Final Restoration (No. of Months)
1	Intact	>2mm	Good	Yes	Autogenous Bone	4
2	Intact	>2mm	Good	Yes	Bioactive Glass	3
3	Intact	>2mm	Good	Yes	Bioactive Glass	5
4	Intact	>2mm	Good	Yes	Autogenous Bone	3

wide diameter (4.8mm) Straumann implants with Sandblasted Large-Grit Acid –Etched (SLA) surfaces (Tapered Effect ® implant, Straumann AG, Basel, Switzerland). The transmucosal polished collars of the implants were a uniform height of 1.8mm (StandardPlus) and 6.5mm in diameter (WideNeck). All the implants placed were either 10 or 12 mm in length.

Surgical Technique

All patients received oral 1.0 gram Amoxicillin one hour pre-operatively[6].The surgical procedures were all carried out under local anaesthesia in sterile surgical conditions. The teeth were extracted with minimal trauma by first performing a peri-incision of the free gingival attachment, which was then freed off the cervical margins. The teeth were then luxated and mobilised with a periotome before forceps delivery. In all the cases, forceps delivery failed and the teeth eventually had to have the roots divided before being removed.

After the teeth were extracted, the sockets were thoroughly curettaged and cleansed with copious saline irrigation to remove remnants of periodontal tissue and debris. The surgeon ensured that there was fresh bleeding from the socket walls before proceeding with the implant site preparations.

The site preparations were then carried out according to the implant system protocol. A surgical guide was used throughout to ensure prosthodontically favourable placement of the implant in three dimensions. The drilling procedures were carried out with copious irrigation and the osteotomies were made apical to the socket depth so as to allow engagement of the apical bone for primary stability. Perforation of the inferior alveolar canal was avoided. A final lavage of the osteotomy sites were carried out to ensure a debris free site before inserting the implants[7,8,9].

The implants were inserted first with a handpiece at the recommended torque and final seating done manually with a handwrench. Titanium healing abutments were then placed.

The peri-implant socket gaps were then grafted accordingly (Table 3). Patients 1 and 4 had had autogenous bone grafted into peri-implant sockets as simultaneous removal of wisdom teeth were required. Patients 2 and 3 received Bioactive Glass alloplastic bone substitutes (Biogran®, BIOMET 3i, Palm Beach Gardens, FL, USA) as peri-implant socket graft material.

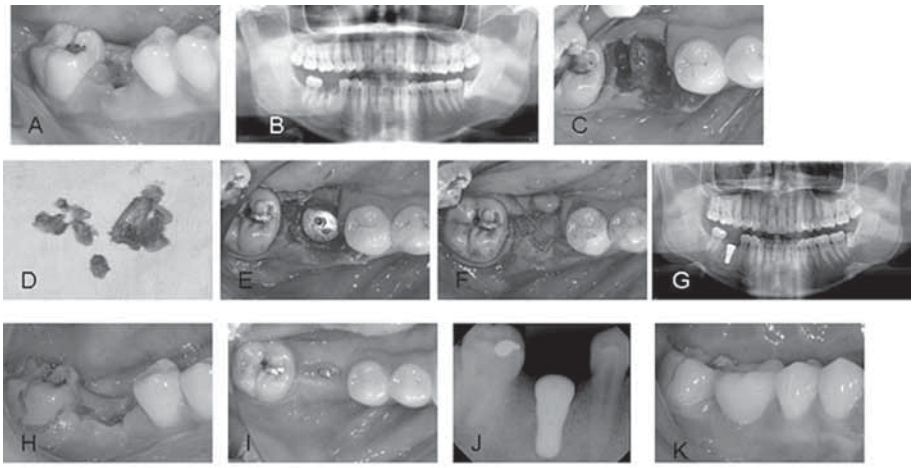


Fig 1. Patient 1, a 28 year old male with unrestorable mandibular right first molar (A). B , radiographic findings reveal no obvious peri-apical pathosis and adequate apical bone above inferior alveolar canal for engagement of implant. C and D, intact socket following tooth removal. E and F, implant placed as single stage, peri-implant socket space grafted with autogenous bone particles and collagen plug as crestal socket dressing. G, immediate post implant placement x-ray. H and I, one week and four months post placement clinical pictures showing uneventful healing. Note excellent soft tissue growth at 4 months, almost covering healing abutment. J, four months post placement x-ray. K, final crown

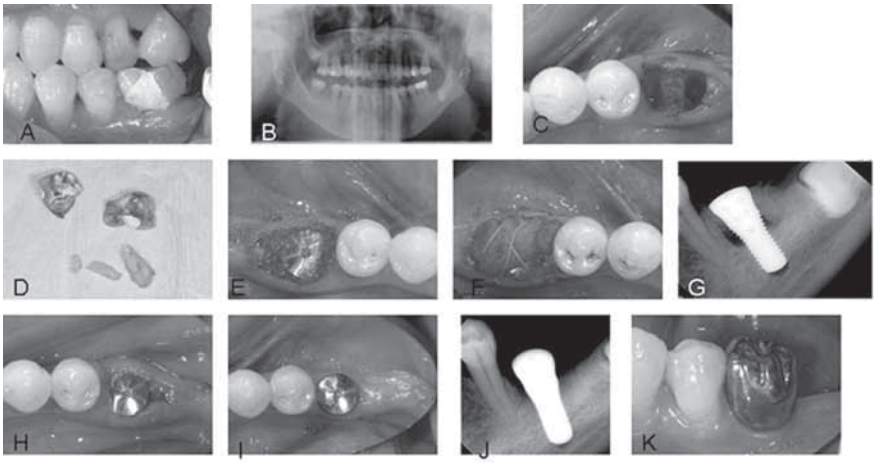


Fig2 . Patient 2, a 49 year old male with unrestorable mandibular left first molar (A). B, radiographic findings reveal no obvious peri-apical pathosis and adequate apical bone above inferior alveolar canal for engagement of implant. C and D, intact socket following tooth removal. However, socket appears avascular. E and F, implant placed as single stage, peri-implant socket space grafted with autogenous bone particles and collagen plug as crestal socket dressing. G, immediate post implant placement x-ray. Note encroached canal and poorly condensed grafting material. H and I, one week and three months post placement clinical pictures showing uneventful healing. J, three months post placement x-ray reveals good bone remodelling. There appears to be bony regeneration of the superior cortical canal. K, final crown

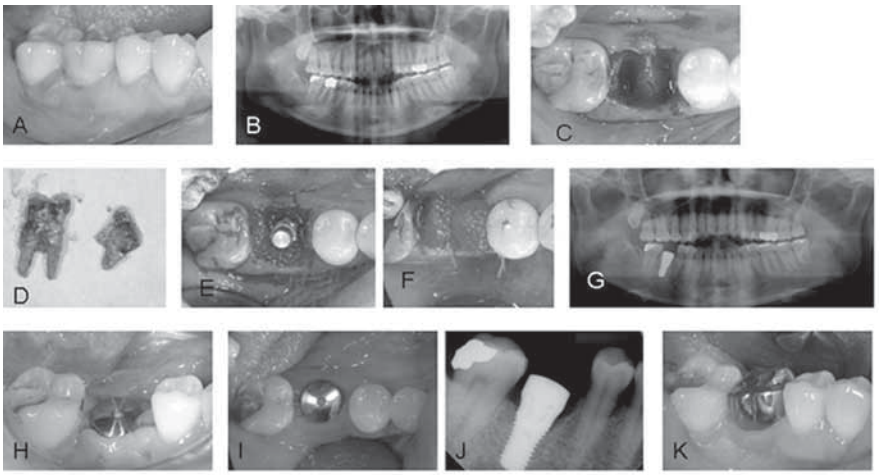


Fig 3. Patient 3, a 51 year old female with unrestorable, vertically fractured mandibular right first molar (A). B , radiographic findings reveal no obvious peri-apical pathosis and adequate apical bone above inferior alveolar canal for engagement of implant. C and D, intact socket following tooth removal. E and F, implant placed as single stage, peri-implant socket space grafted with autogenous bone particles and collagen plug as crestal socket dressing. G, immediate post implant placement x-ray. H and I, one week and five months post placement clinical pictures showing uneventful healing. J, five months post placement x-ray. K, final crown

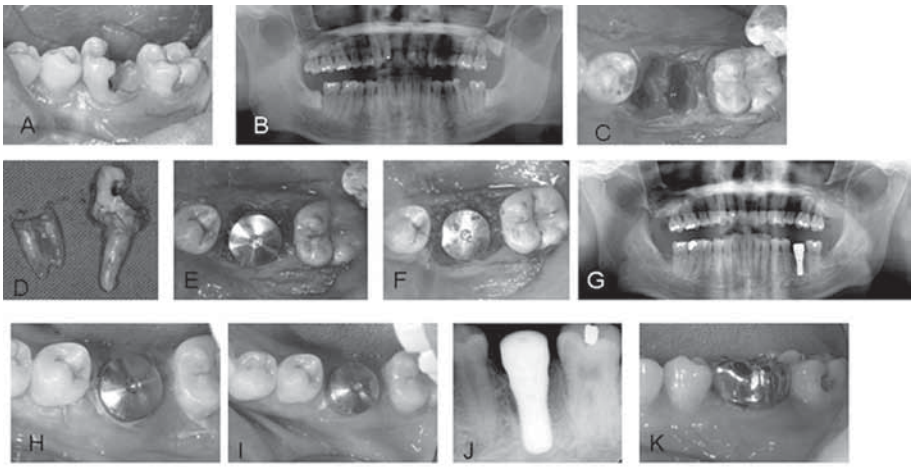


Fig 4. Patient 4, a 42 year old male with unrestorable mandibular left first molar (A). B , radiographic findings reveal no obvious peri-apical pathosis and adequate apical bone above inferior alveolar canal for engagement of implant. C and D, intact socket following tooth removal. E and F, implant placed as single stage, peri-implant socket space grafted with autogenous bone particles and collagen plug as crestal socket dressing. G, immediate post implant placement x-ray. H and I, one week and three months post placement clinical pictures showing uneventful healing. J, three months post placement x-ray. K, final crown

Resorbable collagen dressings (CollaPlug®, Colla-Tec Inc., American Biomaterials Corporation) were then secured over the socket-implant sites via figure of eight sutures.

Immediate postoperative radiographs were done as a baseline record and to confirm complete seating of the healing abutments.

The patients were discharged with postoperative medications consisting of oral Amoxicillin 500 milligrams eight hourly and Panadeine two tablets eight hourly or as when necessary.

Follow-up reviews were conducted at one week post-surgery, thereafter at a month and then referred for prosthodontic restoration after between three to five months of healing.

RESULTS

All the four extraction sockets had intact socket walls after extraction. Following placement of the implants, primary stability of all the cases were good as verified manually with a torque wrench.

All the four cases had good soft tissue architecture preservation at one week post-surgery with minimal oedema and there were no complaints of pain nor discomfort during the early postoperative healing period.

All the implants achieved successful osseointegration after a healing period of between three to five months. The residual peri-implant socket spaces were found to be well healed, exhibiting no implant thread exposures at the end of the healing phase.

The soft tissue architecture remained stable with preservation of adequate attached gingiva throughout the healing period of the implants as well as after final prostheses delivery, contributing to aesthetically pleasing and biologically sound results.

All four patients were very pleased with the functional outcomes of their treatment.

COMPLICATIONS

Only Patient 2 presented with surgical complications. The extraction was not straightforward and was complicated by repeated fractures of the crown during the procedure. The tooth had to be eventually removed in pieces by sectioning the roots with a surgical bur. However, the buccal and lingual walls of the socket were fortunately preserved intact following tooth removal. It was also noted that the bone quality of the socket was dense and relatively avascular in nature.

During the implant site preparation, the patient complained of increased painful sensitivity as the drills were reaching the final depth. At one point, he felt extreme pain and the drilling process was halted for inspection of the osteotomy. However, there was no pulsative bleeding observed from the base of the implant preparation (Fig. 2C). A final lavage of the osteotomy was carried out to ensure

a debri-free site before inserting the implant. The patient did not have further complaints of any pain or discomfort during the implant insertion.

The final seating was confirmed when the implant bottomed out at the base of the osteotomy and did not show further apical movement. The transmucosal polished collar was also verified to be at the correct crestal position 3mm beneath the gingival margin for proper crown emergence.

It was noted from the immediate postoperative periapical radiograph that the superior cortex of the inferior alveolar canal showed loss of cortical continuity at the apical tip of the implant. The bioactive glass bone substitute was also noted to be incompletely condensed around the middle third of the implant (Fig. 2G). The patient was informed of the findings and discharged.

At one week follow-up post-surgery, the patient did not present with any neurosensory disturbances and there were no other complications subsequently.

DISCUSSION

Immediate placements of dental implants into fresh extraction sockets present to the surgeon unique challenges not encountered in conventional implant placements.

Some of these challenges have been identified[10,11]:
a) Size of the extraction socket is larger than the size of the implant.

b) Infected, poorly vascularised, necrotic bone at the implant site.

c) Difficulty in the control of implant position and angulation.

d) Bony dehiscence/perforation of the bony housing during site preparation.

e) Incomplete seating of cover screws and/or healing abutments.

f) Difficulty in achieving primary stability.

These challenges arise fundamentally from the surgical objective, which is to insert an implant, essentially a symmetrical object, into an extraction socket which is variable in three-dimensional morphology. Relative to a healed ridge, an extraction socket, which is basically a bony defect, may be considered a compromised implant site. In particular at the lower molar socket, considerations must be given to the inferior alveolar canal to ensure that it would not be encroached during the site preparation.

Therefore, the surgeon performing this procedure should possess adequate experience with conventional methods before taking on such cases.

However, if carried out correctly, the benefits of this protocol are deeply appreciated by both the clinician and patients because it minimises the number of surgical procedures in the whole treatment as a single stage protocol is employed.

There is a paucity of well-controlled, randomised clinical trials documenting immediate placements of dental implants into fresh extraction sockets. A comprehensive review by Chen et al [4] in 2004 revealed that most reports were non-randomised with respect to the timing of implant placement and bone augmentation used. Only four longitudinal studies with mean follow-up of three to five years were reported and the rest consisted of case reports with an observation period of 12 months or more. There is also a lack of a consistent, well-defined protocol in terms of patient selection, investigations and surgical technique available in the literature.

However, absolute contraindications to immediate implant placements have been agreed to by many and they are as follows[12,13,14]:

1.Presence of periodontal disease.

2.Presence of acute/subacute periodontal or periapical infection.

3.Unfavourable anatomy.

Presence of the above should automatically exclude a case from immediate implant placement. All the patients in this case series underwent detailed surgical and prosthodontic evaluation prior to surgery. The most important issue addressed at this stage was the bone volume adequacy for implant placement. All the bony assessments were done with the aid of a panoramic radiograph only. Particular attention was paid to the amount

of bone beyond the root apices and superior to the inferior alveolar canal for engagement of the implant without encroaching the canal. This would be the single most important factor in determining primary implant stability.

The surgical protocol was standardised for all four cases. All four teeth were extracted with minimal trauma by first luxating them with a periotome. This was a useful technique, resulting in preservation of intact labial walls of all the four sockets, which is required for soft tissue framing[15].

In addition, the site preparations had to be carried out in strict accordance to the planned implant positions as dictated by the surgical guide in ensuring a restorable outcome. The author would like to stress that the implant needs to be placed in a three-dimensional position relative to the final crown morphology and not into any one of the multi-rooted sockets that best conform to the implant dimensions. Failing to do so would compromise the restorative outcome.

The author felt that this was the most challenging phase of the surgery as the relatively large discrepancy between the dimensions of the molar sockets and the diameters of the drill present a unique challenge of creating a congruent osteotomy. Furthermore, encroachment of the inferior alveolar canal must also be avoided.

In all the cases, there were no bony fenestrations after osteotomy. This was achieved because the osteotomies were carried out entirely within the confines of the sockets according to the surgical guide.

Once this key phase is over, the implant placements would be relatively straightforward. All four implants demonstrated good primary stability. All the residual peri-implant socket distance for all the implants were found to be more than 2mm. Hence grafting was performed for all the peri-implant socket gaps as recommended by Chen et al[4].

The choice of graft material was made predominantly by its ready availability. In Patients 1 and 4, autogenous bone was used as there was simultaneous mandibular impacted wisdom teeth removal.

The bone was harvested from the ramus after removal of the wisdom teeth and particulated for grafting into the residual peri-implant socket. Patients 2 and 3 had Bioactive Glass.

A single stage protocol was adopted in this case series. The author wish to mention that the choice of healing abutments is important at this stage because healing abutments with excessive cervical flare or customised anatomical abutments usually present with incomplete seating due to possible interference by the crestal socket bone. All healing abutments chosen in this case series were without flare and of adequate height to emerge slightly above the socket (Table 2). This prevents soft tissue overgrowth over the healing abutments. All the healing abutments were verified to be well seated by immediate post-surgical periapical radiographs.

There is also lack of data regarding the requirement of complete soft tissue coverage in single stage immediate implant placement. A report by Schwartz-Arad D[16] in a report of nine patients indicated that implants can be successful without sealing the socket orifice with a resorbable membrane.

In his protocol, the author used a resorbable collagen sponge dressing over the socket, including the healing abutment and graft material, primarily as a blood clot stabilisation.

All four patients were very pleased with the final outcomes of their treatment. Though patient 2 had radiographic evidence of inferior alveolar canal encroachment from site preparation, there was no prolonged postoperative mental paraesthsia.

In retrospect, the author felt at the first instance when the patient complained of pain during drilling, a decision should have been made to change the depth of drill to 10mm instead of 12mm. This is because from anecdotal experience, pain and sensitivity would be experienced as the drills approach within 2mm away from the canal. Had this precaution been taken, perforation of the superior cortex of the canal would have been avoided.

CONCLUSION

Immediate implant placements into fresh extraction sockets of mandibular molars should not be attempted by the novice surgeon. However, with good case selection following detailed clinical

and radiographic examination, adequate clinical experience and judgement, this protocol that is well received by patients can lead to successful functional outcomes in the short-term.

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