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Research Article

IMMEDIATE IMPLANT PLACEMENT IN A MANDIBULAR MOLAR

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A B S T R A C T

Immediate dental implants have greatly reduced the treatment time and the number of surgical interventions. This case report describes a 40 year old male patient who reported with a fractured left mandibular second molar which was followed up by extraction and an immediate placement of an endosseous implant with xenograft, collagen membrane and closed with sutures. The prosthetic rehabilitation was done after 4 months with a screw-cement retained metal ceramic crown.

INTRODUCTION

Dental implants have become a standard treatment option for replacement of missing teeth. Originally, it was standard protocol to wait for a period of 4 to 6 months after tooth extraction to place the dental implant. This was to allow the healing of the alveolar bone. However, this waiting period was a major disadvantage of this treatment modality as it would result in bone loss and a second surgical intervention was required in the same area. Subsequently, attempts were made to shorten this duration of waiting period. Techniques such as early placement, immediate delayed placement and immediate placement were developed. The immediate implant placement in an extraction socket was first described by Schulte and Heimke in 1976.[1]

The first classification described the timing of implant placement as mature, recent, delayed or immediate depending on soft tissue healing and predictability of Guided Bone Regeneration (GBR) procedures. However further classifications based on hard and soft tissue healing and treatment time approach were subsequently described, as shown in (Table 1) (2,3)

Table 1 Timing of implant placement

Author / Year	Classification	Implant placement
Hämmerle et al. (2004)	Type I	In fresh extraction sockets
	Type II	After soft tissue coverage (4- 8 weeks)
	Type III	Radiographic bone fill (12-16 weeks)
	Type IV	Healed socket (>16 weeks)
Esposito et al. (2006)	Immediate	In fresh extraction sockets
	Immediate-delayed	< 8 weeks post extraction
	Delayed	> 8 weeks post extraction

The efficacy of GBR therapy employing autogenous and non-autogenous particulate materials combined with various membranes to regenerate alveolar bone at the time of tooth extraction has also been demonstrated. Concomitant placement of regenerative materials has been shown to result in predictable, high levels of osseointegration (4).

Not only are the time period and number of surgeries reduced, there is better aesthetics, higher patient satisfaction as compared to delayed implants and prevention of undue resorption bound to happen post extraction. It also allows for maintenance of gingival form and promotes peri-implant gingival tissue esthetics by maintaining the interdental papillae. Small osseous defects, which are frequently found adjacent to implants placed at the time of tooth extraction, can be grafted with autogenous or synthetic bone grafts. In this case report the harmony of hard and soft tissues was preserved by immediate implant. There are many indications for

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immediate implant placement such as tooth extraction due to root fracture secondary to trauma, root resorption, failed RCT, anterior tooth replacement for aesthetic reasons.

Case Report

The case report describes a 40 year male patient who reported with excruciating pain in the lower left back tooth region. The tooth 37 was fractured. After careful clinical examination and a CBCT, unfavourable prognosis for the tooth was explained to the patient. The patient had a previous bad dental experience due to which he opted to undergo extraction under general anaesthesia and early rehabilitation was opted for and an immediate implant placement was planned. Pre surgical radiographic evaluation was carried out with a CBCT scan (Fig. 1). After measuring the socket dimensions a Biohorizon implant (tapered internal, laser-lok, 4.5plat) of size 4.6*12 mm was selected. The fractured tooth was atraumatically extracted using a periotome (Fig. 2). The extraction sockets were evaluated for any osseous defects, infection or granulomatous tissue. The sockets were thoroughly debrided with curettes and saline solution and after sequential drilling under copious cold saline irrigation, the implant was placed (Fig. 3). The jumping distance between the implant and the cortical bone, was filled with bio-oss bone graft (it is a bovine derived xenograft) and bio-guide membrane. The closure of the site was done using 4-0 polypropylene sutures and a healing abutment (Fig. 4) was placed to avoid the second stage surgery and also to avoid losing attached gingiva after a periosteal release for a buccal advancement flap to close the huge socket . Primary stability of 40Ncm was achieved by wrenching the implant into the bone beyond the apex of the socket. Atraumatic operating technique, strict asepsis and the immediate insertion of the Implant resulted in the preservation of the hard and soft tissues at the extraction site. After 4 months a closed tray impression was made, using implant analogues and transfer coping, using addition silicone impression material. A metal ceramic prosthesis was fabricated. (Fig. 5) Post operative IOPAR was taken. Follow up was done over a period of 18 months.

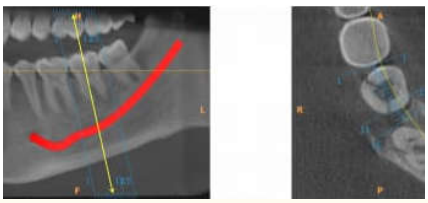


Fig. 1

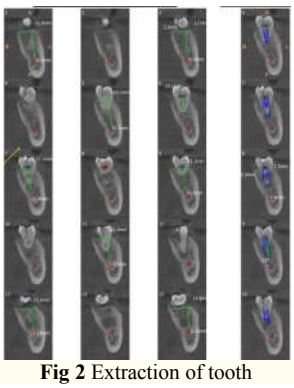


Fig 2 Extraction of tooth

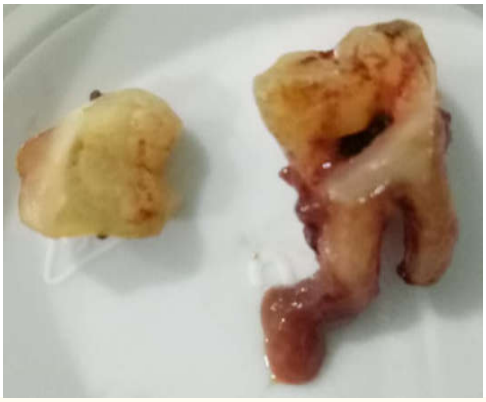
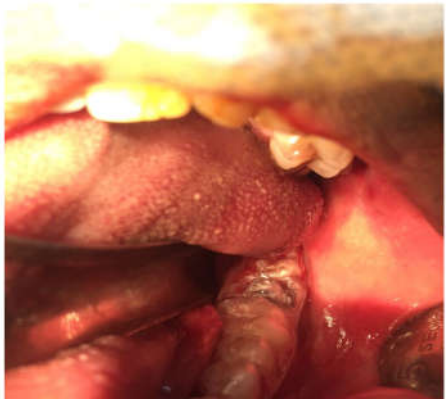


Fig 3 With non limiting design surgical stent in place after flap elevation



Checking parallelism after implant placement

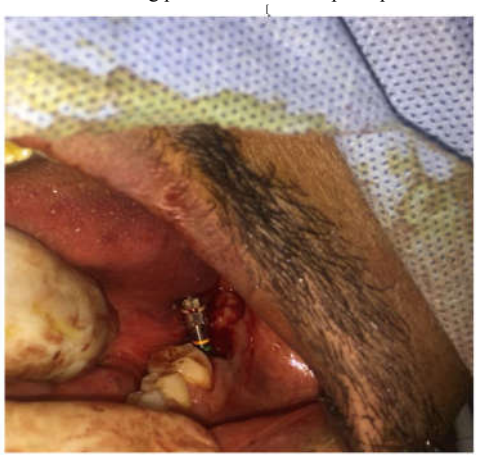
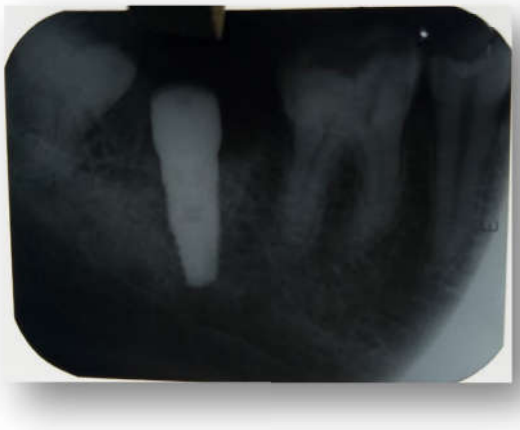


Fig 4 IOPA of implant in position: a 1 week post-op, b At 3 months,



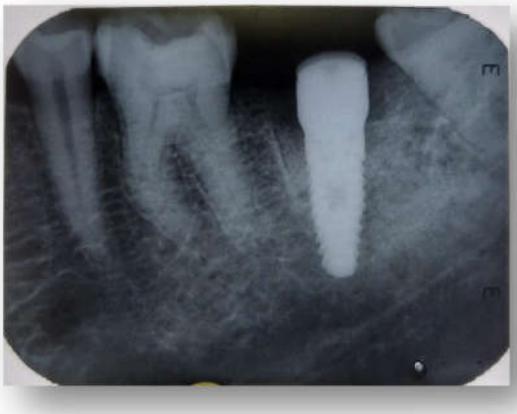
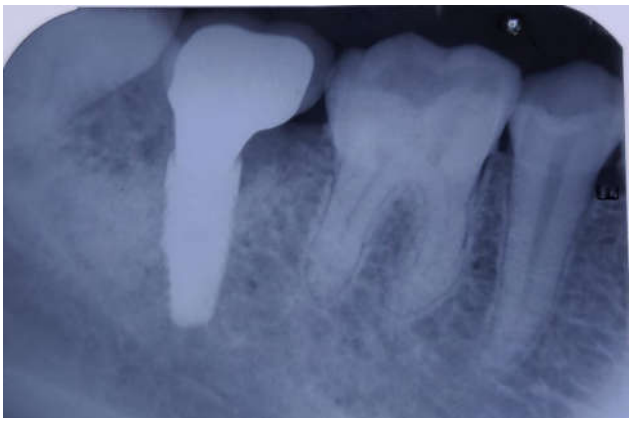
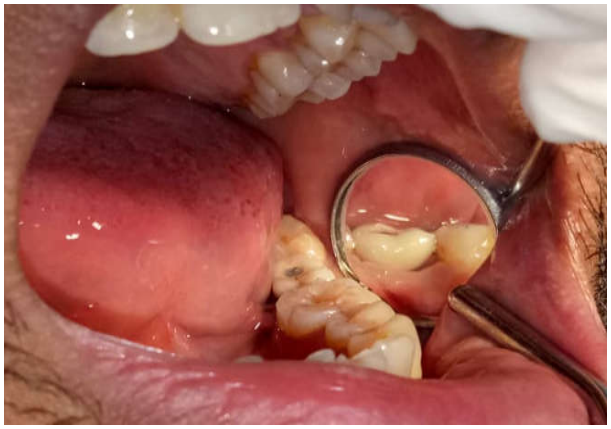


Fig 5 Screw cement retained PFM





DISCUSSION

In the modern era, immediate implant concept is gaining popularity for replacing missing teeth, especially when anterior teeth are missing. Krump and Barnett reported high success rates with dental implants placed at the time of extraction.[5] Evidence has shown that immediate implant placement presents more advantages as compared to delayed implant insertion, which are implants in fresh extraction sites can be placed in the same location as the extracted tooth thereby minimizing the need for angled abutments, osseointegration is more favorable, the bony receptors are preserved by preventing atrophy of the alveolar ridge thereby preventing recession of the mucosal and gingival tissues, immediate placement of implants keeps contaminants away from the extraction socket, waiting times for primary healing of the soft tissues, and regeneration of the osseous structure are eliminated, immediate restorations can be provided for better esthetics.

One year after implant loading the survival rates were 93.3% with clinically insignificant crestal bone loss. Others have used various materials and methods including demineralised freeze dried bone and barrier membranes to augment edentulous ridges and small defects adjacent to dental implants.[6,7,8,9,10]

Concept of Osseointegration

Endosseous wound healing comprises of stages of hematoma formation, clot resolution and osteogenic cell migration which leads to the formation of new bone. The osseous healing phase consists of-

1. Osteoconduction that relies on recruitment and migration of osteogenic cells to implant surface
2. *De nevo* bone formation
3. Bone remodeling

Ossteointegration was defined by Branemmark [11] as a direct structural and functional connection between living bone and the surface of a load-carrying implant. Osborn and Newesley [12] proposed the concept of contact or distance osteogenesis. While the former involves *de nevo* bone formation directly on the implant surface, the latter is formation of new bone on the surfaces of existing peri-implant bone. Immediately after implantation serum proteins adhere, and during the first three days mesenchymal cells attach and proliferate. Osteoid formation and matrix calcification occurs by 6 days and 14 days respectively. Remodelling starts by 3 weeks.

Rationale of using Bone Graft with Implants

Bone grafts are used along with implants in procedures such as sinus lift, immediate implant placement in extraction sockets and ridge augmentation. Bone grafts serve as a scaffold and promote bone formation.

According to Schmitz and Hollinger [13], a critical–size defect does not heal spontaneously without placement of the graft during the healing period. Thus bone augmentation is recommended in gaps wider than 2mm left between socket wall and coronal neck of the implant during immediate

implant placement. All grafts have their unique properties owing to which they are usable in different conditions.
Structure and Biochemical Properties of different grafts

Autografts

These contain properties of osteoinductivity due to bone morphogenic protein (BMP), osteoconductivity due to bone mineral and collagen and osteogenecity due to osteoblastic cells, preosteoblastic precursor cells. Insufficient amount, morbidity are the drawbacks. Autografts can be of three types: bone marrow, cancellous and cortical.[14]

Allografts

These are graft materials harvested from different individuals of the same species and require processing in order to lessen antigenecity and disease transfer. They are osteoconductive, osteoinductive. Immunogenecity is decreased when grafts are deep frozen and even more when freeze dried.[14]

Xenograft

These are obtained from the bone of individuals of other species, their composition and biomechanical properties being almost similar to bone. Two illustrations of xenograft used in dentistry are:

1. Coral-derived bone substitutes having geometry similar to that of human cancellous bone
2. Demineralised bovine bone grafts, biocompatible and osteoconductive. There are two types of demineralization: a) high temperatures b) chemical extraction of calcium and other minerals[15]

Alloplast

These are synthetic osteoconductive materials with composition similar to bone e.g. calcium phosphates, bioactive glass, hard tissue replacement polymer[16]

Cellular and Molecular Events after Bone Grafting

Autografts

An autograft is very osteogenic, easily revascularized and rapidly incorporated. It lacks mechanical strength, but this is balanced by early production of new bone. Active bone formation and resorption occurs 4 weeks of graft placement. In the secondary phase, osteoblasts lay down seams of osteoid that surrounds the core of dead bone. The most important difference between cortical and cancellous grafts is in the rate of vascularization and degree of osteoinduction, which is less in the former due to the dense architecture and lower number of endosteal cells. For osseointegration of the graft to proceed successfully, the host tissue must have sufficient vascularity to diffuse nutrients to the cells before revascularization occurs and bud new capillaries into the graft to create a more permanent vascular network. Osteogenesis is activated by surgical trauma, which releases a large quantity of cytokines with osteogenic effects, such as BMP-2, platelet-derived growth factor (PDGF), tumor growth factor-β (TGF-β), and vascular endothelial growth factor (VEGF). This repair reaction with the formation of woven bone originates from the bone walls subjected to trauma, which stimulates the osteoblastic precursors, due to exposure of the bone matrix, and also acts as a solid wall for attachment of the osteoblasts. Placement of the graft with autogenous endosteal osteoblasts embedded within creates a biochemical environment at the recipient site that is hypoxic (O2 tension of 3-10 mmHg), acidotic (pH4.0-6.0), and rich in lactate. Osteoblasts survive the first 3-5 days after transplant to the host site because of their surface positioning and ability to absorb nutrients from recipient sites. The platelets trapped in the clot degranulate within hours and release the PDGF depending on the oxygen gradient of the graft incorporated, with mitogenesis of osteocompetent cells and angiogenesis of the capillaries at the recipient site. By 3 days, budding capillaries are seen outside the surface of the graft, which penetrate the graft and form a vascular network by 10-14 days. PDGF is then replaced by macrophage-derived growth factor (MDGF) and other mesenchymal tissue stimulators from the TGF-β family. During the initial week of graft placement only minimal osteoid deposition is noted, but after established vascular network formation, due to abundant oxygen and nutrient availability, acceleration in bone healing is noticeably seen. Consolidation of the graft during the first 3-4 weeks by the chemical and cellular phase activity of bone healing enables formation of a scaffold framework for initiation of the osteoconductive phase of healing. This phase of bone healing with cellular regeneration is referred to as phase-I bone regeneration, where disorganized woven bone similar to fracture callus is formed. The addition of certain growth factors to the material, such as PDGF, recombinant human BMP (rhBMP), TGF-β, and insulin growth factor (IGF),increases the speed and quantity of bone regeneration.Phase-I bone undergoes resorption and remodeling until its eventually replacement by less cellular, more mineralized and structurally organized phase-II bone forms. Phase-II bone is initiated by osteoclasts that arrive at the graft site through the newly developed vascular network. This bone forms as in response to demands placed by the jaw and graft working in function. This bone develops into mature Haversian systems and lamellar bone that can withstand normal shear forces from the jaw and impact compressive forces that are typical of dentures and implant-supported prostheses.[17]

Allograft

Cancellous allograft is a poor promoter of bone healing compared to autograft. Allografts are incorporated faster than their cortical counterparts. They act as a scaffold onto which host bone is laid. They are never completely resorbed and thus remain entrapped in the host bone.[14] Bone formation starts from the defect walls and progresses toward the center. Along the interface, spots of apparent mineral deposition arise between the mineralized woven bone and the demineralized matrix [demineralized freeze-dried bone allografts](DFDBA), which are spherical and cylindrical precipitates having diameters 3-5 pm at around 4 weeks, as seen in an animal study on minipigs.[18] Recalcification of DFDBA is restricted to areas where new mineralizing bone matrix is deposited on their surface. Sites where the particle surface faces the marrow tissue stay nonmineralized. At 12

weeks, bone formation spreads over the whole defect area, but it still includes a considerable amount of the grafted material and represents a composite of partially recalcified DFDBA, woven bone, and most superficially, lamellar bone deposits. Remodelling starts and osteoclastic resorption extends along bony surfaces as well as on recalcified DFDBA particles.

Xenograft

Coral-derived HA According to the study on minipigs,[18] at 4 weeks the rather compact coral-derived HA granules are evenly dispersed in the defect sites and are invaded by dense fibrous tissue and bony trabeculae. Thin layers of woven bone cover the outer surface of the granules as well as the lining of their pores. At 12 weeks, the bony filling of pores and interspaces becomes much denser. Half of the newly formed bone still consists of woven bone, reinforced by parallel-fibered and lamellar bone. The overall remodelling activity, however, is low. At 24 weeks, the composite of coralline filler and bony regenerate seems the same except for the maturity of the bone structure.

Enhanced remodelling replaces much of woven bone with lamellar bone but is restricted to the bone compartment, not extending into the adjacent coralline material.

Alloplast

Calcium phosphate-based graft materials Several calcium phosphate parameters can affect cellular activity: dissolution, composition, topography, surface energy. After colonization of the substrate by monocytes/macrophages that are recruited during the inflammatory reaction following surgery, osteoclasts are responsible for bone resorption. They degrade calcium phosphate ceramics in a similar way to bone mineral: osteoclasts attach firmly to the substrate-sealing zone. In the center of this sealing zone, they secrete H+ leading to a local pH = 4-5. In vivo, osteoclasts participate partially in the degradation of calcium phosphate ceramics into the minerals available for the bone regeneration by providing the space required for bone formation.[19] Defects grafted with β-TCP in minipigs showed newly formed bone throughout the defects at 4 weeks,but the amount and maturity was less than that seen with autograft. Graft particles had almost disappeared, also, and were substituted by bone. At 8 weeks complete trabecular bone filling is seen, with β-TCP almost resorbed by dissolution rather than cellular resorption.

Contraindications

The existence of an acute periapical inflammatory process, abscess and granulation tissue in the implant site constitutes an absolute contraindication to immediate implantation.

In the case of socket-implant diameter discrepancies of more than 5mm which would leave most of the implant without bone contact, prior bone regeneration and delayed implant placement may be considered. Avoid immediate implant placement with huge labial bony dehiscence or fenestration defects, insufficient bone apically to ensure primary stability of the implant.

CONCLUSION

It was found that the immediate implant therapy has several advantages such as reduced treatment length, preservation of soft and hard tissues surrounding the implant and reduced number of operations in a carefully selected case.

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