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Original Research Article

Immediate implant placement of BCS implant with and without platelet rich fibrin – An original research

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ABSTRACT

Recently, immediate implant placement has rapidly gained popularity as this procedure definitively shortens the duration of the treatment, reduces the number of surgical sessions, and minimizes the discomfort of patients. However, the clinical effectiveness of immediate implantation in the molar regions has rarely been challenged. It has been reported that immediate implant placement does not seem to counteract alveolar ridge alteration and reconstruction after tooth extraction.

1. Introduction

Traditional techniques for replacement of lost tooth with an implant involves a two-stage surgical approach with a healing time for implant integration and a transitional period during which the patient bears a temporary, removable prosthesis. Branemark and colleagues recommended a stress-free unloaded healing period to ensure osseointegration of endosseous implants.[1–4] High success rates for the two-stage implant protocol have been documented.[5–8] A healing period approximately 4-6 months without loading has been traditionally accepted protocol for obtaining mineralized bone at the dental implant interface. It was believed that premature loading of the implant could induce the formation of fibrous connective tissue instead of bone at the implant interface. In cases where the implant was loaded earlier, highly mineralized bone tissue, not fibrous tissue, was found at implant interface. Immediate loading means delivering a prosthetic restoration (temporary or definitive) at the same time the implant is placed or within 48 hours following surgery. The patient is able to obtain acceptable esthetic result during the initial treatment period, and functional rehabilitation is improved. The long treatment period that involves the wearing of a temporary prosthesis may be of great inconvenience which often cause compromised patient compliance, and is sometimes the reason for not choosing implant supported prosthesis at all. Recent reports have documented the successful placements of dental implants into the fresh extraction socket in the anterior as well as in molar regions.[9] Immediate loading today is a widely accepted practice all over the world. It is the treatment of choice for most Implantologists.

Augmentation procedures tend to increase the risk and cost of dental implant treatment as well as the number of surgical procedures. Patients who have severely atrophied jaw bones paradoxically receive little or no

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treatment.[10] Therefore an alternative is required which can compensate for the loss of crestal bone so as to benefit such patient with inadequate crestal bone loss dimensions.

Basal implantology also known as bicortical implantology or just cortical implantology is a modern implantology system which utilizes the basal cortical portion of the jaw bones for retention of the dental implants which are uniquely designed to be accommodated in the basal cortical bone areas.[10] The basal bone provides excellent quality cortical bone for retention of these unique and highly advanced implants. Especially with high retentive macro thread designs and use of cortical anchorage; use of single piece implants for this treatment modality is very reliable. Basal implants are placed trans-osseously and anchored in the basal, cortical bone. The two critical factors that determine the success of an immediately loaded implant is the proper insertion of the implant into basal bone with optimum primary stability and then the prevention of over loading of the bone to implant interface during the healing period. During the first phase of bone remodelling, due to osseous remodelling there is an onset of osteoclastic activity. This causes the decrease in the primary stability of the implant and likewise a decrease of the resistance of the bone around the implant.[11] The concept of primary stability is of paramount importance for the survival of immediately loaded implants

Bicortical screws (BCS) are also considered basal implants, because they transmit masticatory loads deep into the bone, usually into the opposite cortical bone, while full osseointegration along the axis of the implant is not a prerequisite. BCS provide some elasticity, atleast initially and they are not prone to peri-implantitis due to their polished and their thin mucosal penetration diameter. In cases with profound periodontal involvement, the alveolar bone is already compromised and weakened, by using the basal cortical bone (2^{nd} cortical), it is possible to place implants immediately following the extractions and debridement of sockets.[12,13] Screwable basal implants (BCS brand) have developed with 3.5mm to 12mm thread diameter and length of 10-38mm.

This immediate placement minimizes the need for angulated abutments, osseointegration is more favourable, the bony receptors are preserved by preventing atrophy of the alveolar ridge, preventing recession of the mucosal and gingival tissues, keeps contaminants away from the socket. Waiting times for primary healing of the soft tissues and regeneration of the osseous structure are eliminated. Non-functional restorations can be provided for better aesthetics, especially in the anterior region. The other important factor which enhances the success rates of implants is PRF".

Platelet rich fibrin (PRF) is an autologous fibrin matrix that belongs to a new generation of platelet concentrates, with simplified processing and without biochemical blood handling. Platelet rich fibrin has numerous growth factors, such as platelet-derived growth factor (PDGF), Transforming growth factor (TGF) and insulin like growth factor (IGF). These growth factors accelerate early bone regeneration by increased angiogenesis, chemotaxis, mitosis, and stem cell proliferation. It offers several advantages which include promotes of wound healing, bone growth and maturation, wound sealing and hemostasis. Thereby it improves the overall bone regeneration after immediate implant placement.

Hence, this study was to compare the outcome of BCS implant placement with platelet rich fibrin (PRF) and without platelet rich fibrin.

2. Materials and Methods

The present study is conducted on 16 patients, who had to undergo dental extractions and teeth replacement. Group 1 consists of 8 patients in whom implant placement will be done with PRF and Group 2 patients consists of 8 patients in whom implant placement will be done without PRF. Post-operative radiographs are taken for assessment.

2.1. Inclusion criteria

1. Patient in need of extraction of grossly carious teeth, root stumps or periodontally compromised teeth.
2. Age more than 18 years.
3. ASA TYPE 1 Patients.
4. Adequate quality and quantity of bone to achieve primary stability.
5. Presence of adequate mesio-distal space for implant placement.
6. Platelet count more than 1,50,000/mm^3

2.2. Exclusion criteria

Any condition, disease or medication that might compromise healing or osseointegration.

1. Patients who are treated with radiation therapy.
2. Patients with severe bruxism.
3. Acute infection/inflammation, associated with teeth to be extracted.
4. Peri-apical cyst or any other significant peri-apical pathology.

2.3. Methods

2.3.1. Surgical procedure

Each case was precisely evaluated by thorough extraoral and intraoral examination followed by complete medical history. Intraoral periapical and panoramic radiographs were taken. A written consent was obtained from all the patients. Pre-operative oral prophylaxis was done. All the patients were operated under antibiotic coverage with standard dosage of tablet Augmentin 625 mg (Amoxicillin 500 mg

plus Clavulanic acid 125 mg) and Metronidazole 400mg (metrogyl/ flagyl) 24 hours prior to surgery. The patients were advised to use 0.2% Chlorhexidine mouthwash 3 times a day one day before scheduled surgical appointment. The treatment protocol proceeded as follows: 2% lidocaine with 1:200000 epinephrine was administered locally in addition to indicated nerve block to achieve adequate anesthesia and hemostasis. A crevicular incision, if required, was given and a full thickness mucoperiosteal flap was reflected. Periotome was used to break the periodontal ligament fibers and tooth was extracted out of the socket with a minimal trauma to the surrounding bone, using dental forceps. Only the teeth with adequate bone thickness were included in the study. Following tooth extraction, the extraction socket was debrided thoroughly.

An osteotomy, minimum of 2 mm was done using a pilot drill beyond the apex in both the maxillary and mandibular extraction socket. Then a guide pin/pilot drill was inserted into the prepared osteotomy and a RVG was taken to assess osteotomy depth and angulation. After confirming the proper depth and angulation the initial osteotomy was enlarged with successive twist drills.

After assurance of proper angulation and final osteotomy the implant placement was done. This was followed by an intraoral RVG at the end of surgery. The mucoperiosteal flap, if reflected, was repositioned and passive soft tissue primary closure was achieved. Interrupted 3-0 silk sutures were placed.

Post-operative pharmacological protocol was followed which included tablet Augmentin 625 mg (bid) for 5 to 7 days, Metronidazole 400 mg (tid) for 5 to 7 days & tablet Diclofenac Sodium 50 mg (bid) for a minimum of 3 days. The sutures were removed after 5 to 7 days.

Alginate impression was taken and temporary crown (non-functional) was fabricated and cemented within 48 hours of implant placement and permanent crowns were placed after 3 months. Follow up was done at an interval of 1, 2, 3, 6 months.

2.3.2. PRF preparation and placement

The PRF was prepared fresh just before placement at the surgical site. For the PRF preparation10 ml of blood was drawn from the antecubital vein and transferred to the test-tube without anticoagulant. The blood sample was immediately centrifuged at 3000 rpm for 10-12 min. After centrifugation fibrin clot was squeezed between gauze-piece to obtain PRF.

2.3.3. Radiographically

1. Standardized intraoral digital periapical radiographs (Kodak 5100) were taken during pre-operative assessment, immediately after surgery & post operatively at a follow up period of 1, 3 and 6 months.

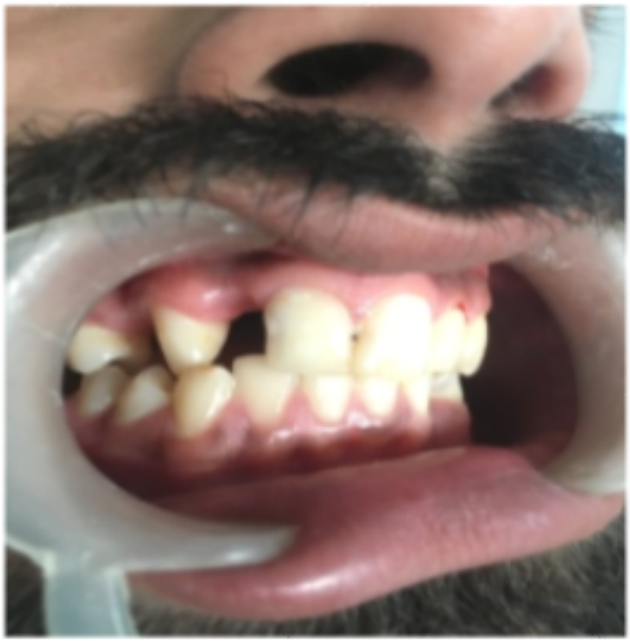

Fig. 1: Preoperative intraoral photograph

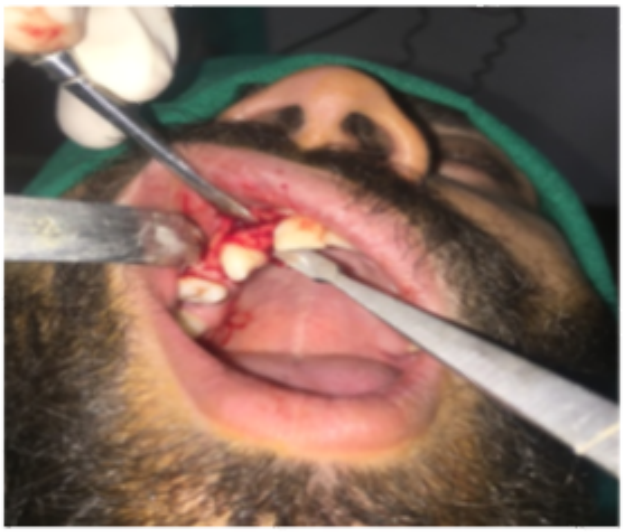

Fig. 2: Intraoral view

2. Long cone paralleling technique was used to take radiographs.
3. Non-metallic radiographic grid (X-RAY MESH GAUZE)[14] with a pre-measured 1 mm ×1 mm canvas meshwork & 1mm^2 frameworks was used.

2.3.4. Evaluation of clinical and radiographic

1. Both the clinical and the radiographic parameters were evaluated to estimate the overall success rate of the implant.

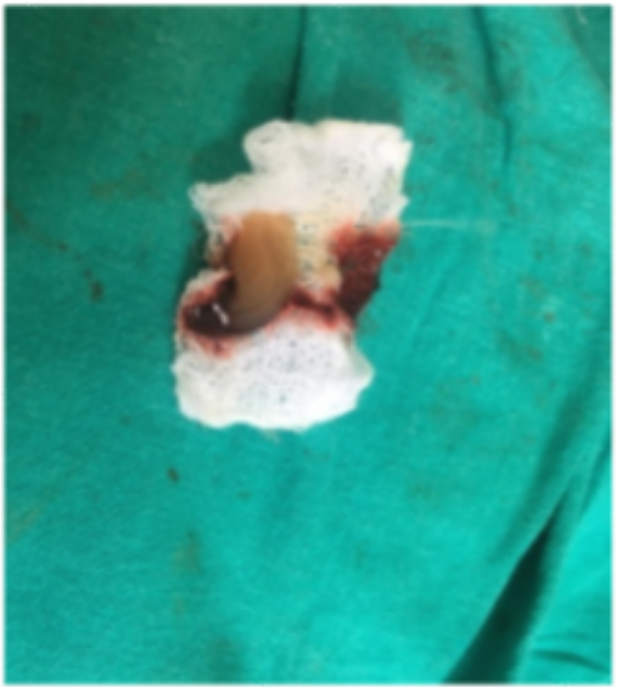

Fig. 3: PRF prepared for osteotomy site

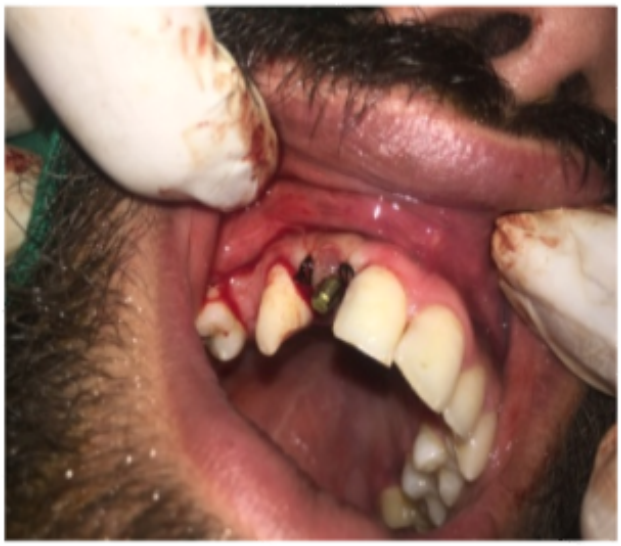

Fig. 4: Primary closure done

2.3.5. Clinical parameters

The following clinical parameters were assessed:

A. Implant Stability: This was done by evaluation of Implant Mobility.

B. Mucosal Health of Peri-implant tissue: This included healing of gingival margins around the implant (gingival index).

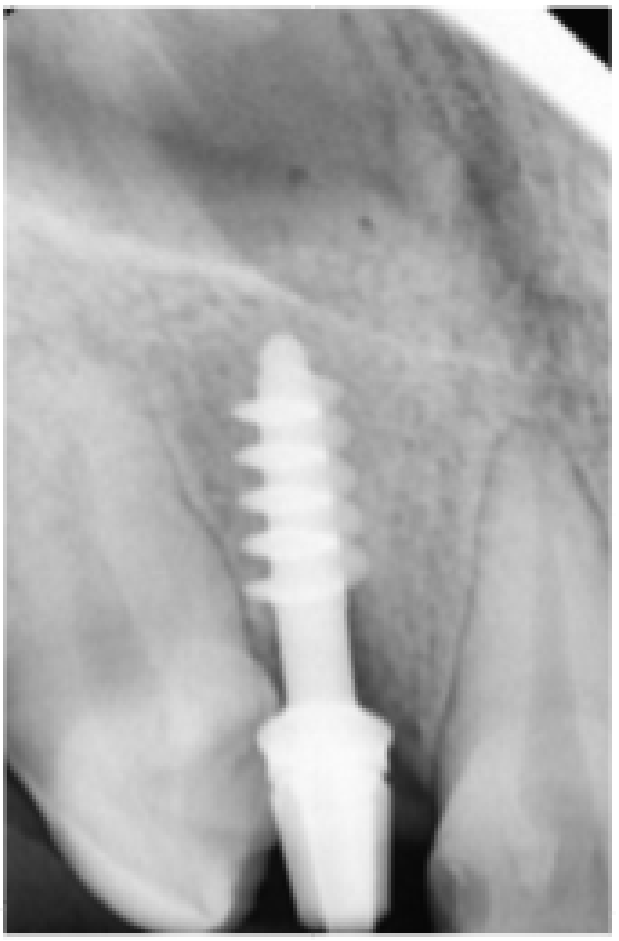

Fig. 5: Post-operative Radiograph

2.3.6. Radiographic parameters

1. Implant's neck was considered as the main reference point for measurement of bone loss.

3. Results

The mean mobility of all implants in group 1 (with PRF) in immediate post operatively and at 1 month, 3 and 6 months was 0 and in group 2 (without PRF) 2 implant showed mobility at immediate post-operative till 1 month. After that none showed mobility. In PRF group there was a significant increase in Gingival Index Score preoperatively to 7 days, till 6 months ($p<.001$); which is very highly significant. With PRF the mean Crestal Bone Loss at 6 months was 0.68±0.16. Without PRF the mean Crestal Bone Loss at 6 months was 0.70±0.19. 14 out of 16 cases showed good overall optimum success rate forming 87.5% of the study sample during a follow up of 6 months. 02 out of 16 cases showed satisfactory overall success rate forming 13.33% of the study sample during a follow up of 6 months.

4. Discussion

The bone which ultimately remains after resorption of the alveolar bone following loss of teeth is the basal bone which lies below the alveolar bone. This basal bone is less prone to bone resorption and infections. It is highly dense, corticated and offers excellent support to implants. The conventional implants are placed in the crestal alveolar bone which comprises of bone of less density and is more prone to resorption. The basal bone is less prone to bone resorption because of its highly dense structure. The implants which take support from the basal bone offer excellent and long-lasting solution for tooth loss. At the same time, load bearing capacity of the cortical bone is many times higher than that of the spongious bone.[15]

Basal implantology also known as bicortical implantology or just cortical implantology is modern implantology system which utilizes the basal cortical portion of the jaw bones for retention of the dental implants which are uniquely designed to be accommodated in the basal cortical bone areas. Because basal implantology includes the application of the rules of orthopedic surgery, the basal implants are also called as "orthopedic implant".[12]to mark a clear distinction between them and the well-known term "dental implant".

First single-piece implant was developed and used by Dr. Jean-Marc Julliet in 1972. Because no homologous cutting tools are produced for this implant, its use is fairly demanding. In the mid-1980s French dentist, Dr. Gerard Scortecci, invented an improved basal implant system complete with matching cutting tools. Together with a group of dental surgeons, he developed Disk-implants. Since the mid-1990s, a group of dentists in Germany have developed new implant systems and more appropriate tools, based on the Disk-implant systems. Dr. Stefan Ihde introduced bending areas in the vertical implant shaft. In 2005, the lateral basal implants were modified to screwable designs (BCS).[15]

These screwable basal implants are flapless implants and are inserted through gum, without giving a single cut after extraction of teeth. Bi-cortical screws (BCS) are also considered basal implants, because they transmit masticatory loads deep into the bone, usually into the opposite cortical bone, while full osseointegration along the axis of the implant is not a prerequisite. BCS provide at least initially some elasticity and they are not prone to peri-implantitis due to their polished surface and their thin mucosal penetration diameter.[12]

In most situations, the BCS implants can be inserted in a minimally invasive fashion – often flapless and involves minimum bone cutting. Being minimally invasive, they are also associated with minimum post-operative edema and healing at the procedure sites is rapid and often non-eventful.

The level of predictability and high success of current implant therapy have provided a cause to re-evaluate both the surgical and prosthetic protocol that has been proposed. A number of studies have reported that immediate non-functional loading of implants with a provisional prosthesis after stage 1 surgery can result in a high success rate.[16]

The present study assessed the same concept, utilizing BCS implants for single teeth replacements. Hard and soft tissue changes around the implant were evaluated both radiographically and clinically to assess the success of implants during a follow up period of 6 months.

The results of the present study were analyzed with regards to the following parameters:

1. Primary implant stability
2. Mucosal Health (Gingival Index) around the implant.
3. Crestal Bone Loss.

4.1. Primary implant stability

Implant stability is a combination of the mechanical and biological stability: mechanical stability is the result of compression of bone tissue during implantation; biological stability is the result of newly formed bone cells, which are created on the implant surface during the osseointegration process. Implant mobility is an indication of lack of osseointegration.[8]

In our study the implant mobility was assessed, immediately post -operative and at a follow up period of 1 month, 3 months and 6 months with two rigid instruments which were used to apply a labio-lingual force and a score was given using Modified Miller's Mobility index. In our study, all the 12 implants showed score 0 of Modified Miller's Mobility index at all time frames of follow up.

Lack of clinical movement does not mean the true absence of mobility. A healthy implant may move less than 75μm yet it appears as zero clinical mobility. Clinical lack of implant mobility does not always coincide with a direct bone–implant interface. However, when observed clinically, lack of mobility usually means that at least a portion of the implant is in direct contact with bone, although the percentage of bone contact cannot be specified. A clinically mobile implant indicates the presence of connective tissue between the implant and bone, and suggests clinical failure for an implant.[17]

The two critical factors that determine the success of an immediately, non-functional loaded construction is the proper insertion of the implant into cortical bone with high primary stability and then the prevention of overloading of the bone-to-implant interface during the bone's healing. Both these aspects are covered well during the placement of BCS implant. These results were in accordance with the studies conducted by Behneke et al.[18] and Kan et al.[19]

4.2. Mucosal health around the implant

The success of the implant depends on the health of peri- implant tissues. The overall gingival health was evaluated using a Gingival Index given by Apse et al. However soft tissue texture and color around implant depends on the normal appearance of the recipient tissues before implant placement, and may be influenced by the material characteristics of the implant surface. Hence, we did preoperative evaluation of gingival health in all our cases. Furthermore, difficulties in recording mucosal inflammation have been reported, such as nonkeratinized peri-implant mucosa normally appearing redder than keratinized tissue.[20]

In our study, mean Gingival Index Score, "In PRF group there was a significant increase in Gingival Index Score Preoperatively to days 7, till 6 months ($p<.001$); which is very highly significant". These results were in agreement with the earlier studies conducted by Blanes et al.[21] Lekholm and van Steenberghe[22] and Rismanchian and Fazel.[23]

Peri-implantitis is the single most common cause for failure of conventional implants. This happens mostly because of the rough implant surface as well as the interface problems between the multiple parts of the implant. Judicious use of monobloc, smooth surface basal implants eliminate the threat of peri-implantitis by almost 98%.

Conventional dental implants are contraindicated in patients with acute periodontitis. This is because of the high risk of the patient to contract gingival infections leading to failure of the implants. These patients often present with multiple mobile teeth and painful, inflamed gums which bleed easily. However, smooth surface basal implants work wonderfully well in such patients owing to the fact that they are less prone to bacterial attack (the load bearing area is far away from the area prone to infections in the gum regions and the smooth surface implants do not permit bacterial colonization and multiplication).[10]

4.3. Crestal Bone Loss

Osseointegration is a histological outcome and cannot be clinically ascertained in patients. Therefore, surrogate clinical variables must be used to determine tissue stability around the implant over time. One such surrogate variable that has been used is the level of the osseous tissue mesial and distal of the implant as determined by radiographic evaluation. One convenient aspect of the radiographic evaluation is the level of the bone adjacent to the implant as measured from a predetermined location on the implant restoration.[1]

The marginal bone loss occurred in the 1–2 mm range in the first year after restoration and after the first year generally very small amounts of bone loss occurred or the level gets stabilized. The presence of ongoing bone loss is a clinical sign of instability and likely, pathology. Based on the loading conditions, some bone loss may be observed, but equilibrium tends to be reached in the bone level. Progressive bone loss suggests that a problem exists and the clinician needs to take therapeutic action.[1]

Conventional radiography represents a widely accepted technique for the long-term evaluation of marginal bone changes at interproximal sites of osseointegrated implants. In general, the long-cone paralleling technique, supported by positioning devices, is used. However, conventional radiography yields a high proportion of false negative findings, ie, it has low sensitivity in the detection of early pathologic and/or bone remodeling changes. Therefore, radiographic methods are confirmatory rather than exploratory and should only be considered in conjunction with assessment of the clinical parameters. Nevertheless, the distance from a landmark on the implant (eg, implant shoulder for 1-stage transmucosal implant systems or apical termination of the cylindric portion of the implant for 2-stage submerged implant systems) to the alveolar bone crest represents a reliable parameter for long-term monitoring in clinical practice. In our study these landmarks were the junction of implant neck and abutment and height of alveolar crest.[20]

The mean Crestal bone loss inferior to 1.5mm during the first year in function and an annual bone loss not exceeding 0.2mm thereafter had been proposed as one of the major success criteria.[8] In the present study, crestal bone loss was evaluated at a follow up period of 1, 3 and 6 months by summing up the mean of mesial and distal marginal bone loss levels from the implant's neck with the help of radiographic (RVG) and a score was given. In our study, the mean With PRF the mean Crestal Bone Loss at 6 months was 0.68 ± 0.16 and Without PRF the mean Crestal Bone Loss at 6 months was 0.70 ± 0.19.

Anatomic factors, such as the quality and architecture of bone tissue, as well as implant features, e.g. length, surface area, coating, implant timing and occlusal load may influence alveolar bone crest resorption. These results were in accordance with previous researches by Andrea Enrico Borgonovo et.al. 2013 in which the mean bone loss was 0.445 ± 0.87mm.[24]

4.4. Final assessment of implant status

Thus, during the 6 months follow up, no implant failure was reported, and with the radiographic evaluation no peri-implant radiolucency was present. Six months postoperatively, 87.5% of the implants showed optimum success and were considered osseointegrated and 13.335 of the implants showed satisfactory outcome according to the clinical criteria of Misch (absence of movement, health of peri-implant tissues, bone loss or pathology on radiologic images).[25] Our results are similar with the study by Sigmar Kopp[26] gives overall survival rate of nearly 96 %.

All patients in this series continue to maintain healthy fixed crowns or bridges, enjoying a satisfactory prosthesis. Implant failure is easier to describe than implant success or survival and may consist of a variety of factors. Any pain, vertical mobility, and uncontrolled progressive bone loss warrant implant removal.

Thus, in our study 16 implants were evaluated in regard to both radiological and clinical parameters and highly satisfactory results were obtained in relation to these parameters. However, further in vitro and in vivo studies should be done to confirm these findings in clinical settings and evaluate the short- and long-term effects of BCS implants.

5. Conclusion

The present study evaluated the prognosis of single piece bi-cortical screw (BCS) design implants for immediate replacement of natural tooth with and without PRF. The parameters assessed were; primary stability of implant, mucosal health around implant, and crestal bone loss around the implant. Within the limitations of this study, it was found that:

1. Out of 16 implants all the implants in group I(WITH PRF) WERE stable throughout the follow up period, whereas in group II (WITHOUT PRF) 2 implant showed mobility in 1^{st} month follow up after which all the implants were stable and showed no mobility throughout the follow up period.
2. The measurement of gingival index scores showed there was no periimplantitis around all the BCS implants placed, at all the time intervals followed up except at 7^{th} day.
3. With PRF the mean Crestal Bone Loss at 6 months was 0.68±0.16 and Without PRF the mean Crestal Bone Loss at 6 months was 0.70±0.19.

Hence, considering the results of our study, it can be concluded that BCS implants with PRF are predictable and affordable treatment options for missing teeth in both maxilla and mandible. However, their placement should be combined with adequate prosthesis. A thorough understanding of the maxillofacial anatomy is recommended so that bi-cortical engagement is achieved. Still further studies need to be carried out on a greater number of patients and over a longer duration of time period for better results and their implications in clinical practice.

6. Conflict of Interest

The authors declare that there are no conflicts of interest in this paper.

7. Source of Funding

None.

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