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Effect Of Hydrophilic Implant Surface on Crestal Bone Level in Immediately Placed Implant: A Case Report With 6 Month Follow Up

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ABSTRACT

This case report represents an atraumatic extraction of a fractured maxillary central incisor of left side, followed by immediate placement of hydrophilic implant (straumann aqua) in the extraction socket. definitive prosthesis was placed after 4 months of implant placement. this immediate implant placement helped in preservation of soft tissue and surrounding bone, along with better esthetics and early loading.

Introduction:

The dental implant is a predictable and well-established treatment modality for partially or completely edentulous patients for the rehabilitation of patients with missing teeth. Although the long-term survival rate is high, 7-9% failure is reported, which continues to encourage research aimed at enhancing osseointegration and maintaining stability of perimplant tissue.[1,2] Thus, immediate

implant placement has gained increased acceptance due to its advantages like reduced overall treatment time, alveolar bone and soft tissue contour preservation, greater patient comfort and improved esthetics.[3]

The success of immediate implant placement is governed by a combination of patient, operator, and implant-related factors. Patient factors such as systemic health, oral hygiene, smoking, oral hygiene, gingival biotype, and the quality and quantity of bone affect healing and osseointegration. Operator-related factors like case selection, atraumatic extraction, socket wall preservation through debridement, adequate primary stability and precise 3D implant positioning. Implant-related factors like thread pattern, macro design, platform switching and surface characteristics significantly influence primary stability and bone response. Various surface modifications like acid etching, sandblasting, and advanced hydrophilic treatments enhance surface roughness and bioactivity, promoting faster and more predictable early osseointegration. When combined with strict aseptic protocols, infection control and well-planned provisionalization, these interrelated factors together determine the clinical outcome and long-term success of the immediate implant placement.[4]

Crestal bone maintenance is a critical determinant of long term success and esthetic outcome. Even in successfully osseointegrated implant crestal bone remodelling has been documented, especially during healing and functional loading phases. Though the histomorphometric evaluation is the gold standard for assessing bone changes standardized periapical radiograph provides a widely accepted means for measuring crestal bone level.[5,6]

Careful case selection is important to achieve predictable outcomes in immediate implant cases. Kan's and Gluckman's serve as a valuable clinical tool by assessing facial bone thickness and socket integrity, respectively. While Kan's classification helps to predict aesthetic outcome based on facial bone morphology, Gluckman's classification categorises the extraction socket based on the extent of bony defects, guiding implant placement and regenerative procedures. When used together, these classifications enhance treatment planning, risk assessment, and predictability of both esthetic and functional outcomes.[7,8]

Due to the limited clinical evidence of hydrophilic implant surfaces in immediate anterior implant placement cases, this case report aims to demonstrate the clinical performance of a hydrophilic implant in an immediate extraction case, which

emphasises early healing and crestal bone response.

Case Report: A 31 years male patient visited to the department of oral and maxillofacial prosthodontics and implantology with a non-restorable tooth irt 21 region. (Fig 1) On clinical and radiographic examination, it was found that the tooth was non-restorable with a fracture line extending below the alveolar crest but was confined to the tooth structure. There was a presence of adequate alveolar bone with no relevant medical history. As the conventional fixed prosthesis was rejected by the patient due to unnecessary reduction of the adjacent tooth, immediate implant placement was planned for this case. After making the diagnostic impression and mounting of the cast was evaluated for interocclusal space, overjet, and overbite. CBCT analysis (Fig 2) revealed a Kans class 1 socket with D1-D2 bone quality, supporting the decision of immediate implant placement.

Surgical procedure: After the local anaesthetic administration using lignocaine and adrenaline, a minimally invasive surgical approach was performed. A full-thickness flap was raised buccally and palatally, ensuring preservation of the interdental papilla. The atraumatic extraction of a fractured tooth was done using periotomes and anterior forceps to prevent damage of socket wall.The extraction socket was thoroughly degranulated using curettes and irrigated with normal saline. The integrity of the socket was confirmed both clinically and radiographically. Implant osteotomy was done according to the manufacturer's instructions, and a hydrophilic implant (Straumann Aqua internal hex) (3.75×13mm) (Fig 3) was placed, engaging bone beyond the apex to achieve primary stability with an insertion torque of approx. 35-40Ncms. After placing the coverscrew, the flap was sutured using a horizontal mattress and interrupted suture.

Radiographic evaluation: To assess the crestal bone level, radiography (RVG) along with long cone paralleling technique and XCP positioning was used and assessment was done at baseline (just after implant placement) and at 1,3 and 6 months follow up intervals. [Fig 4 (a,b,c,d)] For reference, the implant shoulder and the most coronal point on the alveolar crest were used. Mesial and distal crestal bone levels were measured digitally using RVG software, and mean values were calculated and recorded for the assessment of crestal bone changes over time. (Fig 5)

Postoperative care: Postoperatively, systemic antibiotics and analgesics were prescribed, instructions including avoidance of hot and hard food for 24

hours, applying an intermittent ice pack on the first postoperative day and rinsing twice a day with 0.2% chlorhexidine gluconate mouthwash for 14 days. After 7-10 days, sutures were removed. The patient was advised to do gentle oral hygiene using an extrasoft tooth brush with a charters brushing technique after the initial healing period.

Restorative procedure: For prosthetic rehabilitation, the patient was recalled after four months. A digital impression was made following confirmation of adequate osseointegration, and over the implant, a definitive prosthesis made from porcelain fused to metal was placed. The patient was subsequently recalled for follow-up to evaluate esthetic, function and peri-implant tissue.

Fig 1: Preoperative Photograph

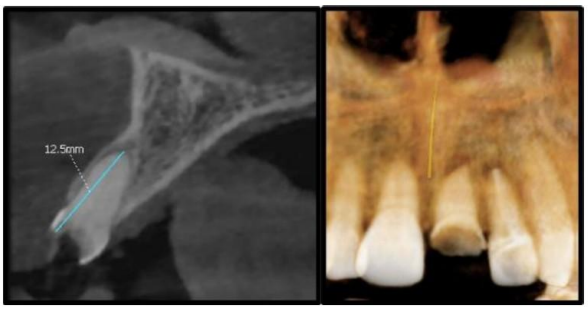

Fig 2: Preoperative CBCT Report

Fig 3: Implant Placement

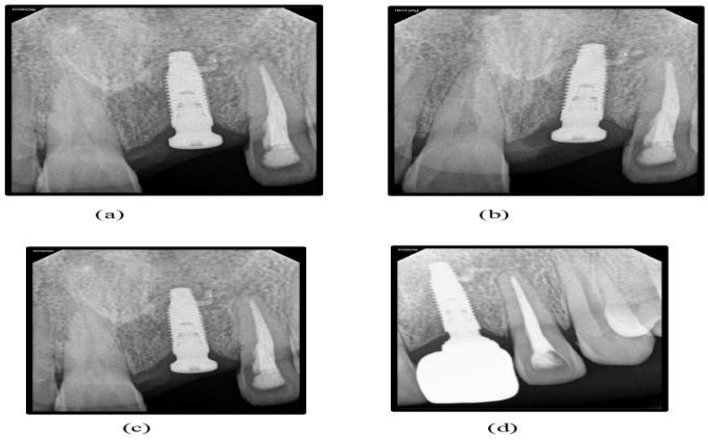

Fig 4: 4(a) Crestal bone level at surgery, 4(b) Crestal bone level at 1 month, 4(C) Crestal bone level at 3 month, 4(d) Crestal bone level at 6 months

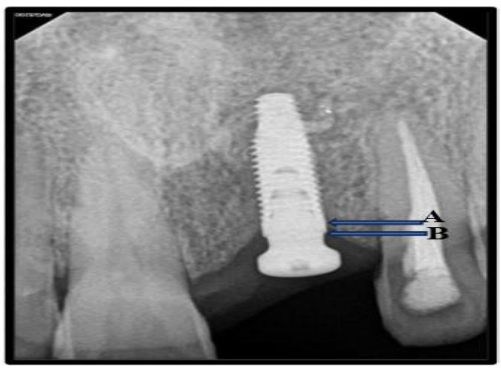

Fig 5: Implant shoulder (A) First bone implant contact (B) and the distance between both crestal bone level

Discussion: Immediate implant placement is of great demand biologically and mechanically because the fresh extraction socket often presents with compromised bone quality, perimplant jumping space and an increased risk of infection, especially in

medically compromised patients. To achieve predictable osseointegration under such circumstances requires adequate primary stability and meticulous surgical planning, including atraumatic extraction through debridement, strict aseptic protocol, and appropriate antibiotic coverage, and to further enhance healing, implant surface modification has evolved as an important strategy. Hydrophilic implant surfaces are characterized by increased surface energy and wettability, which facilitates rapid blood clot stabilization and promotes efficient protein adsorption at the bone implant interface. This enhances early osteogenic cell attachment, angiogenesis and woven bone formation, thereby accelerating osseointegration and improving early bone to implant contact. Experimental and clinical studies have reported improved early stability and higher early BIC values with hydrophilic implants compared with conventional surfaces, which may support earlier loading protocols and enhance clinical predictability in immediate implant cases.[6,9]

Crestal bone remodelling during the healing period is a multifactorial process influenced by the establishment of biological width, inflammatory response, vascular changes and biomechanical factors such as implant abutment microgap positioning and functional loading. Although some degree of marginal bone remodelling is inevitable, maintaining the crestal bone in the long term is essential for achieving both functional and esthetic success. Many studies show that while hydrophilic surfaces enhance early healing, they donot shows significant long-term superiority in marginal bone preservation when compared with conventional implant surfaces.[10]

Although hydrophilic surface demonstrates biological advantages, requires meticulous handling, more cost and cannot compensate for poor technique. Hence, larger randomized trials with long term follow-up are needed to confirm clinical superiority.

Conclusion: Reducing the treatment time with immediate implant placement and modification in implant design with various treatments (hydrophilic) has enhanced osseointegration during the early stages. It was found that the crestal bone level of hydrophilic implants exhibited bone apposition at the end of the first month and during remodelling, less bone resorption at the sixth month.

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