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SUCCESS OF EARLY IMPLANT PLACEMENT WITH AND WITHOUT INTRA SOCKET APPLICATION OF SIMVASTATIN FOR SOCKET PRESERVATION- COMPARATIVE STUDY

Clinical Research

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ABSTRACT

Tooth extraction triggers a series of biological processes, including inflammation, epithelialization, and tissue remodelling. Bone resorption is an inevitable consequence of tooth extraction, significantly altering edentulous sites in the jaw, Strategies to enhance bone regeneration or limit bone resorption involve various surgical grafting methods that utilize autogenous bone, membranes, bone substitutes, platelet-rich fibrin (PRF), platelet-rich plasma (PRP), growth factors, stem cell therapies, and more recently, osteopromotive pharmaceutical agents. Since the 1990s, Simvastatin (SIM) has been widely researched among other pharmaceutical agents for its osteopromotive properties. Simvastatin (SIM), primarily a drug used to treat hypercholesterolemia, also exhibits pleiotropic effects on bone metabolism. SIM has been shown to decrease bone resorption by inhibiting the fusion of osteoclast precursors and reducing the number of active osteoclasts.9 **Aim of the Study-** This study aims to further evaluate and compare the effects of locally applied Simvastatin for socket preservation followed by early implant placement versus early implant placement without socket preservation. **Methodology-** A comparative study was carried out in department of Oral and Maxillofacial Surgery Meghna Institute of Dental Sciences on 20 patients, 10 subjects in the case and 10 in the control group with socket preservation done using simvastatin and without simvastatin placement after extraction of teeth, respectively. all 20 subjects were followed up with dental implant placement **Results-** The simvastatin treatment appears to consistently elevate bone density well above this threshold, ensuring consistent implant success at the 6-week mark. This finding underscores the practical utility of simvastatin in enabling early and effective implant procedures. The efficacy of simvastatin was evaluated with CBCT at 6 weeks.

KEYWORDS

Simvastatin, Socket Preservation, Early Dental Implant, Rehabilitation

INTRODUCTION

Dentist and dental specialists employs standardized, considerable clinical skills in an attempt to cope with the consequences of partial and /or complete edentulism. The loss of periodontal ligament by tooth extraction leaves the alveolar bone without a chance to reformation, which leads to bone resorption only.[1] The resorption shows variation in rate with recorded fast bone loss at first 6 months after extraction and the following 2 years. The pernicious sequelae of edentulism, the patient lacks most of the ordinary oral function, which requires planned rehabilitation. Implant therapy is one of the recent trends to restore oral function and also the biological effects on the bone state.[5] Tooth extraction triggers a series of biological processes, including inflammation, epithelialization, and tissue remodeling, which can pose challenges for future implant placement. As a result, it is important to preserve, and when necessary, regenerate adequate bone to ensure proper implant stability.[18] Strategies to enhance bone regeneration or limit bone resorption involve various surgical grafting methods that utilize autogenous bone, membranes, bone substitutes, platelet-rich fibrin (PRF), platelet-rich plasma (PRP), growth factors, stem cell therapies, and more recently, osteopromotive pharmaceutical agents.

Since the 1990s, Simvastatin (SIM) has been widely researched among other pharmaceutical agents for its osteopromotive properties. Simvastatin (SIM), primarily a drug used to treat hyper-cholesterolemia, also exhibits pleiotropic effects on bone metabolism. These effects are largely linked to the upregulation of BMP-2 and vascular endothelial growth factor gene expression, which promotes the differentiation of osteoblastic cells. Additionally, SIM has been shown to decrease bone resorption by inhibiting the fusion of osteoclast precursors and reducing the number of active osteoclasts.[9]

These antiresorptive agents help prevent bone loss and can increase bone mass around the implant site. Their effects are localized, acting specifically at the implant interface. In vivo studies have shown a modest increase in osseointegration when bisphosphonates are used. Experiments with drugs like zoledronate and pamidronate demonstrated an increased bone-to-implant contact area, supporting their potential in enhancing implant stability.

Early implant placement, performed within 3 to 8 weeks after tooth extraction, involves placing the implant once the extraction socket is fully covered by soft tissue. This approach was introduced as a practical alternative treatment. It is believed that soft tissue healing during this period helps resolve local pathology and improves soft tissue volume.[18]

Therefore, a key objective is to preserve the socket and minimize bone loss around future dental implants. This study aims to further evaluate and compare the effects of locally applied Simvastatin for socket preservation followed by early implant placement versus early implant placement without socket preservation. The research seeks to identify key factors contributing to the success of early implant placement while also addressing the challenges associated with its implementation.

MATERIALS AND METHOD

A randomized comparative prospective study was carried out in 20 patients willing for implant placement of tooth or teeth with poor prognosis after obtaining ethical committee approval all the standards have been followed in conducting the study. The study was conducted on volunteer patients indicated for socket preservation.

All the patients' medical and personal histories were recorded, and a comprehensive oral examination was performed. The initial radiographic evaluation was conducted using an orthopantomogram.

All patients underwent preoperative blood assessments .

Patients were clearly informed about the treatment and follow up appointments, the teeth indicated for extraction was extracted under local anesthesia following sterile protocol, through curettage of socket followed by placement of crushed simvastatin tablet powder mixed with saline, this mixture is impregnated to gelfoam pellet and placed into the extraction socket mucoperiosteal flap was sutured to achieve primary closure followed by a post operative radiograph in study group.

In control group subjects' socket was packed with plain gelfoam without any socket preservation technique.

Patients in both the groups were instructed to take a CBCT after 6

weeks of extraction, The resulting CBCT images were analyzed, and tracings from these images were created to ascertain the three-dimensional position of the implant.

Placement of early implant (6-8 weeks after extraction) was planned based on the available bone height and width along with bone density and anatomical structures based on images obtained through CBCT technology. Selection of implant size, width, position, and placement of endosseous dental implant occurred in accordance in study and control group.

Changes in bone regeneration and density of bone was evaluated and compared with CBCT at an interval of 6 weeks after extraction and 3 months after implant placement in both the groups.

CBCT Showing Bone Density in Simvastatin Group

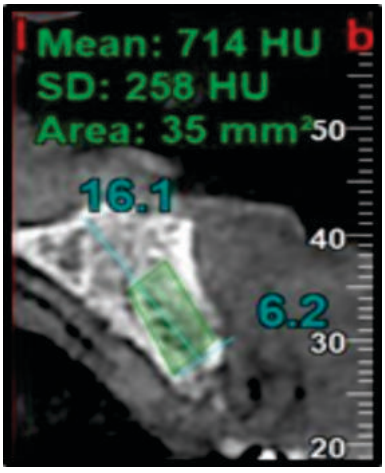


Figure 1 CBCT after 6 weeks of Extraction (Study Group)

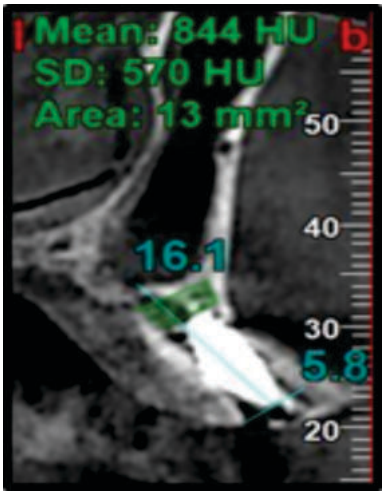


Figure 2 CBCT after 3 months of Implant Placement(Study Group)

CBCT Showing Bone Density in Control Group

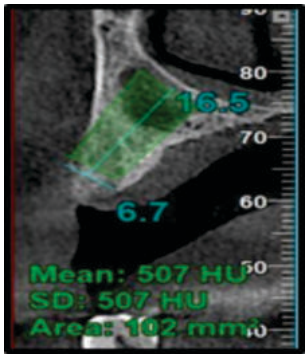


Figure 2 CBCT after 6 weeks of Extraction (Control Group)

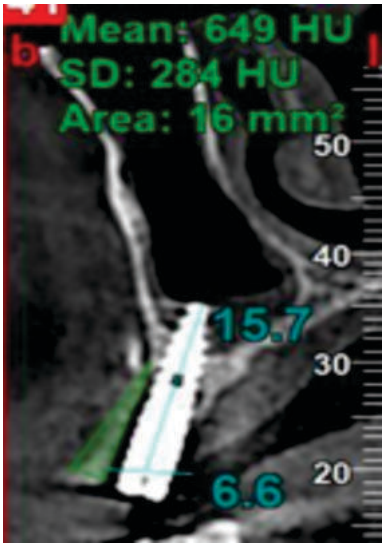
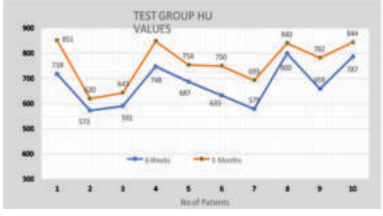


Figure 4 CBCT after 3 months of Implant Placement (Control Group)

RESULTS

This study was performed on 20 dental sockets which of 10 contained simvastatin and 10 of them without that. Bone density was objectively assessed using Cone Beam Computed Tomography (CBCT) at specified time points (6 weeks and 3 months post extraction).The findings indicate significantly higher mean bone density values in the simvastatin treated group at both 6 weeks and 3 months post-extraction, compared to the control group.

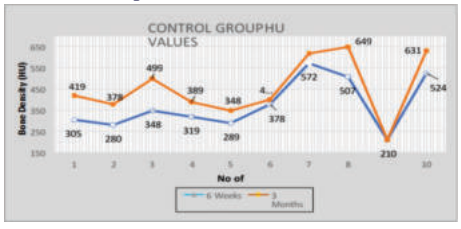


Graph 1 Test Group Analysis

Mean % increase of HU values from 6weeks to 3 months of all Test Group Patients is –12.5%,As part of secondary objective, this value clearly indicates that Bone density has increased considerably in initial weeks after extraction along with the acceleration of bone maturation.

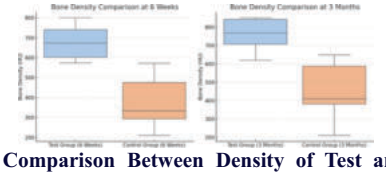
The Control Group, also comprising of 10 other patients, underwent tooth extraction but simvastatin was not placed for socket preservation, allowing their bone to heal naturally without pharmaceutical intervention.

Table 2: Control Group Values



Graph 2: Control Group Analysis

Mean % increase of HU values from 6weeks to 3 months of all Test Group Patients is – 21.6%. this clearly indicates that, Bone density formed as per its natural healing process and its acceleration is not rapid.



Graph 3: Comparison Between Density of Test and Control Groups

DISCUSSION

A critical clinical outcome evaluated was the success rate of dental implant placement at the 5-8 week, directly correlating with the observed bone density values.

In the Test Group, all 10 out of 10 patients (100%) successfully underwent implant procedures after 6 weeks, attributed to their considerably high bone density values. The lowest bone density recorded in a successfully implanted patient in this group was 573 HU at 6 weeks (Subject 2, Male, 53 yrs).

In contrast, in the Control Group, only 9 out of 10 patients (90%) could be placed with an implant at 6 weeks. One male patient (Subject 9, 43 years old) could not proceed with implant placement due to "weak bone density value".[1] This patient's bone density was recorded as 210 HU at both 6 weeks and 3 months, indicating a lack of significant bone regeneration. The lowest bone density observed in a successfully implanted patient in the Control Group was 289 HU (Subject 5, Female, 34 yrs).

Simvastatin has been shown to stimulate the expression of bone anabolic factors such as vascular endothelial growth factor (VEGF) and bone morphogenetic protein-2 (BMP-2), and to promote osteoblast differentiation and mineralization in non- transformed osteoblastic cells (MC3T3-E1). It significantly increases mRNA expression of alkaline phosphatase, type I collagen, bone sialoprotein, and osteocalcin (OCN), while simultaneously downregulating the expression of collagenase-1 and collagenase-3.

Gutierrez et al. found that the topical application of statins was 50 times more effective in promoting bone formation in rats compared to oral administration. As a result, various carriers—such as gelatin sponges, collagen sponges, PLGA, and methyl cellulose—have been used for the local delivery of simvastatin.

In our study, we selected a gelatin sponge as the carrier due to its slow resorption rate, allowing for the sustained release of simvastatin to maximize its bone- regenerative effect. Additionally, gelatin sponges are biocompatible, bioresorbable, and their flexible, sponge-like structure enables easy adaptation to the shape of bone defects acting a osseoconductive.

The early implant protocol involves a healing period of 4–8 weeks after tooth extraction, during which additional keratinized mucosa can form at the extraction site (Schropp et al. 2003a, 2003b). This allows for the elevation of an intact flap and tension-free closure without shifting the mucogingival line.[4]

Placing implants at an early stage(5-8wks) may lower the risk of mucosal recession commonly associated with immediate implant placement (Evans & Chen, 2008). This approach benefits from reduced osteoclastic activity, as the bundle bone undergoes resorption during early healing .[20]

CONCLUSION

simvastatin can play a crucial role as an adjunctive therapy in accelerating bone regeneration, thereby facilitating earlier and more predictable dental implant procedures. The ability to achieve a denser bone bed at an earlier stage has the potential to shorten overall treatment timelines, improve primary implant stability, and ultimately enhance patient outcomes by providing faster functional and aesthetic restoration.

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