Innovative Method “DV-PIMS” Technique and Dental Implant Design for Grafting Injectable Platelet-Rich Fibrin around the Dental Implant – Goat Jaw Cadaver Study

Abstract

Aims: Dental implants have revolutionized the treatment modality for replacing missing teeth. The ability of implants to osseointegrate with the bone leads to its success. The problem is sometimes there is inadequate bone available for implant. If hygiene is not maintained, biofilms of bacteria can be formed around the dental implant. One approach to this problem has been development of bioactive surgical additives. Platelet-rich fibrin (PRF) appears as an alternative. There are various techniques of using PRF. These techniques need skill and practice to use PRF. Objective: To evaluate implant stability and flow of injectable PRF (i-PRF) of regular implant and modified innovative design implant. Materials and Methods: Thirty goat jaw bones were selected. Implants were placed in mandibular posterior region. Fifteen implants were placed using regular dental implant system (Group A) on the left side of jaw bone. The other 15 implants were placed using modified dental implant (Group B) on the right side of jaw bone. The body of these implants at middle has drainage vents to drain/flow the i-PRF-like dye. The dye was injected through regular and modified implants (DV-PIMS technique). Then the stability was checked with the help of Periotest. Cross section was taken 3 cm away from dental implant at the angle of mandible, to check the flow of i-PRF/platelet-rich plasma (PRP)-like dye. Results: Periotest evaluation showed a mean of 2.3 for implant Group B and a mean of 1.5 for implant Group A. The flow of i-PRF-like dye was seen in Group B, and Group A does not show any flow. Conclusion: There are various techniques of using PRF. These techniques need skill and practice to use PRF. This (DV-PIMS) method aims to explain new implant design that disperses an i-PRF solution from inside out. The screw section of the new implant is made of a reservoir running vertically down inside. That reservoir is filled with (injectable) PRF, and then a cover screw is placed. The solution will begin to slowly diffuse out, through the vents in implant, keeping biofilms from forming or avoiding at the screw–bone interface and accelerate healing process.

Keywords: Bioactive surgical additives, dental implant, implant stability, osseointegrate, platelet-rich fibrin

Introduction

Dental implantology has revolutionized the treatment modality for replacing missing single or multiple teeth with implant supported crown/prostheses. The criteria for success of an implant include its ability to osseointegrate with the bone bed in the host, to support a prosthesis, and to sustain occlusal stresses during function. Bone loss around the implant reduces its longevity. Bone loss begins from the crest/collar region of an osseointegrated implant and progresses apically. The possible causes of crestal bone loss could be a local inflammation/infection and mechanical stresses acting on the crestal bone around the implant crest.

Module/collar. In the successful results of dental implants’ placement, implant stability is considered as a prerequisite and important factor toward long-term results in dental implantology treatment modality. The well-planned treatment mainly involves bone augmentation and use of bioactive surgical additives, so as to achieve optimal alveolar ridge dimensions. Patients with alveolar ridge defects or less dense bone are managed with bone grafts, bioactive surgical additives, or sinus lift procedures to achieve a successful and stable dental implant placement. However, current implants and their methods of implantation have a number of limitations and disadvantages. Most dental implants fail

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due to the nonoccurrence of osseointegration, leading to a loose and unattached implant. Other dental implants fail due to a perioperative infection. Infection at or near the site of insertion of a dental implant (either perioperative or postoperative) is resolved by a time-intensive and costly process.

Selection of dental implant with proper design also plays an important role to avoid crestal bone loss. Introduction of bioactive surgical additives in dentistry to control the inflammation and accelerate the speed of healing is one of the great challenges in clinical research. Platelet-rich fibrin (PRF) appears as a natural and satisfactory option with better prognosis and with less complications.[5]

Many implant designs and methods have been developed by various companies to achieve greater degree of osseointegration and initial healing. Two factors should be considered (1) implant collar design and (2) method of using platelet concentrates. Tissue regeneration is a thought-provoking area in the field of dentistry. Platelets had been proven to be a good source of growth factors. Using platelet concentrates is a way to accelerate and enhance the body’s natural wound healing mechanisms. There are various techniques of using PRF. The previous techniques need skill and practice to use PRF.[6]

Keeping all the above points under consideration, a study was planned on goat jaw cadaver, for innovative implant design to avoid initial crestal bone loss and to store and flow injectable PRF (i-PRF) and the innovative method/ “DV-PIMS” technique called Deepak Vikhe Pravara Institute of Medical Sciences Technique – for using i-PRF with less skills and a way to accelerate and enhance the body’s natural wound healing mechanisms.

Purpose of the study
This study was undertaken on goat jaw cadaver/jaw bone to evaluate implant flow of i-PRF with new method and dental implant design for grafting PRF (i-PRF) around the dental implant. Second, to evaluate implant stability of implants with regular design and implants with modified innovative design.

Aims and Objectives
The aim of this study was to determine and evaluate the implant stability of regular implant and modified innovative design and to evaluate flow of i-PRF through modified dental implant.

Goat mandibular jaw bone with adequate bone support was used for implant placement. Implants were placed in goat jaw bone in the posterior region.

Materials and Methods
Materials
Required armamentarium: 30 goat jaw bones, LifeCare dental implant system (System A), EZ Hi-Tec Implant (LifeCare, [Herzelia Industrial Area, Israel]), modified dental implant, Periotest instrument (Periotest S 3218; Medizintechnik Gulden, [Eschenweg, Austria]), and dye in i-PRF consistency. This dye was compared with the actual i-PRF consistency and then used. Heavy-duty micromotor with disc bur was used. Thirty goat mandibular jaw bones were selected with adequate bone height and width for implant placement. Implants were placed in goat jaw bone in the posterior region.

Methods
After receiving institutional ethical clearance (CPCSEA) committee approval, 30 goat jaw bones with proper bone height and width were selected for DV-PIMS technique called Deepak Vikhe Pravara Institute of Medical Sciences Technique – for using i-PRF. Implants were placed in mandibular posterior region. Fifteen implants were placed using LifeCare dental implant system (EZ LifeCare) (Group A) in the left side of jaw bone with 35 N torque. The other 15 implants were placed with modified dental implant (Group B) on the right side of jaw bone with 35 N torque. The size of implants selected in both the groups was 4.2 × 10 mm. Group B dental implants were modified implants of EZ LifeCare implant with three zones of implant collar, as given below. This modified dental implant has been provisionally registered for Patent; application number is 201721035360 (Government of India) [Figure 1]. Ethical approval from Institutional CPCSEA Committee has been taken. Dated = 23/06/2018.

Zone 1 = polished collar
Zone 2 = dotted collar
Zone 3 = micro-threads

The polished collar region, a dotted collar region, and a micro-threaded collar region can be sequentially arranged one below the other. In an aspect, the polished collar region and the dotted collar region can be at least partially in contact with gingival tissue, whereas micro-threaded
collar region can be at least substantially in contact with crestal bone. The different portion of the crest module/neck collar design includes a polished collar (hereinafter interchangeably referred as “zone 1”) to avoid plaque accumulation, a dotted collar (hereinafter interchangeably referred as “zone 2”) for gingival tissue attachment, and a micro-threaded collar (hereinafter interchangeably referred as “zone 3”) to avoid crestal bone loss. The body of modified implants at middle has reservoir running vertically down the inside with drainage vents to drain/flow the dye [Figures 2 and 3]. The vents are 45° facing downward. The implants have modified pitch of 0.2 mm. The bottom portion can include a rounded profile.

The dye was injected through regular and modified implants with the help of syringe with proper viscosity [Figure 4]. A 5-mL syringe with 21-gauze needle used, with adjustable stopper placed at 1 cm. Then the stability was checked with the help of Periotest between regular implant design and modified implant design implant [Figure 5]. Cross section was taken 3 cm away from the dental implant at the angle of mandible as it was difficult to section and measure less than 3 cm, to check the flow of i-PRF/platelet-rich plasma (PRP)-like dye through goat mandible [Figure 6]. The flow of the dye was checked in millimeters from dental implant to the extent. The goat cadaver was to be discarded in co-ordination with biomedical department with proper bioethical guidelines. Periotest is the device to check the stability of dental implant. Periotest values were tabulated and analyzed. Statistical analysis was done by descriptive statistics mean, standard deviation, percentage, and so on. Statistical test of significance namely Student’s unpaired t-test was applied at 5% level of significance. Statistical analysis software SYSTAT Version 12 was used.

**Results**

Within limitation of this study, Periotest evaluation showed a mean of 2.3 for implant Group B and a mean of 1.5 for implant Group A [Table 1]. The flow/grafting of i-PRF was seen in Group B (modified implant), whereas Group A does not show any flow. More stress should be given on developing implant collar, implant design, and technique of grafting i-PRF around dental implant to reduce the initial crestal bone loss and for better initial healing. By applying Student’s unpaired t-test, there is a significant difference.
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