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By M Jeevitha

WORD COUNT	2648	TIME SUBMITTED	17-SEP-2024 11:16AM
		PAPER ID	111751871

Word Count – Words: 2648

A clinical report with 1-year follow-up of a minimally invasive transcrestal surgical technique for sinus elevation utilizing an alloplastic phosphosilicate putty in the atrophic posterior maxilla

M. Ahamed Faizal[1], Renganath. M. J[1], Jacob Raja[1], M. Jeevitha[2]

[1]Department of Periodontology, Rajas Dental College and Hospital, Tirunelveli, Tamil Nadu, India

[2]Department of Periodontology, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences (SIMATS), Chennai, Tamil Nadu, India

Corresponding author

M. Jeevitha,

jeevitham.sdc@saveetha.com

ABSTRACT

Achieving principal stability of implants at the time of placement is essential for successful osseointegration. The stability of the implant is influenced by both the quality & quantity of the available bone. Implant placement in the posterior maxilla is complicated by sinus pneumatization and decreased bone density. Osseodensification has emerged as a unique biomechanical technique for enhancing bone quality, facilitated by Densah bur technology. In this case report, the patient needed a fixed tooth replacement in the upper right back tooth region. This required sinus augmentation and posterior maxillary implant placement which were done at the same time. The osteotomy for the implant was performed using densification drill, and the sinus floor was elevated with viscoelastic putty graft material. This approach effectively lifted the sinus membrane and improved bone density, enabling the placement of standard-sized implants.

Keywords: health, implant therapy, indirect sinus lift, innovative, osseodensification, putty

INTRODUCTION

Maxillary sinus augmentation is a frequently carried out clinical procedure in the posterior maxilla that plays a crucial role in the success of implants placed there. The initial six

months following tooth extraction are characterized by the highest rate of resorption, which can jeopardize the placement of future implants and modify the dimensions of the ridge in terms of both width and height [1]. Insufficient bone height is a significant determinant in the placement of implants within the posterior maxilla [2]. Previous studies have established a correlation between low-quality bone (Type III/IV) and the occurrence of implant failures in the posterior maxillary region. The absence of functional loading following tooth loss can result in substantial bone resorption and subsequent thinning of the walls, potentially leading to sinus pneumatization [3].

In the context of prosthetic rehabilitation using dental implants, hard tissue deficiencies are frequently observed in the posterior edentulous maxilla. The success rates for longer implants tend to be higher, especially in areas characterized by low bone density [4][5]. One effective approach to address this issue is the ridge augmentation through sinus elevation by grafting, which enhances both the volume and quality of bone necessary for implant placement [6].

Over time, numerous augmentation methods have been put forth [7,8]. Approaches to sinus elevation may include the lateral window or transcrestal techniques. The direct access window method requires more broad access to the surgical area and necessitates surplus incisions for adequate access. Conversely, Summers' transcrestal procedure utilize osteotomes to elevate the sinus floor. An additional method, the indirect sinus lift technique employs the transcrestal route and involves the simultaneous placement of dental implants while elevating the sinus membrane through the osseodensification principle. This method utilizes a densifying bur, which is a minimal deformation of the bone as a result of rolling and sliding contact characteristic of the biomechanical bone preparation technique for dental implant osteotomy [9]. The utilization of putty-like bone substitutes is increasingly prevalent in bone grafting procedures. These materials possess physical properties that enhance the safety and predictability of sinus lift operations, while their handling characteristics broaden the range of treatment options for bone grafting in confined anatomical spaces.

This study employs a viscoelastic calcium phospho-silicate alloplastic putty (CPS putty), which is delivered through a specialized cartridge system. It is a fully synthetic graft substitute for bone regeneration and repair. Its bioactivity arises from the chemical release of silica, sodium, calcium and phosphate ionic dissolution products which have been shown to promote the differentiation of undifferentiated cells into osteoblasts over multiple generations. It has been effectively utilized in various osseous defects without any reported adverse effects. Additionally, CPS putty provides hydraulic pressure to elevate the Schneiderian membrane, acting as a "protective cushion." This approach mitigates the risks of mechanical perforations of the Schneiderian membrane and benign paroxysmal positional vertigo associated with traditional osteotome techniques [10].

In this case report, the transcrestal sinus lift was conducted using densification drills and CPS putty with a follow-up period of one year.

CASE REPORT

A 50-year old female patient reported to the department of Periodontics and Implantology in a private dental college foe replacing her missing right upper and lower back teeth with fixed prosthesis. Patient gave a dental history of two implants placed in relation to maxillary right first and second premolars before 1 year. Clinical examination revealed clinically healthy gingiva, missing maxillary first molar and healthy dental implants in relation to maxillary right first and second premolars. The patient's biochemical tests revealed no evident problems and his systemic health was good. The CBCT analysis of maxillary right first molar revealed a residual bone height of about 8.2 mm and a bone density classified as D3 by Hounsfield units (Figure 1).

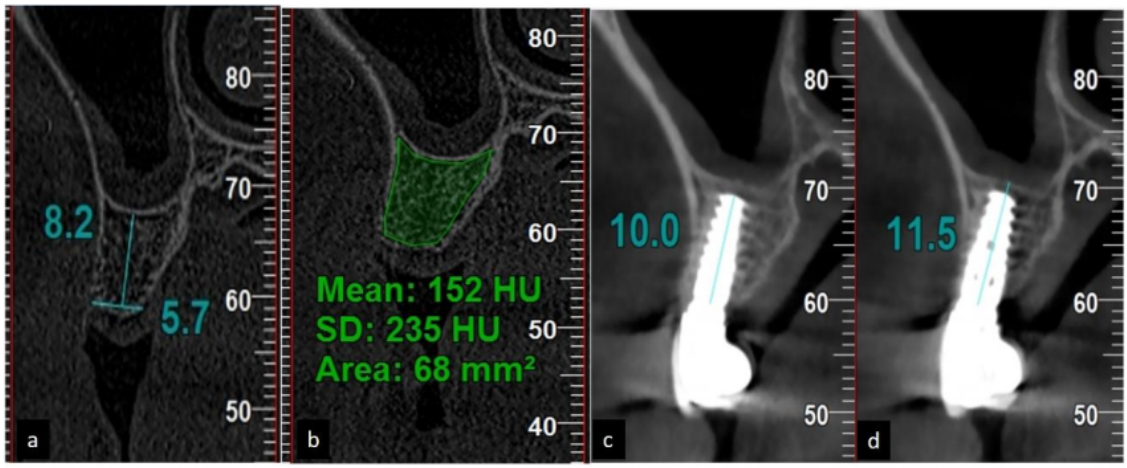

Figure 1. a and b. Preoperative CBCT showing residual bone height of about 8.2 mm; c and d. 1 year Post- operative CBCT

Informed consent was secured after the patient received a comprehensive explanation of the procedure. A mid-crestal incision was performed, followed by the elevation of a full-thickness flap. The initial entry point and drill angulation, achieved with a Lancet drill to a depth of 8 mm at a speed of 800 rpm in a clockwise direction and was confirmed through radiographic imaging. Subsequently, a crestal approach was employed, utilizing Densah burs with diameters of 2.0 mm and 2.3 mm to expand the osteotomy site until it was approximately 1.0 mm from the sinus floor.

Utilizing a cartridge delivery system, around 0.5 cc of CPS putty (NovaBone) was injected into the osteotome region (Figure 2). This procedure continued until hydraulic pressure resulted in the elevation of the sinus floor. The elevation was deemed adequate when a tactile sensation of resistance to further bone grafting was felt and radiographic verification of the drill's position was obtained.

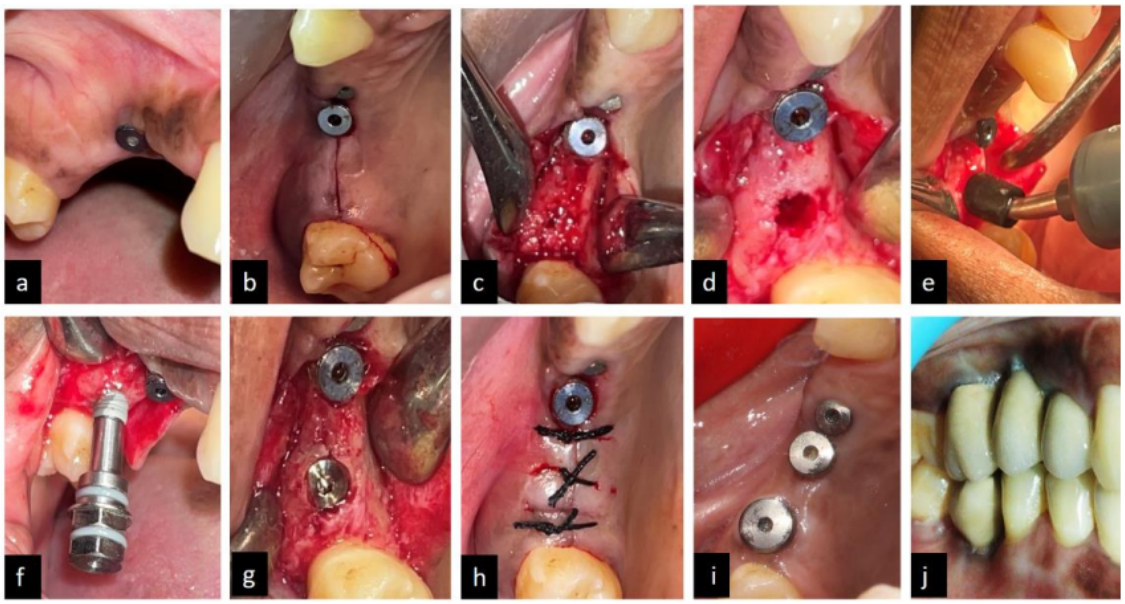

Figure 2: a. Preoperative clinical picture showing edentulous area in relation to upper right first molar. Note the presence of preexisting implants in relation to upper right first and second premolars. b. Mid-crestal incision c. Flap elevation d. Osteotomy in relation to upper right first molar e. Sinus elevation done using NOVA bone putty f. Achieved primary stability >35 Ncm g. Immediate post-operative image after Implant placement h. Flap closure with 3.0 silk sutures i. 6- months post-operative image after Implant placement j. Screw retained crowns given in relation to upper right first and second premolars and first molar,

The final densification bur for the osteotomy was employed to advance the graft beyond the sinus floor while operating in Densification Mode (counterclockwise) at a reduced speed of 300 rpm without irrigation. A torque of 35N was applied to place implant size of 4.2 x 10 mm. A cover screw was subsequently positioned. The flaps were sutured using 3.0 mersilk to ensure a tension-free primary closure.

Postoperative radiographs were taken. A regimen of amoxicillin at a dosage of 500 mg three times daily for five days was prescribed post-surgery. Ibuprofen (500 mg) also prescribed as needed. The patient was instructed to use a 0.12% chlorhexidine gluconate mouth rinse twice daily for ten days. A soft diet and diligent oral hygiene were recommended for duration of two weeks. Sutures were removed 14 days post-surgery, and the recovery period was characterized by absence of complications.

After three months of recuperation, prosthetic implant loading procedures commenced. The implants were exposed as part of a stage 2 procedure to obtain a gingival collar and take impressions. A healing abutment was then installed in place of the cover screw. The missing maxillary right first molar was replaced with a screw-retained metal prosthesis, and a six-month post-operative radiograph was obtained.

After 6 months the clinical and radiographic evaluation was done and a metal ceramic screw retained crown was inserted. Following the procedure, the patient underwent clinical and radiographic evaluations for more than a year and it was determined that their condition was within acceptable bounds.

DISCUSSION

The largest paranasal sinuses in the human body are the maxillary sinuses. Their capacity is roughly 12.5 milliliters [11]. A thin bilaminar mucoperiosteal membrane also termed as the Schneiderian membrane, lines the sinus. It is made up of ciliated pseudostratified columnar epithelium on the lumen side and a single cell osteogenic periosteum towards the bone side. For effective mastication, implant placement becomes essential in a partially edentulous posterior maxilla. According to Sharan and Madjar, pneumatization of the maxillary sinus with vertical bone loss is the common physiological alteration in the edentulous posterior maxilla [12]. To achieve ossoeintegration, the bone surrounding an implant must be of a sufficient quality and quantity. The edentulous posterior maxilla may compromise this fundamental need for an implant's surrounding bone to the appropriate degree and quality in a vertical direction [13].

When implants are placed in sinus augmented sites, one of the most critical factors affecting their survival is the height of bone, which is measured between the sinus floor and the crest of the alveolar bone. In order to achieve primary stability in the implants in the posterior maxillary zone, the vertical height of the bone is very crucial. According to Jensen et al, there is a direct correlation between survival rate and residual bone height. If there is 5 mm or more of vertical bone height present, the survival rate is 96%; if there is 4 mm or less, the survival rate is approximately 85%. Therefore, the survival rate of the implant is directly correlated with the amount of available bone height [14].

In 1994, Summers introduced a surgical technique utilizing osteotomes for performing indirect maxillary sinus elevation procedures. This method is deemed suitable when the residual height beneath the sinus measures between 5 to 6 mm and the bone density falls within the D3 category, corresponding to 350-850 Hounsfield units [15]. The technique involves the sequential use of progressively larger osteotomes to induce microfractures in the sinus floor, thereby compacting the surrounding bone both apically and laterally at the implant site.

Potential complications associated with this procedure include sinus infections, implant failures, displacements of the implant into the sinus cavity, graft failures, perforations of the sinus membrane, and benign paroxysmal positional vertigo (BPPV) [16]. Furthermore, there is a risk of patient injury if the osteotomes are improperly tapped during the preparation of the osteotomy. To address some of these limitations, the densification elevation technique has been developed. This technique employs drills that feature multiple lands and a negative rake angle, which serve to enhance bone density and stability. The design of these drills promotes regulated bone growth, which is critical for optimal implant placement and long-term results [17]. Additionally, the non-cutting tip of the drill minimizes the likelihood of perforating the antral membrane as it advances to breach the sinus floor [18].

A diverse array of biomaterials, such as particle alloplastic substitutes, has been proposed for sinus augmentation procedures. The ongoing research into biomaterials has enhanced the physical properties and handling characteristics of alloplastic bone substitutes by introducing innovative features, including a moldable putty consistency. In this study, the graft material referred to as Novabone Putty comprises glycerin as the binder phase, calcium phospho-silicate as the additive phase, and polyethylene glycol also as an additive and available in syringes and pre-mixed cartridges [19].

The method employed in this case report facilitates both sinus lifting and grafting, while simultaneously allowing for the installation of an implant with adequate stability. This approach minimizes the necessity for a subsequent surgical procedure to place the implant following sinus augmentation, ultimately leading to a reduction in the overall rehabilitation timeline.

CONCLUSION

Enhanced stability and bone volume in the posterior maxilla is essential for reliable implant therapy and can be attained through atraumatic indirect sinus lifts employing the sinus elevation technique alongside osteotomes and alloplastic putty material. A stable bone volume was noted in the peri-implant region during the one-year follow-up. The use of indirect sinus lift with calcium phosphosilicate putty presents a clinically safe and effective method for simultaneous implant placement, reducing patient discomfort and facilitating a less invasive approach.

Conflict of interest: none declared

Financial support: none declared

Author contributions: All authors contributed equally to the manuscript

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