ORIGINAL RESEARCH

Effect of Schneiderian Membrane Perforation on Posterior Maxillary Implant Survival

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ABSTRACT

Background: To assess the survival rate of implants placed in the posterior maxilla by intentionally perforating the Schneiderian membrane and protruding the implant up to 3mm beyond the sinus floor in cases of reduced crestal bone height (CBH).

Materials & Methods: 56 patients with reduced CBH received 63 implants in the posterior maxilla. All implants intentionally penetrated the Schneiderian membrane and engaged the sinus floor cortical bone. All patients were followed up and implant survival was assessed at the end of one year post implant restoration.

Results: Out of 63 implants, there was only one failure (98.4% Survival rate) after a follow up period of one year. 7 patients experienced mild epistaxis during the immediate post-operative period with no associated implant loss. One patient developed sinusitis secondary to the surgical procedure, which was treated by antibiotic therapy and the patient improved clinically with no associated implant loss.

Conclusion: An intentional perforation of the Schneiderian membrane using a 2mm twist drill at the time of implant placement and protrusion of the implant up to 3mm beyond the sinus floor does not alter the stability and outcome of dental implants, one year post-restoration. This could be associated with minor complications ranging from epistaxis to sinusitis, which are manageable.

Key words: Schneiderian membrane, implant, sinus floor, perforated membrane.

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Introduction

The extraction of posterior teeth and subsequent pneumatization of the maxillary sinus compromises osseointegrated implant placement in the posterior maxilla and necessitates associated surgical procedures like sinus floor elevation (sinus lift) and maxillary ridge augmentation. Sinus lift and bone grafting is the procedure of choice when the crestal bone height (CBH) is less than the shortest available implant length and has been used, as a technique, with considerable success.[1] Nevertheless, these surgical procedures are not only considered invasive to patients, but also increase the overall treatment time, especially for the commonly employed "2-stage sinus lift technique".[2] Sinus floor elevation or sinus lift could be done through internal or external approach which involves elevation of the sinus lining and placement of bone graft or bone

substitute material between the sinus lining and sinus floor.[3]

The Schneiderian membrane is a thick membrane, composed of pseudo-stratified ciliated columnar epithelium that lines the maxillary sinus. Although during *Le Fort-I* osteotomy of the maxilla, this membrane is always significantly torn and damaged. However, in implant dentistry, the posterior maxilla implant has been a source of concern and apprehension, due to the risk of sinus perforation, damage to the Schneiderian membrane and its complications.[3] Almaghrabi et al[4] in their report of a case of severe sinus infection following sinus lift, quoted literature suggesting a 20% risk of complications like infection, bone/graft sequestration and sinusitis. They also documented a proportional increase in complications related to pre-existing sinus disease.

Conversely maxillary sinus penetration by implants has been reported by Branemark et al[5] as early as 1984. On the other hand perforations of the Schneiderian membrane are not uncommon and are associated with 25% of all sinus elevation procedures done.[6] Published literature relating to implant placement in the posterior maxilla shows ample reports of incidental perforations of the Schneiderian membrane and the subsequent uneventful outcomes. However there were no studies evaluating intentional perforation of the Schneiderian membrane and their effect on implant survival.

While it is an established fact that initial stability of the implant is a key factor during implant placement and for successful osseointegration.[7] It is our hypothesis that the initial stability of posterior maxillary implants could be improved by the accurate bicortical engagement of the implant with the crestal cortical bone and the floor of the sinus cortical bone.

The aim of this study was to assess the outcomes and complications of placing implants in the posterior maxilla with reduced CBH by intentional perforation of the Schneiderian membrane using a 2mm twist drill and up to 3mm implant protrusion beyond the sinus floor to concomitantly engage the sinus floor cortical bone.

Patients and Methods

Fifty-six patients (37 females and 19 males) with an average age of 52 years, who underwent placement of 63 implants in the posterior maxilla were included in this study after obtaining an informed consent explaining the details of the surgical procedure in general and the intentional sinus perforation in particular (Table 1). Ethical approval for the study was obtained from the institutional ethical committee.

Patients with uncontrolled diabetes, patients who were currently under anticoagulant medication, patients with smoking habits and patients with previous history of sinusitis were excluded from the study sample. Forty nine patients received a single implant in one side of the posterior maxilla and seven patients received bilateral posterior maxillary implants either at the premolar or the molar tooth site. Pre-operative orthopantomographs (OPG) (Siemens, Germany) were obtained for all the patients (using the same machine with the same magnification percentage). The CBH at the intended site of implant placement was measured from the OPG after correction for magnification. Primary inclusion criterion for the study was CBH in the range of 5mm to 8mm as measured from OPG. Intra-operatively the previously measured CBH was confirmed using a depth gauge (KLS Martin, Germany). (Fig1.) All the patients were free from systemic illnesses or had mild systemic illness that was controlled, and all patients were classified ASA1/ASA2 of the American Society of Anesthesiologists physical status classification.

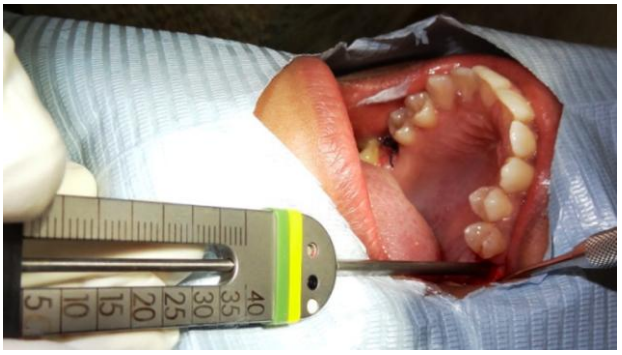

Fig 1: The depth gauge being used to measure crestal bone height. (Intra-operative)

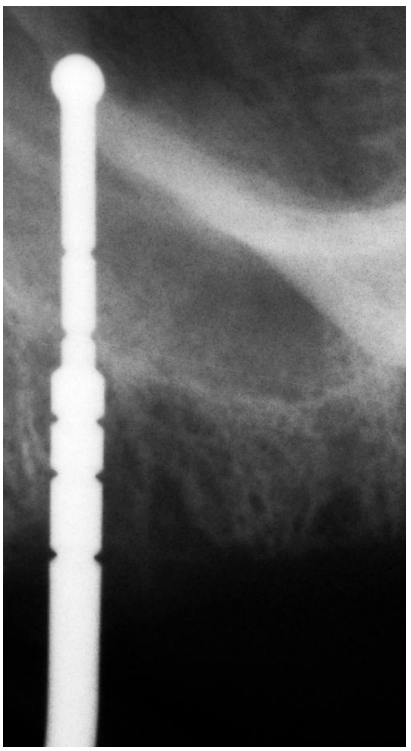

Fig 2: Periapical radiograph showing the depth gauge penetrating the sinus floor.

Surgical Procedures

The treatment plan was discussed and consent was obtained from all patients prior to the surgical procedure. All the patients underwent implant placement under local anesthesia (Lidocaine 2% with epinephrine 1:80,000, Dentsply Pharmaceutical, USA) and strict aseptic protocol. A crestal incision was made at the site of implant placement and the bone was then exposed. A 0.25 mm round drill (Mesinger, Germany) was used to locate the proposed site of the implant. Then, a 2 mm twist drill was used until the sinus was perforated (Replace select, tapered implants; Nobel Biocare, Sweden). The depth gauge (KLS Martin, Germany) was used to measure the actual CBH indicated by the distance from crest of the alveolar ridge to the floor of the maxillary antrum (Fig.1) which was also verified by a Periapical radiograph (Fig.2). Schneiderian membrane perforation was confirmed using the Valsalva test. This was followed by implant site preparation with 3mm, 4mm and 5mm twist drills in sequence as per manufacturer's recommendations. The depth of implant site preparation was 2 mm less than the measured crestal bone height.

After the site was prepared, an implant fixture was placed (Replace select, tapered implants; Nobel Biocare, Sweden). If the CBH was 5 to 6 mm, an 8 mm implant was placed and if the CBH was 7 or 8 mm, a 10 mm implant was placed (Table 1). Initial stability of the implants placed was confirmed with a placement torque of at least 25cmN (W&H implant med, Austria). A cover screw was then placed and the wound was

Table 1: Sizes of implants used and corresponding CBH*

Implant size		No. of Implants (n)	Mean CBH (mm)
Diameter (mm)	Length (mm)		
4.3	8	19	5.3
4.3	10	7	7.3
5	8	32	5.1
5	10	5	7.2

sutured with 4-0 black silk (Ethicon coated vicryl, Johnson and Johnson, USA). All the patients received postoperative oral antibiotics Amoxicillin 500mg (GlaxoSmithKline, Middlesex, United Kingdom) every 8th hourly for 5 days and in patients allergic to beta-lactam antibiotics

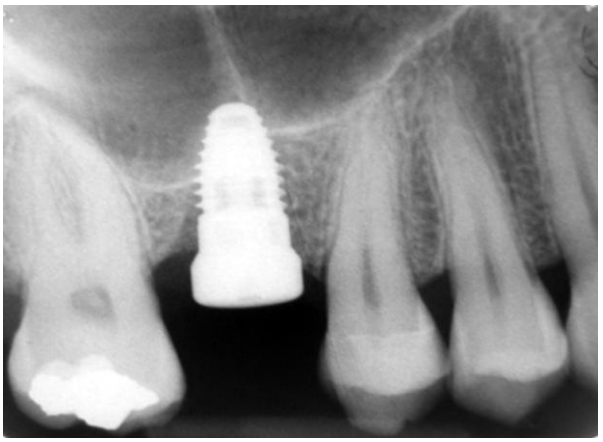

Fig 3: Radiograph showing implant placed at site # 16. Apical portion of the implant is seen penetrating the sinus floor. (3 months post-operative)

Clindamycin 300mg (Pfizer, New York, USA) every 6th hourly for 5 days and pain medication Paracetamol 500mg for 5 days. The same clinician (NN) performed all the surgical procedures. All the cases were performed using a two-stage technique and implants were restored between 12 and 14 weeks after their initial placement. All patients were evaluated during the first week after surgery, at the time of second stage (Fig.3), three months after prosthodontic crown placement and one year post restoration. (Fig.4).

Results

One year post-restoration, all patients were evaluated both clinically and radiographically (Fig.4). All implants with the exception of one were successful and stable with an overall survival rate of 98.4%. The only implant failure happened prior to the second stage and required removal before restoration (implant length, 10mm; CBH, 7 mm). The reason for failure is not clear and the patient did not have active infection, discharge or oro-antral communication.

In terms of complications, none of the patients in this study had severe hemorrhage from the nose, but 7 patients reported mild epistaxis during the

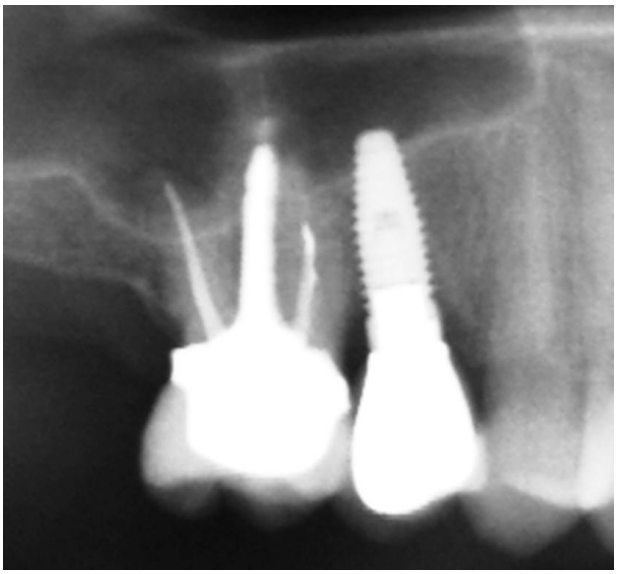

Fig 4: Radiograph showing restored implant at site # 15. Apical portion of the implant is seen penetrating the sinus floor. (1 year post-operative)

1st post-operative day, which was self limiting. One patient developed sinusitis 10 days after surgery and was treated with Clindamycin 300mg (Pfizer, New York, USA) every 6th hourly for 5 days. The sinusitis resolved without the need for further interventions, and the implant was restored 14 weeks after the initial placement. At the 1-year follow-up visit, no long-term sequelae were noted. There were no other long-term complications.

Discussion

In this study, implants were placed in the posterior maxilla after intentional perforation of the sinus floor and the Schneiderian membrane to compensate for the reduced CBH instead of conventional sinus lift. The overall survival rate was 98.4% at the end of one year follow up. However, Hernández-Alfaro et al[8] placed 278

implants in repaired Schneiderian membranes, of which 31 implants failed. Perforations in their study varied from less than 5mm to greater than 10mm.

Becker et al[9] showed a 98.8% survival rate after placement of 93 implants in cases of perforated Schneiderian membrane, however they treated the perforations with either a collagen membrane or suturing. In this study, the perforation was made with a 2-mm twist drill and the CBH was confirmed using a depth gauge. It could be that the perforation created in this study was relatively small compared to those in previous studies, and the relative under-preparation of the implant site assisted in producing an excellent level of initial stability.

Fermergard and Astrand[10] reported that accidental perforations of the Schneiderian membrane during implant preparation as evidenced by a positive Valsalva test, did not affect the success rate of the implants placed. Cricchio et al[11] in their study of 11 implants placed in the posterior maxilla reported that all the implants resulted in either a minor or major perforation of the Schneiderian membrane, however only one implant failed overall. In another study reported by Nedir et al[12] wherein implants were placed protruding beyond the sinus floor without any perforation of the Schneiderian membrane using an "osteotome sinus floor elevation" technique, there was radiographic evidence of new bone formation on the antral floor around the implants.

Scala et al[13] in their study on capuchin primates placed 16 implants extending into the sinus without perforating the Schneiderian membrane and reported only one failure. Schleier et al[14] placed 62 implants with internal sinus elevation and intentionally protruded the implants into the sinus cavity, they show that the average bone gained have increased by 3.5mm+\-1.8mm in the premolar region and by 4.5mm+\-1.9mm in the molar region. Though the Schneiderian membrane was perforated in three patients, they reported an overall survival rate of 94%.

In another study reported by Agamy and Neidermier[15], 31 patients had implants placed with sinus floor elevation without bone grafting, so that the implants protruded into the sinus. They found that the average sinus floor elevation was 2.95 mm and the increased apical bone thickness was 1.89 mm.

Multiple studies have reported the placement of implants into the posterior maxilla with sinus elevation without bone grafting and show survival rates of more than 90%.[16-19] Taschieri et al[20] in a recent study, reported 100% survival rate after placement of 15 implants embedded with plasma rich growth factors, in premolar extraction sites, after osteotome sinus lift and without bone grafts. They achieved a mean membrane lift of 2.9mm and no complications were reported at 1 year follow-up. Two other previous studies have shown similar results in terms of bone gain.[21, 22] Galindo-Moreno et al[23] reported two cases of antral migration of implants, and in one of the cases the migrated implant which had been left behind at the patient's behest, showed no signs of clinical complications at 4 years follow up. Moreover, they suggested perforation of the Schneiderian membrane and inadequate primary stability as reasons for implant migration.

In the present study, though an intentional perforation was made in the sinus membrane, it was small (~2mm) and all implants were placed with good initial stability. There were no incidences of implant migration during the follow up period. Moreover engagement of the implant to the cortical plates of bone at the alveolar crest and at the sinus floor could have rendered excellent initial stability and contributed to the success of the implants. Implant survival rates following accidental maxillary sinus perforation are reported to be in the range of 88.6% to 98%

provided the Schneiderian membrane was intact or was treated.[24, 25] However in this study the overall implant survival rate was 98.4% despite the fact that all implants were placed after intentionally perforating the Schneiderian membrane. The minor post-operative complications of sinusitis and epistaxis reported in the study did not contribute to long-term problems.

Conclusion

Based on the results of the present study, posterior maxillary edentulous areas with reduced CBH may be successfully rehabilitated with implants that penetrate the Schneiderian membrane and extending into the maxillary antrum, provided the initial implant preparation is limited to a maximum width of 2mm and portion of implant extending into the sinus cavity is not more than 3mm.

Clinical Significance

Though not an alternative for time tested sinus lift procedure, implant placement by antral perforation as described in this study may be considered because of its conservative nature and minimal associated complications.

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