Displacement of Dental Implants into the Maxillary Sinus: A Case Series Study

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ABSTRACT

Objective: Dental implant placement in the posterior maxilla is challenging due to poor bone quality and volume. Displacement of implants into the sinus is a common complication. This study was conducted to evaluate the risk of displacement in relation to various factors.

Materials and Methods: A retrospective observational study was conducted on 21 patients with 22 implants accidentally displaced into the maxillary sinus during a period of three years (November 2017-October 2002) The following data are collected: patient information, medical condition and smoking habit, geometry and size of the implant and anatomical region of displacement, time of displacement and removal after placement, available bone height and the associated sinus lift procedure. The surgical technique and type of anaesthesia for implant removal were also recorded.

Results: The mean age of patients was 43±9 years with male to female ratio of 2:1. About 67% of patients were smokers and score II ASA (American Society of Anaesthesia). More than half of patients had oroantral communication and 1/4th had sinusitis. Most implants were in the first molar region (68%) followed by the second molar (18%). The displaced implants accompanied by closed sinus lift were 82%, in addition, 82% of cases dislodged intraoperatively. The height and diameter of implants were 8-10 mm (59%) and 4-5 mm (73%) respectively, 82% were tapered and 64% were associated with 2-4 mm of residual bone height.

Conclusion and Recommendation: Dental implant displacement into the maxillary sinus should be expected when placing implant in the posterior maxilla with deficient bone volume and poor quality. The patient should be informed of this complication in the informed consent.

Keywords: Caldwell-Luc, Dental implant, Displacement, Maxillary sinus, Sinus lift

INTRODUCTION

Rehabilitation of esthetic, function and phonation of partially or completely edentulous patients with implant-retained prosthesis has become a common treatment modality in the last three decades[1]. However, alveolar bone resorption along with other anatomical changes that follows tooth extraction may cause mechanical and biological difficulties in fixed prosthetic rehabilitation with dental implants[2].

Dental implant placement in the posterior maxilla region can be even more challenging due to high bone resorption rate, thin buccal cortical bone[3] poor bone quality (type IV bone[4]. In addition, pneumatization of the maxillary sinus leads to subantral bone resorption, which further reduces the vertical bone height[5]. These factors pose certain difficulties and many complications, including implant loss due to failure to attain and maintain osseointegration. One rare but severe complication is implant displacement into the paranasal sinuses.

Immediate intraoperative displacement or late migration of the implant into the sinus might happen more often in patients who undergo implants placement with simultaneous subantral bony grafting[6]. Another important factor is the vertical height of residual alveolar bone, in particular the placement of implants with height of less than 4 mm with simultaneous bony grafting[7]. The placement of implants without an adequate primary stability, lack of experience and skills of the surgeon, the alterations of the intrasinus and nasal pressures, autoimmune reaction to the implant, inadequate relief of the interim prothesis, over instrumentation may lead this unfavorable situation[8]. Moreover, placement of dental implants without sinus lifting procedure in highly pneumatized sinuses, application of excessive force during implant placement, violation of the integrity of the sinus membrane, as well as tapping the osteotome with excessive force during sinus osteotomy are other causes of implant displacement[9].

Although an implant dislodged into the sinus may remain symptomless, it can be associated with oroantral communication and/or infection that may involve the maxillary sinus, the orbit and the ethmoidal, frontal, and sphenoid sinuses[7].

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Signs and symptoms may be acute or chronic. Acute symptoms include epistaxis, fluid or air passage through the oroantral communication, pain, nasal speech. Chronic oroantral fistulae acts as a pathway for further bacterial and fungal penetration, leading to pan-sinusitis[10]. Chronic symptoms include dull pain, free escape of fluids, antral polyps, postnasal drip, dysgeusia, voice alterations, earache and mucopurulent nasal discharge[11].

The displaced dental implant within the maxillary sinus should be removed as soon as possible. There are several methods to remove the implant from maxillary sinus, such as: through a bony socket defect, intraoral antrostomy (Caldwell-Luc technique), Functional Endoscopic Sinus Surgery (FESS) and access through transoral endoscopy by canine fossa[12]. Maxillofacial surgeons are more familiar with the direct transoral approach, which consists of creating a bone window in the anterolateral maxillary wall, while the transnasal endoscopic approach is gaining popularity, especially among oto-laryngologists[13,14].

MATERIALS AND METHODS

This is a retrospective clinical case series study conducted on 17 patients referred to our hospital for the removal of implants displaced or migrated into the maxillary sinus during a period of 5 years (2016-2020). The research was approved by the ethical committee of the Kurdistan board for medical specialties. The study was conducted in accordance with Helsinki declaration for experiments involving human subjects and informed consent was obtained from each patient.

Data collected include age and sex, smoking habit and medical status according to the American Society of Anesthesiologists[15], presence symptoms and oroantral communication, sinus lift procedure simultaneous with implant placement, the use of bone graft. In addition, length, diameter and design of the implant; site of implant; time of displacement (immediate at the time of insertion or later); the type of surgical procedure and anaesthesia that was used to retrieve the implant were recorded. Furthermore, subantral residual bone height at the implant site was estimated from conventional x-rays (panoramic and intraoral radiographs) or cone beam computed tomography (CBCT).

Before performing surgical removal of the displaced implants, the patients were subjected to thorough clinical examination and radiographic imaging to localize the displaced implants (Figure 1). Caldwell-Luc antrostomy was used to remove the implants (Figure 2). An incision was made in the canine fossa and a window of bone is created in the anterolateral aspect of the maxilla. The sinus membrane was incised, and the displaced implants were removed using long curved artery forceps. The sinus was cleaned of any debris and thoroughly irrigated with normal saline and finally the wound was closed with interrupted silk sutures. SPSS version 25 was used for analysis of data. Chi square test of goodness of fit was used to find any significant difference at p value of 0.05.

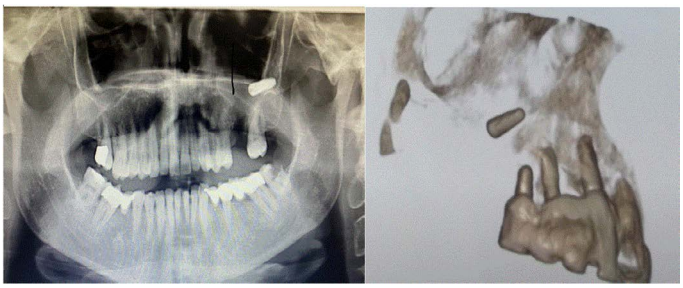

Figure 1: Radiographic localization of displaced implants

Figure 2: Removal of displaced implants by Caldwell-Luc antrostomy

RESULTS

A total of 22 displaced implants were removed from 21 patients. There were 7 females (33.0%) and 14 males (67.0%) with a male: ratio of 2:1, however no significant difference was found (P=0.126). The age range of patients was 37-64 years (mean 43± 9). Twelve patients (57.0%) with displaced implants were in the age range of 55-64 years, with significant difference being noted (P= 0.049) among the three age groups, (Table 1). The number of smoker patients was 15 (71.0%) versus 6 nonsmokers (29.0%) and the number of patients with ASA I was 8 (38.0%) versus 13 patients (62.0%) with ASA II systemic disease. The difference was significant in the former (P= 0.049) and not in the latter (P= 0.126), (Table 2). The implants were removed from the maxillary sinus by Caldwell- Luc transoral antrostomy under local anaesthesia, except one patient who was operated on under general anaesthesia.

Table 1: Age and sex distribution of patients

	Sex		Total	
Agerange (years)	Male No. (%)	Female No. (%)	No. (%)	
35-44	2 (14.0)	1(14.0)	3 (14.0)	
45-54	4 (29.0)	2 (29.0)	6 (29.0)	Chi^2=6 P=0.049
55-64	8 (57.0)	4 (57.0)	12 (57.0)	
Total	14(100)	7 (100)	21(100)	
Chi^2=2.33, P= 0.126				

Table 2: ASA score and smoking habit of patients

ASA Score	Smokers No. (%)	Nonsmokers No. (%)	Total No. (%)	Statistics
ASA I	3 (20)	5 (83)	8 (38)	
ASA II	12 (80)	1 (17)	13 (62)	Chi^2=1.19 P= 0.275
Total	15 (100)	6 (100)	21 (100)	
Statistics	Chi^2=3.857, P= 0.049			

ASA: American Society of Anaesthesia

The time interval between implant displacement and the surgical removal is within one week in 17 (77.0%) implants, within two weeks in three implants (14.0%) and within three weeks in two implants (9.0%). In 20 patients, single implant displacement was noted. One patient was presented with migration of two implants into the right maxillary sinus. Out of 22 displaced implants, 15 implants (68.0%) were found in the region of first molar, four (18.0%) in the second molar, and three (14.0%) in the second premolar region. The difference in both the time of removal and anatomical region of displacement was significant (P= 0.00), (Table 3).

Table 3: Time of surgery and anatomical region of displacement

Time of surgery since displacement	Anatomical region of displacement			Total No. (%)	Statistics
	1st Molar No. (%)	2nd Molar No. (%)	2nd Premolar No. (%)		
One week	11 (73.0)	3 (75.0)	1 (33.0)	15 (68.0)	
Two weeks	3 (20.0)	1 (25.0)	2 (67.0)	6 (27.0)	Chi^2= 13.889 *P*= 0.000
Three weeks	1 (07.0)	0 (0.0)	0 (0.0)	1 (5.0)	
Total	15(100)	4 (100)	3 (100)	22 (100)	
Statistics	Chi^2= 11.83, *P*= 0.002				

The symptoms associated with implant displacement, the simultaneous sinus lift, and the timing of displacement (immediate versus delayed) are shown in (Table 4). The number of patients presents with oroantral communication is 9 (53.0%). Most displaced implants are associated with indirect sinus lift 15 (68%). Implants displaced at the time of placement were 18 (82.0%). No significant difference in the associated symptoms was noted (P=0.266), while the simultaneous sinus lifting and immediate post-extraction placement were associated with a significantly higher risk of displacement (P=0.00).

Table 4: Symptoms, simultaneous sinus lifting and time of displacement

Patient symptoms	No. (%)	Statistics
Oroantral communication	9 (53.0)	Chi^2= 3.95 *P*= 0.266
Sinusitis	4 (24.0)	
Nasal obstruction	3 (18.0)	
Headache	5 (5.0)	
Total	21(100)	
Simultaneous sinus lifting		
Indirect lifting	15 (68.0)	Chi^2=12.37 *P*=0.002
Direct lifting	5 (23.0)	
No lifting	2 (9.0)	
Total	22 (100)	
Timing of displacement		
Immediate displacement	18 (82.0)	Chi^2=8.90 *P*=0.002
Late displacement	4 (18.0)	
Total	22 (100)	

The implant dimensions and design and residual bone height are shown in (Table 5). Most of the displaced implants are 8-10 mm (59.0 %) in length, 4-5 mm (73.0 %) in diameter, and tapered in design (82.0 %). About 64.0% of displaced implants were associated with 2-4 mm of residual subantral bone height. The difference is significant for the three parameters (P=0.00).

Table 5: Implant dimensions and design and residual bone height

Implant Dimensions		No (%)	Statistics
Heigh (mm)	6-8	5 (23.0)	Ch2=15.09 *P*=0.001
	8-10	13 (59.0)	
	10-12	3 (14.0)	
	> 12	1 (4.0)	
	Total	22 (100)	
Width (mm)	<4	5 (23.0)	Ch2=16.15 *P*=0.000
	4-5	16 (73.0)	
	>5	1 (4.0)	
	Total	22 (100)	
Implant Design			
Tapered		18 (82.0)	Ch2=8.90 *P*=0.002
Cylindrical		4 (18.0)	
Total		22(100)	
Residual bone height (mm)			
<2		4 (18.0)	
2-4		14 (64.0)	Ch2=18.36 *P*=0.000
4-6		3 (14.0)	
6-8		1 (4.0)	
Total		22 (100)	

DISCUSSION

Rehabilitation of edentulous ridges with implant retained fixed prosthesis is a common procedure now a days. Dental implant placement is commonly performed by oral implantologists as well as by general dental practitioners. Dental implant placement in the posterior maxilla is a challenging procedure due to deficient bone quantity (height and width) and poor quality (D3, D4, low bone density). Pneumatization of the maxillary sinus is the main cause of vertical bone loss due to subantral bone resorption.

Displacement of dental implants into the maxillary sinus is not uncommon complication[16]. The displacement may occur perioperatively at the time of implant placement[17], early postoperatively[18], prior to loading[19], or even after functional loading[20]. The incidence of dental implant displacement into the maxillary sinus is reported between 0.6%-3.8.0%[16].

Intraoperative displacement may occur due to several factors, including unskilled operator, poor surgical planning with placement of implant in poor bone quality and volume. Moreover, overzealous preparation of the implant bed, the use of excessive force during placement or violation of the integrity of sinus membrane during drilling[21]. Presence of inadequate bone height with spongy type 3 o 4 bone quality will not anchor the implant and lead to poor primary stability. Poor stability will lead to micro motion of the implant that impede the healing process by causing damage to the capillaries and preventing chemotaxis of the osteogenic cells[22].

The operator knowledge and surgical skills are of most importance in developing complications. In the present study most of the displaced implants were placed by junior dentists with limited or no training in dental implant procedures. This finding is also found by Galindo-Moreno et al[23]. The dentists attending condensed short courses of few days sponsored by implant companies that are aimed at selling their products and are conducted off the academic environment of dental schools. In the present study 86% of the implants are displaced during primary surgery, which further indicates the inadequate planning and poor knowledge of biomechanics of implants and insufficient surgical skills.

Displacement of implants during postoperative period and before functional loading may occurs due to failed osseointegration that result from infection such as sublinical oroantral fistula or sinusitis[24]. Migration of dental implants after functional loading has been attributed to three mechanisms: periimplantitis, faulty distribution of occlusal force that initiate bone resorption and suction effect in the intrasinus or nasal pressure[25].

Implant length, diameter and geometry are also considered as an important factor in displacement. In the present study 59.0% of the implants are 8-10 mm and 73.0% are of 4-5 mm in diameter. Sgaramella

et al[9] have also found that most displaced implants are more than 10 mm in length, while shorter implants appeared to have a lower incidence of displacement. In a small case series study of nine implants Ridaura -Ruiz et al[26] found that the length of displaced implants ranged between 10-15 mm and all the migrating implants were at least 2 mm longer than the available bone height. It has been recommended that dental implants in the posterior maxilla should be at least 10 mm in length and 5 mm in diameter to achieve good stability and longevity[27,28].

In the present study about 82.0 % of the displaced implants are tapered vs. 18.0 % cylindrical type. Paradoxically, Sgaramella et al[24] have found that 62.5% of the displaced implants are cylindrical. This difference could be attributed to obvious decrease in the use of cylindrical implants in the last decades However, the use of tapered implants in the posterior maxilla may improve the primary stability in less experienced hands[24].

The most frequently displaced implants are those placed in the first molar region (82.0 %) followed by second molars (18.0 %). Sgaramella etal[9] have also found that the first molar is the most frequent displacement (58.3%) followed by second premolar, second molars (16.6%) and first premolars (8.3%). The high incidence of first molar-replacing implant displacement may be attributed to the higher number of implants placement in this area and the fact that first molars are lost earlier than other teeth. Consequently, the bone in this are undergoes resorption more than other areas.

Most displaced implants in this study (64.0 %) occurred in areas with 2-4 mm of residual bone height. Achieving adequate primary stability is difficult if the vertical subantral bone height is inadequate. A minimum of areas 4-5 mm of bone is needed to simultaneously place implants with sinus lifting. In the absence of adequate bone to anchor the implant at the time of sinus lifting, a two-stage procedure should be adopted. A sinus lifting and augmentation with delayed implant placement may prevent such complication by increasing the volume and improving the quality of bone before implant placement[29].

In the present study 90.0 % of displaced implants are associated with sinus lifting (68.0 % indirect and 23.0 %) procedures. Sgaramella et al[24] also found that 25.0 % of the displaced implants are associated with sinus lift. Biglioli and Chiapasco[30] reported that 33.0 % of displaced implants accompanied sinus lift procedures. Galindo-Moreno[23] also reported this observation in 53.3% of the dislodged implants. Indirect sinus lift, which comprises 68.0 % of the lifted cases in the present study may lead to greater displacement than open technique, possibly because of poor implant stability caused by difference in the diameter between the final osteotome and the implant diameter.

The displaced implants can be retrieved from the sinus by peroral Caldwell-Luc antrostomy[19] or pernasal endoscopic approach[31]. The peroral antrostomy offers better mechanical and visual access to the sinus, as compared to the endoscopic sinus surgery. However, it is considered more aggressive. The reported complications of this approach are damage to the infraorbital nerve and floor of the orbit, anaesthesia of maxillary teeth and scar[24]. Endoscopic approach is le traumatic, bit it is not suitable if the location of the implant is out of reach of the surgical forceps or where there is an oroantral fistula that need closure by local flaps. In this study Caldwell-Luc approach was used to remove the displaced implants because more than half of patients had oroantral communications that are closed by local flaps. The high number of oroantral communication in the present study may be attributed to the failed and traumatic attempt by the referring dentist in removing the displaced implants through the implant hole.

CONCLUSION AND RECOMMENDATIONS

Displacement of dental implants into the maxillary sinus is not uncommon sequala of dental implant placement in the posterior maxilla. The operator should have adequate skill in this procedure and the patients should be warranted about this complication. The displaced implant should be removed to prevent infection related complications.

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Competing Interest: None

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