Review Article

Different Treatment Modalities of Displaced Implants into the Maxillary Sinus: A Systemic Review

Omar N Elprince[1], Samira M Osailan[2], Osama N Kariri[3], Abdullah I Albakri[3], Mushal A Alhendouz[3], Ali S Alsallouk[3], Fahad M Alotaibi[3], Khames T Alzahrani[4]*, Abdulrahman J Alhaddad[5], Osama A Qutub[6] and Rayyan A Kayal[7]

[1]Oral and Maxillofacial Surgery, Vision Colleges of Dentistry and Nursing, Riyadh, Saudi Arabia; [2]Oral and Maxillofacial Surgery Department, King Abdulaziz University, Jeddah, Saudi Arabia; [3]Dental Department, Vision Colleges of Dentistry and Nursing, Riyadh, Saudi Arabia; [4]Prosthodontics Department, BDS, PGD Endo, Ministry of Health, Taif, Saudi Arabia; [5]Oral and Maxillofacial Prosthodontics Department, King Abdul-Aziz University, Jeddah, Saudi Arabia; [6]Prosthodontics, Oral and Maxillofacial Prosthodontic Department, King Abdulaziz University, Jeddah, Saudi Arabia; [7]Department of Periodontology, King Abdulaziz University, Jeddah, Saudi Arabia

Corresponding author:
Khames T Alzahrani
BDS, PGD Endo, Ministry of Health, Taif, Saudi Arabia
Surgery Department, King Abdulaziz University, Jeddah, Saudi Arabia,
E-mail: ddtt200800@gmail.com

Abstract

Dislocation of dental implant into the maxillary sinus has been reported and attributed to a number of factors. It is a complication that may occur intraoperatively or postoperatively. The treatment modalities of migrated implants range from a no treatment and follow up approach to surgical intervention to retrieve the dislocated implant. The purpose of this systematic review is evaluating the different treatment modalities reported for addressing this complication. Using the medline and pubMed central databases, this study examined the different treatment modalities and instruments used to address the problem of migrated implant into the maxillary sinus. The results of this research have revealed that sinusitis is the most common reported complication associated with implant migration. Additionally, Caldwell-Luc surgical operation for implant retrieval into sinus was the most common used treatment modality. Furthermore, using surgical aspirator, vascular forceps and endoscope were among the most used instruments employed to facilitate implant retrieval.

Keywords: Displacement of implant; Implant passage; Maxillary sinus; Implant retrieval; Implant removal

Introduction

Implant therapy for replacement of missing teeth has become the standard of care as the prognosis and predictability of this treatment continue to elevate. Some areas of the mouth do present challenges and might need adjunctive procedures and more experienced clinicians. The posterior maxilla is one the most challenging area when it comes to placing implants. This is due to the soft nature of bone and compromised anatomy in this area due to pneumatization of the sinus as well as loss of vertical and horizontal alveolar ridge after maxillary posterior teeth loss. One of the reported complications of placing implants in this area is displacement if the implant fixture into the maxillary sinus. The surgical placement of implant in this area along with continuously biting force after completion of implant prosthetic phase might potentiate the implant migration and passage. [1] Moreover, the unbalanced air pressure between the maxillary sinus and nasal cavity in addition to the body reaction to the implant may lead to peri-implantitis that might cause bone resorption and result in implant displacement. [2] Passage of dental implant into the maxillary sinus has been attributed to many factors including; lack of primary stability, inexperience clinician, frictional forces of transitional denture, over drilling, excessive force during removal of non-integrated dental implants. [3]

Migration or passage of implants into the sinus may occur intra operatively or postoperatively. The adverse effect of this complication as well as the management depends largely on when it occurs. The presence of a dislodged implant inside the sinus cavity might affect the nature of the sinus lining leading to thickening of the Schneiderian membrane or inhibition of muco-ciliary clearance. In addition, the scattered bone graft material if present-may cause sinusitis and sinus congestion due to obstruction of the maxillary ostium. [4] An oroantral fistula may develop due to obstruction of the ostium and sinusitis. Studies have also documented that the dental implants can passage or roam into paranasal sinus, orbital floor or the carinal fossa from the maxillary sinus; changing the air pressure or causing foreign body reaction in addition to local tissue necrosis. [5] On the other hand, case series stated that there is no relation between implant displace into the sinus and sinusitis at a follow up interval of 4 years. [6] While other literatures suggested that the migrated implants into the sinus result in long-lasting sinusitis that needs a surgical intervention, even if there is no obvious complication. [7]

The intervention protocols for migrated or displaced implants into the sinus can either be surgical, if there is signs and symptoms, utilizing a lateral buccal wall approach which is known as Caldwell-Luc procedure or conservatively if there is no signs or symptoms by observation. Nowadays, the surgical

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approach handle the displaced implants using the endoscopic sinus surgery by creating a tiny window in the lateral wall of the sinus. [8] Another treatment modality that has been proposed in literatures is removal of displaced dental implant through nasal cavity using the endoscope. The approach uses an endoscope through the ostium in the middle meatus to enter the maxillary sinus and other paranasal sinuses. It also facilitates the removal of the migrated implant and other foreign bodies, cure of maxillary inflammation and establishment of appropriate pathway of the maxillary ostium conservatively. However, nasal endoscopy is unable to close the oro-antral communication which can be easily closed with buccal extended flap when using Caldwell-Luc procedure. [9-15] The purpose of this paper is to make a comprehensive systematic review regarding different treatment modalities of migrated or displaced implants into the sinus.

Literature Review

In this paper, we used the guidelines of PRISMA systemic review to allocate, analyze and summarize the data. Academic research engine databases were used to detect the most related published papers at; KAU Deep Knowledge, PubMed, Clarivate Web of Science, Cochrane Library, Medline, and EMBASE databases. The keywords used to find the published articles were: "Displacement," "migrate," "passage," "dislocate," "implant," "maxillary sinus," "retrieval" and "removal" with the following search formula: (Subject 1 OR subject 2 OR subject 3 OR subject 4 AND subject 5 AND subject 6 AND subject 7 OR subject 8).

Then we shriveled our finding with the following keywords: Treatment modalities, displaced implant into the maxillary sinus and excluded any research that described implant displacement to any place other than the maxillary sinus. To ensure that the data achieved is valuable and clear, this research included only the novel articles (published and approved). Additionally, the authors limit their search time line to be within 22 years starting from 2000. Four authors separately assessed the result of the search strictly to select the peer-reviewed papers, wrote in English language, defining the different treatment modalities used in treatment of migrated implant into the sinus and the instruments had used.

This paper has incorporated 27 articles demonstrating a number of 134 patients who had a displaced implant into the maxillary sinus [Figure1].

Caldwell-Luc Approach

The 27 research articles were reviewed for the number of patients in the study, complication reported to displacement of implants into the maxillary antrum, method of treatment, accompanied surgical procedure, instruments used for retrieval of the displaced implant, and follow up status of patients after treatment [Table 1].

This study has revealed that the most common reported complications associated with implant migration into maxillary antrum is sinusitis followed by Oroantral communication. [Figure 2]

Caldwell-Luc approach, as a method of treatment for migrated implant, has been reported as the most common approach. Endoscopic nasal approach was the second treatment modalities reported followed by Endoscopic Caldwell- luc approach and then the no treatment approach. [Table 2]

In this systematic review, the authors investigated the most common reported instruments that has been described in

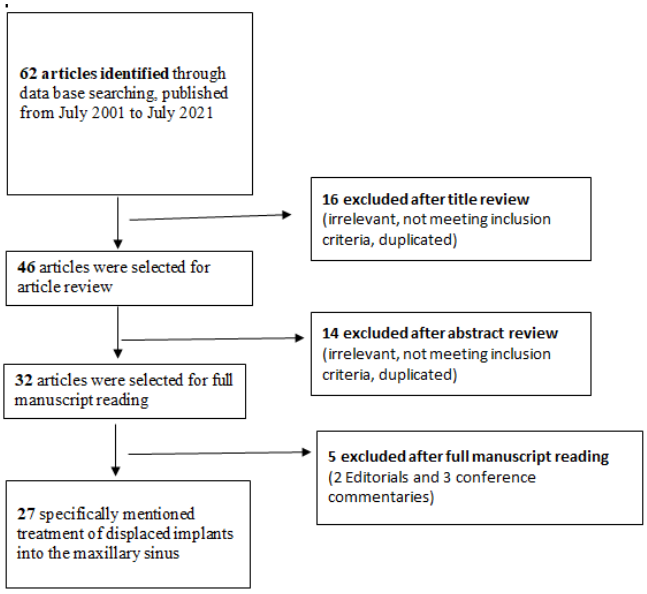

Figure 1: Flowchart of the research based on inclusion criteria of keywords.

Table 1: Reported cases of displaced implants in literatures and methods of treatment.

N	Number of patients in the study	Complications reported of displacements	General method of removal or treatment	Other surgical procedure done with retriviel	Instruments mentioned used in the surgical procedure	Follow up status after treatment	Reference
1	1	pain in the affected side	CL	BG, M, AND another implant placement	SU, VF, HSH	14 months, uneventful	An et al.
2	1	asymptomatic	CL	none	SU, P	7 days, uneventful	Fusari et al.
3	4	asymptomatic	CL	BG	VF	Na	Chrcanovic et al.
4	1	pain in the affected side	CL, E	NA	LHP, E, SU	7 months, uneventful	Scarano et al.
5	11	NA	CL	NA	SA, SU	3 patients reported facial parathesia	Hamdoon et al.
6	2	asymptomatic	CL	NA	LHP, VF	6 months uneventful	Gnigou et al.

7	1	asymptomatic	CL	BG, M	VF	1 month uneventful	Eltas et al.
8	1	foul nasal odor	N,E	none	NASAL BAYONET FORCEPS,E	1 month uneventful	Li et al.
9	1	OAC	CL	none	LHP, SU, SA, VF	Uneventful	Flanagan et al.
10	1	pain in the affected side	CL	none	LHP, SU, VF	12 months uneventful	Bruniera et al.
11	1	sinusitis	CL	none	LHP, VF	1 year uneventful	Laureti et al.
12	1	asymptomatic	none, the implant dis appeared	none	none	6 months uneventful	Damlar et al.
13	1	asymptomatic	CL	NA	NA	6 months uneventful	Ding et al.
14	1	OAC	CL	none	IO, E, SU	Uneventful	Andreasi et al.
15	1	NA	no treatment, the implant migrate from sinus to the stomach	none	none	3 months uneventful	Park et al.
16	1	asymptomatic	ne failed then cl	none	N,E, SU, LHP	Uneventful	Soylu et al.
17	1	pain in the affected site	CL	replacement of the bony lid	E, SU, P	6 months uneventful	Nogami et al.
18	1	nasal congestion and sinusitis	CL	none	NA	12 months uneventful	Nuñez-marquez et al.
19	1	nasal congest	CL	reconstruct defect by titanium mesh and bg	NA	32 months uneventful	Tavares et al.
20	16	-6 PT asymptomatic -10 PT sinusitis	CL,E	NA	E, SU	Uneventful in 9-36 months	Matti et al.
21	2	asymptomatic	-1 PT CL -1 PT no treatment	1 PT: SL, M & BG	none	1 pt: insertion of new implant 1 pt: 5 years uneventful	Kluppel et al.
22	2	asymptomatic	CL	1 PT : BG	none	Uneventful	Üngör cet al.
23	1	asymptomatic	CL	BG	NA	Na	Ebenezer et al.
24	1	nasal congestion	N,E	NONE	E, SU	1 week uneventful	Daniel et al.
25	27	19 PT: OAC 13 PT: sinusitis 7 PT: nasal congestion	4 PT: NE 17 PT: CL 4 PT: CL, E	closure of OAC	E, SU	1 pt with ne developed nasal hemorrhige 1 pt with cl developed sinusitis after 2 years	M chiapasco et al.
26	52	37 PT OAC 38 PT: sinusitis 27 PT: post nasal drip 13 pt: nasal congestion	49 PT: CL 1 PT IMPLANT REJECTED THROUGH NOSE 1 PT: NE 1 PT: CL, E	NA	E, SU	37 pt with no symptoms 18 PTS had sinusitis post-operatively	Manor et al.
27	1	asymptomatic	CL, E	NA	E	Uneventful	Chappuis et al.

literatures which facilitate the surgical procedure of implant retrieval. Our findings have revealed that most of literatures has mentioned that surgical aspirator and vascular forceps (13 report out of 27 research) were used to facilitate implant removal from the sinus [Table 3].

This study has also investigated the most common adjunctive surgical procedure reported in the literatures which accompanied the different treatment modalities to treat displacement or migration of implants into the maxillary sinus. The use of different bone grating materials and membranes to reconstruct the surgical defect has been reported to be the common surgical maneuver accompanying implant retrieval [Figure 3].

Only two studies has reported the placement of implant simultaneously after Caldwell Luc approach to retrieve a displaced implant. [3,9,16-25] Regarding follow up after different treatment modalities used to mitigate implant displacement, 1 patient has been reported to develop nasal hemorrhage after nasal endoscopy and 19 patients has developed sinusitis after Caldwell-Luc approach. 2 papers have not described the follow up status of their patients. The remaining 112 patients have been

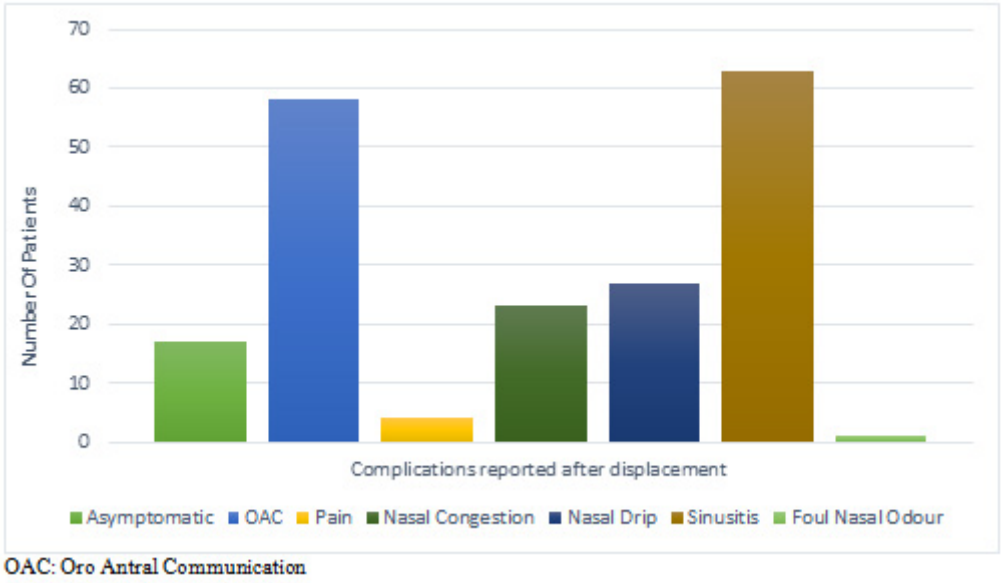

Figure 2: Complications reported after implant displacement.

Table 2: Methods of treatment of migrated implants into the maxillary sinus.

Method of treatment	Caldwell- Luc approach	Endoscopic Caldwell- Luc approach	Endoscopic nasal approach	No treatment
Number of patients	115	8	23	4

Table 3: Instruments reported during surgical retrieval of displaced implant into the maxillary sinus.

Instruments	Surgical aspirator	Vascular forceps	Endoscope	Piezo surgery	Hand piece
Number of studies mentioned the use of this instrument	13	9	8	3	5

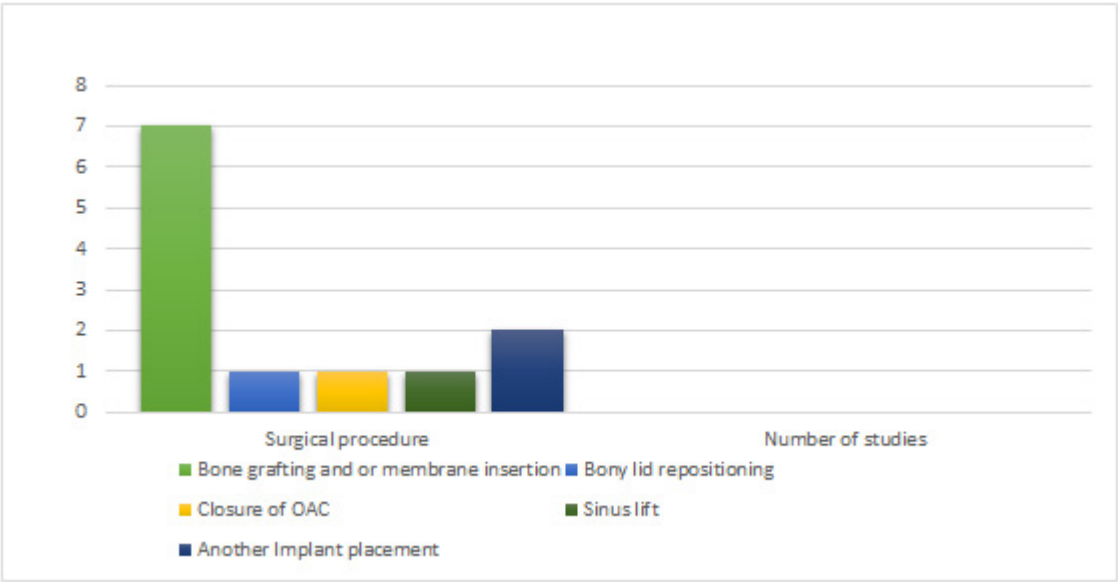

Figure 3: Surgical procedures accompanying treatment of sinus migrated implant.

reported to have uneventful follow up period including patients who had no treatment [Table 1].

Discussion

In tandem with the raise in using dental implants as a modality of replacing missing teeth, a plethora of complications has also been reported related to this trend. One of these complications is implant migration into other unwanted spaces such as the maxillary sinus. [26-34] The main goal of this paper is to investigate the different treatment modalities used to mitigate the aforementioned complication.

Regarding complications related to implant displacement into the maxillary sinus, the investigated studies have revealed many complications such as sinusitis, oro-antral communication, pain on affected site, nasal drip, nasal congestion, and foul nasal odour. In this review, sinusitis has been found to be the

most common complication reported followed by oro-antral complication then nasal drip. Manor et al. [9] and Matti et al. [29] in their retrospective study have reported sinusitis also as the most common encountered complication after implant displacement into the maxillary sinus. However, in this study a significant number of asymptomatic patients after implants migration have been described to be asymptomatic. This finding came in line with other literatures who mentioned that most migrated implant into the maxillary sinus are asymptomatic. [35,36]

As mentioned before in this study the treatment modalities of migrated implants range from surgical approach for retrieval to a no treatment and follow up approach. Caldwell Luc operation has been found to be the most common reported modality to mitigate this situation. Many researchers in their systematic review and retrospective studies have also reached the same result. [9,35,36] The nasal endoscopy approach has come in this study as the second most common approach reported in literatures. However, this approach still has its indications and limitations as described by Matti et al. [29] in his retrospective study of 16 cases of nasal endoscopy to remove a migrated dental implant in the maxillary sinus. Additionally, Soylu et al. [25] has reported that nasal endoscopy might fail to retrieve the displaced implant and Caldwell-Luc approach might still be the most efficient approach for retrieval. The no treatment approach in the allocated studies in this review has been attributed to either patient's request to leave the implant, [36] continuous migration of the implant to other places, [9] or difficulty expressed by the surgeon to retrieve the implant. [3]

While the ultimate aim is not only to retrieve the displaced implant but also to reconstruct the potential bony defect, the most common procedure mentioned to accompany retrieval was placement of bone graft and or membrane. Closure of oro antral communication as accompanied procedure has only been mentioned once in a retrospective study which included 52 patients. [9]

This systematic review has thoroughly investigated the most common reported instruments used during the surgical procedure of implant retrieval. The use of high suction or surgical aspirator has been the most common instrument employed by surgeons to facilitate the retrieval procedure. The second most common reported instrument used was vascular forceps such as curved hemostat which aids in grasping of the strayed implant inside the sinus cavity. Also, endoscope has been reported to significantly facilitate retrieval by providing the surgeon with visibility during the surgical procedure inside the dark room of the maxillary antrum.

The follow up after different treatment modalities in this review has been reported to be uneventful, surprisingly even the 4 reported patients with a no treatment approach have been reported to be asymptomatic. [3,9,21,24]

Conclusion

Displaced dental implants into the maxillary sinus might cause a range of symptoms especially sinusitis. However, the incidence of asymptomatic migrated implant still existed. In order to mitigate this issue, surgical retrieval of the displaced implants through Caldwell-Luc approach is still the golden standard and the most commonly used modality for retrieval. Additionally, the use of surgical aspirator, vascular forceps and endoscope facilitate most of the surgical maneuvers for implant retrieval. Finally, the follow up periods after most of the surgical retrieval modalities are uneventful. Nonetheless, the no treatment approach to a migrated implant into the maxillary sinus still needs to be assessed for its feasibility.

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References

1. Chiapasco M, Zaniboni M, Rimondini L. Dental implants placed in grafted maxillary sinuses: A retrospective analysis of clinical outcome according to the initial clinical situation and a proposal of defect classification. Clin Oral Implants Res. 2008;19:416-28.
2. Galindo P, Sánchez FE, Avila G, Cutando A, Fernandez JE. Migration of implants into the maxillary sinus: Two clinical cases. Int J Oral Maxillofac Implants. 2005;20:291-5.
3. Kluppel LE, Santos SE, Olate S, Freire FFWV, Moreira RWF, De Moraes M. Implant migration into maxillary sinus: Description of two asymptomatic cases. Oral Maxillofac Surg. 2010;14:63-6.
4. Nolan PJ, Freeman K, Kraut RA. Correlation between Schneiderian membrane perforation and sinus lift graft outcome: A retrospective evaluation of 359 augmented sinus. J oral Maxillofac Surg Off J Am Assoc Oral Maxillofac Surg. 2014;72:47-52.
5. González GA, González GJ, Diniz FM, García GA, Bullón P. Accidental displacement and migration of endosseous implants into adjacent craniofacial structures: A review and update. Med Oral Patol Oral Cir Bucal. 2012;17:e769-74.
6. Galindo MP, Padial MM, Sánchez FE, Hernández CP, Wang HL, O'Valle F. Dental implant migration in grafted maxillary sinus. Implant Dent. 2011;20:400-5.
7. Chiapasco M, Felisati G, Maccari A, Borloni R, Gatti F, Di Leo F. The management of complications following displacement of oral implants in the paranasal sinuses: A multicenter clinical report and proposed treatment protocols. Int J Oral Maxillofac Surg. 2009;38:1273-8.
8. Tsodoulos S, Karabouta I, Voulgaropoulou M, Georgiou C. Atraumatic removal of an asymptomatic migrated dental implant into the maxillary sinus: A case report. Oral Implantol. 2012;38:189-93.
9. Manor Y, Anavi Y, Gershonovitch R, Lorean A, Mijiritsky E. Complications and management of implants migrated into the maxillary sinus. Int J Periodontics Restorative Dent. 2018;38:e112-e118.
10. Ann JH, Park SH, Han JJ, Jung S, Kook MS, Park HJ, et al. Treatment of dental implant displacement into the maxillary sinus. Maxillofac Plast Reconstr Surg. 2017;39:35.
11. Fusari P, Doto M, Chiapasco M. Removal of a dental implant displaced into the maxillary sinus by means of the bone lid technique. Case Rep Dent. 2013;2013:260707.

12. Chrcanovic B, Luis Neto Custódio. A Surgical removal of dental implants displaced into the maxillary sinus. Stomatol Glas Srb. 2009;56:139-47.
13. Scarano A, Perrotti V, Carinci F, Shibli JA. Removal of a migrated dental implant from the maxillary sinus after 7 years: A case report. Oral Maxillofac Surg. 2011;15:239-43.
14. Hamdoon Z, Mahmood N, Talaat W, Sattar AA, Naeim K, Qais A, et al. Evaluation of different surgical approaches to remove dental implants from the maxillary sinus. Sci Rep. 2021;11:1-8.
15. Gnigou M, Goutzanis L, Sarivalasis S, Petsinis V. Retrieval of displaced implants inside the maxillary sinus: Two case reports and a short review. Int J Implant Dent. 2019;5.
16. Eltas A, Dundar S, Eltas SD, Altun O, Yolcu U, Saybak A. Accidental displacement of dental implants into both maxillary sinuses during surgery. J Oral Implantol. 2015;41:601-3.
17. Li S, Xing Z, Yu L. Accidental migration of a dental implant into the nasal cavity. J Int Med Res. 2020;48:300060520948736.
18. Bruniera JFB, Silva-Sousa YTC, Faria PEP. A typical case of three dental implants displaced into the maxillary sinus. Case Rep Dent. 2015;2015.
19. Laureti M, Ferrigno N, Rosella D, Papi P, Mencio F, De Angelis F, et al. Unusual case of osseointegrated dental implant migration into maxillary sinus removed 12 years after insertion. Case Rep Dent. 2017;2017.
20. Damlar İ. Disappearance of a dental implant after migration into the maxillary sinus: An unusual case. J. Korean Assoc. Oral Maxillofac. Surg. 2015;41:278-80.
21. Ding X, Wang Q, Guo X, Yu Y. Displacement of a dental implant into the maxillary sinus after internal sinus floor elevation: Report of a case and review of literature. Int J Clin Exp Med. 2015;8:4826-36.
22. Andreasi BM, Andrisani C, Lico S, Ormanier Z, Arcuri C. Endoscopic retrieval of a dental Implant into the maxillary sinus: A case report. ORAL and Implantology. 2016;9:69-75.
23. Park JH, Kim HY, Kim SJ. From the maxillary sinus to the stomach: A rare case report of a displaced fragment of dental implant. Eur J Oral Implantol. 2018;11:469-73.
24. Soylu E, Kilic E, Alkan A. Migration of a dental implant to the maxillary sinus prior to second stage surgery : A case report. 2018;2:2-4.
25. Nogami S, Yamauchi K, Tanuma Y, Odashima K, Matsui A, Tanaka K, et al. Removal of dental implant displaced into maxillary sinus by combination of endoscopically assisted and bone repositioning techniques: A case report. J Med Case Rep. 2016;10:1.
26. Núñez ME, Salgado PAO, Peña CJF, Kewalramani N, Jiménez GA, Velasco OE. Removal of a migrated dental implant from a maxillary sinus through an intraoral approach: A case report. J Clin Exp Dent. 2021;13:e733-6.
27. Tavares RN, Nogueira AS, Sampieri MB da S, Bezerra MF, Gonçales ES. Late displacement of a dental implant into maxillary sinus. Braz J Otorhinolaryngol. 2014;80:359-61.
28. Matti E, Emanuelli E, Pusateri A, Muniz CCS, Pagella F. Transnasal endoscopic removal of dental implants from the maxillary sinus. Int J Oral Maxillofac Implants. 2013;28:905-10.
29. Üngör C, Atasoy K, Şenel F. Migration of dental implants into maxillary sinus during the healing period due to wrong indication: Report of 2 cases. Atatürk Üniversitesi Diş Hekimliği Fakültesi Dergisi. 2015;24:93-97.
30. Ebenezer V, Balakrishnan R, Christopher P, Asir VD. Surgical retreival of displaced implant from maxillary sinus: A case report. Biomed Pharmacol J. 2015;8:525-8.
31. Daniel L, Parumo R, Ma B, Shanmuganathan J. Transnasal endoscopy removal of dislodged dental implant: A case report. J Oral Implantol. 2016;20:43.
32. Chappuis V, Suter VGA, Bornstein MM. Displacement of a dental implant into the maxillary sinus: report of an unusual complication when performing staged sinus floor elevation procedures. Int J Periodontics Restorative Dent. 2009;29:81-7.
33. Turkyilmaz I. A proposal of new classification for dental implant complications. J Contemp Dent Pract. 2018;19:1025-33.
34. Jeong KI, Kim SG, Oh JS, You JS. Implants displaced into the maxillary sinus: A systematic review. Implant Dent. 2016;25:547-51.
35. Guler N, Delilbasi C. Ectopic dental implants in the maxillary sinus. Quintessence Int. 2007;38:e238-9.
36. Ibrahim M. Retrieval of dental implants from maxillary sinus: A systematic review. Ann Rom Soc Cell Biol. 2021;25:185-93.