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SINUS LIFT UP PROCEDURES IN DENTAL IMPLANTS: SYSTEMATIC REVIEW & META ANALYSIS

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ABSTRACT:

Introduction: Several randomized clinical trials (RCTs) have assessed the effectiveness of lifting the maxillary sinuses. Our study did additional research, in which it was witnessed that bone neoformation and implant osseointegration after sinus lifting with/ without grafting material was possible. In the current study we aimed to conduct a systematic review and meta-analysis on the maxillary sinus lift up and implant placement.

Methodology: An electronic search was performed in PubMed/MEDLINE, Cochrane Central Register of Controlled Trials, Web of Science, Embase, till 2020. We considered prospective and retrospective cohort studies, controlled clinical trials, and randomized clinical trials. The search and selection process yielded 18 studies, published between 2005 and 2020. A meta- analysis was conducted only for experimental studies comparing sinus floor elevation with and without grafting material; results were expressed as the standardized mean difference (SMD) or risk ratio (RR) with the 95% confidence interval (CI).

Results: An average gain in bone height of 4.7 mm over an average 39.4 month period was observed in the sinus elevated without grafting material. Regarding implants, there was a cumulative average survival rate of 97%. On meta-analysis, bone gain (P = 0.98) and implant survival (P = 0.13) did not differ significantly

between sinuses lifted with or without grafting material, with a SMD of 0.01 (95% CI —0.42 to 0.44) and with a RR of 0.55 (95% CI 0.26 to 1.19), respectively.
Conclusion: The results of this systematic review suggest that the technique of maxillary sinus lifting with immediate implant placement has a high success rate, with an average bone height increase of 4.7 mm over an average follow-up period of 39.4 months. After conducting the meta-analysis, no significant difference was found in the amount of bone formation or survival of lifted sinus implants between sinuses lifted with or without grafting material.
Key words: Sinus floor elevation; Sinus lift; Bone regeneration; Dental implant.

INTRODUCTION:

The use of osseointegrated implants is presently an efficient and dependable method for the partial or full edentulism. The rate of success be contingent on quantity of bone.[1] Due to atrophic alveolar ridges and/or a highly pneumatized maxillary sinus, situations that imply a limited amount of residual bone, in order to obtain the minimum height required for dental implant placement, the sinus lift are done.[2] Several randomized clinical trials (RCTs) have assessed the effectiveness of lifting the maxillary sinuses.[3–6] The first study of spontaneous vertical bone formation in the maxillary sinus, which ensued after the removal of a cyst, was put out by Lundgren et al. in 2003; this proved the osteogenic potential of the clot within the sinus.[7] Our study did additional research, in which it was witnessed that bone neoformation and implant osseointegration after sinus lifting without grafting material was possible.[8–10] The clot presents benefits over grafting materials, one such benefit being the occurrence of growth factors and bone morphogenetic proteins that are activated upon tissue injury. Further- more, the Schneiderian membrane has osteoprogenitor cells that help in the bone regeneration process.[3] The contact between the clot and the titanium surface generates thrombin, which contributes to osteoblast activation, augmenting the effects of bone growth.[11] The advantage of not using graft materials are shorter treatment time, absence of remaining graft particles, a lower rate of complications, and lower cost of treatment. Hence in the present study we aimed to conduct a systematic review and meta-analysis on the maxillary sinus lift up and implant placement.

MATERIALS AND METHODS

The methodology of this review followed the recommendations of the Cochrane Hand- book for Systematic Reviews of Interventions. [12] The primary outcome variable was the amount of bone height achieved following the maxillary sinus lifting without the use of grafting material and with the immediate placement of implants. The secondary outcome variables were the implant survival rate and the incidence of complications during the follow-up period. PubMed/MEDLINE, Cochrane Central Register of Controlled Trials, Web of Science, and Embase databases were searched for the data collection to 2020. Various search strategies were applied. **Table 1.** We included prospective and retrospective cohort studies, con- trolled clinical trials (CCTs), and RCTs that analyzed the amount of bone formation after maxillary sinus lifting via either the osteotome technique (osteotome sinus floor elevation, OSFE) or

via lateral window access, with simultaneous implant placement and without the use of grafting materials. We excluded the case reports, Animal studies, metabolic disorders, and case series. Two review authors conducted the screening, initially the titles were screened and from the selected studies, full texts were selected. The following terms and variables were considered from the studies, the study design, follow-up, sample size, age, gender distribution, implant related, habits, complications, alveolar bone height. The Cochrane Collaboration tool for assessing risk of bias was used for RCTs.

Statistical analysis

For descriptive statistics, the average rates and standard deviations (SD) of bone gain in height and implant survival were calculated using the data extracted from the included studies. Data were analyzed using Excel software (Mac. 2011, Version 14.0.0; Microsoft). With the objective of determining the effectiveness of sinus floor elevation without graft material, studies that compared the techniques with and without graft material were included in a pairwise metaanalysis. Only six studies were eligible for this meta-analysis. Since the studies used different grafting materials in their control groups, the mean difference in the result of each study was divided by the standard deviation to obtain the standardized mean difference (SMD), thus decreasing heterogeneity and allowing the comparison between studies, as suggested by Glass.18 For the continuous outcome (i.e. bone gain), the estimation of the intervention effect was expressed as the risk ratio (RR) using the mean and SD values of bone gain in millimetres, with a confidence interval (CI) of 95%. For the binary outcome (i.e. implant failure), the number of failures and the total number of implants placed were used to calculate the SMD with 95% CI. The inverse variance method (continuous data) or Mantel–Haenszel method (dichotomous data) was used for the random-effects or fixed-effects model. Heterogeneity was assessed using the x2 test, and the possible impact on the meta-analysis was quantified via I 2 . I 2 values of 25% were classified as representing low heterogeneity, while values of up to 50% and ≥70% were classified as representing medium and high heterogeneity, respectively.19 When significant heterogeneity was found ($P < 0.10$), the results of the random-effects model were validated. When heterogeneity was low, the fixed effects model was considered. The statistical significance level was set at $P < 0.05$. Data were analyzed using Review Manager statistical software. Publication bias was assessed graphically via a funnel plot.

RESULTS

Only 25 full-text were initially selected. Few studies were rejected. (**Table 2**). Only eighteen studies published between 2006 and 2017 were included in this systematic review.[2,6,10-24] A flow diagram of the search and selection process is given in **Fig. 1.**

Study characteristics

Assessments of the risk of bias and quality were conducted using the two analysis scales, in accordance with the study design. For CCTs (randomized and non-randomized), the Cochrane scale was used. Only one study presented a low risk of bias[6] ; the others presented a moderate risk [26] or high risk [25,27-36] of bias (**Table 3**).

Data synthesis and meta-analysis

In our study 1034 implants were installed. 26 implants failed, with mean survival rate of 97% without grafts, and with the graft, 13 of 213 implants failed, with mean survival rate of 94%. Regarding bone height, an average increase of 4.7 ± 1.82 mm over an average period of 39.4 months was seen in the sinus elevated without grafting material. There was no statistically significant difference between the groups (P = 0.13), with a RR of 0.55 (95% CI 0.26 to 1.19) (**Fig. 2**). Regarding the increase in bone height, no significant difference between the groups was seen (P = 0.98), with a SMD of 0.01 (95% CI 0.42 to 0.44) (**Fig. 3).** The funnel plot presented asymmetry when bone height was compared between groups, indicating possible publication bias. Only Two studies were observed (**Fig. 4**).[27,36]

TABLE 1. Systematic search strategy (PICOS strategy).

Population	#1 (Partially edentulous[MeSH] OR edentulous[MeSH] OR edentulous maxilla)
Intervention	#2 (Maxillary sinus[MeSH] OR sinus floor elevation OR sinus membrane elevation OR sinus lift OR maxillary sinus lift OR dental implant[MeSH] OR simultaneous implant)
Comparison	#3 (Sinus floor elevation with graft materials vs. sinus floor elevation without graft materials)
Outcomes	#4 (Bone gain OR bone height OR dental implant survival OR dental implant failure)
Study design	Prospective cohort, retrospective cohort, controlled clinical trials, and randomized controlled trials
Search combination	#1 AND #2 AND #3 AND #4 Database search
Language	No restriction
Electronic databases	PubMed/MEDLINE, Cochrane Central Register of Controlled Trials, Web of Science, and Embase

Table 2. Types of the study, parameters and the Studies excluded.

Prospective cohort studies	8
Retrospective cohort studies	5
Clinical trial	1
Rct	4
The number of participants	10-200
Sinus lifted	749
Implants placed	1247
The prosthetic loading period	2-10 months
Most common complication	Schneiderian membrane
Smoking	5
Types of grafting material were used:	Autogenous, xenogeneic and synthetic.
Reason for rejection	**Authors**
Case report	Sani et al. (2008)
Case series	Atef et al. (2014)
Absence of complete data reported	Gabbert et al. (2009) Markovic et al. (2016)

Duplicate study	Nedir et al. (2010)
Use of membrane	Sohn et al. (2008) de Oliveira et al. (2013)

Table 3. Assessment of the risk of bias and quality (Cochrane scale).

Authors (year)	Adequate sequence generation	Allocation concealment	Blinding	Incomplete outcome data addressed	Selective outcome reporting	Free of other sources of bias	Estimated potential risk of bias
Borges et al. (2011)[26]	Yes	Yes	No	Yes	Yes	Yes	Moderate
Lai et al. (2010)[25]	No	Yes	No	Yes	Yes	Yes	High
Nedir et al. (2013)[27]	Yes	No	No	Yes	Yes	Yes	High
Si et al. (2013)[6]	Yes	Yes	Yes	Yes	Yes	Yes	Low
Nedir et al. (2016)[36]	Yes	No	No	Yes	Yes	Yes	High

Fig. 1. Flow diagram of the screening and selection process (PRISMA format).

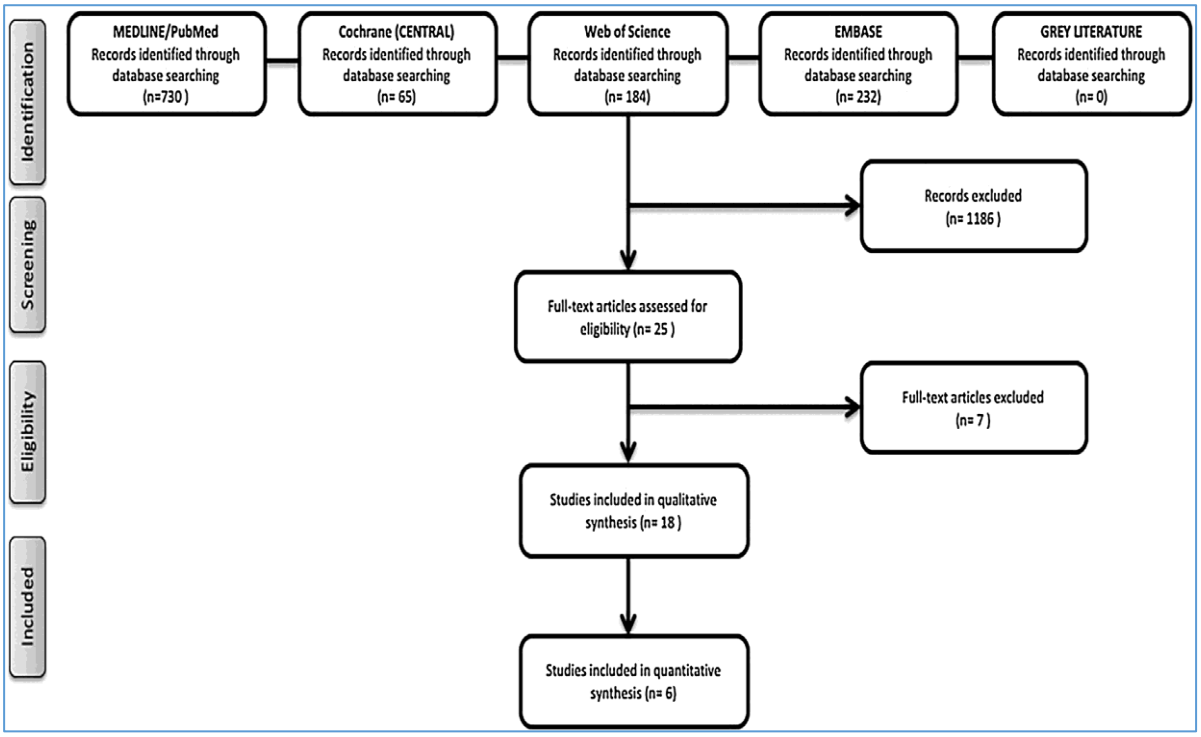

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Fig. 2. Forest plot for the event 'implant failure'.

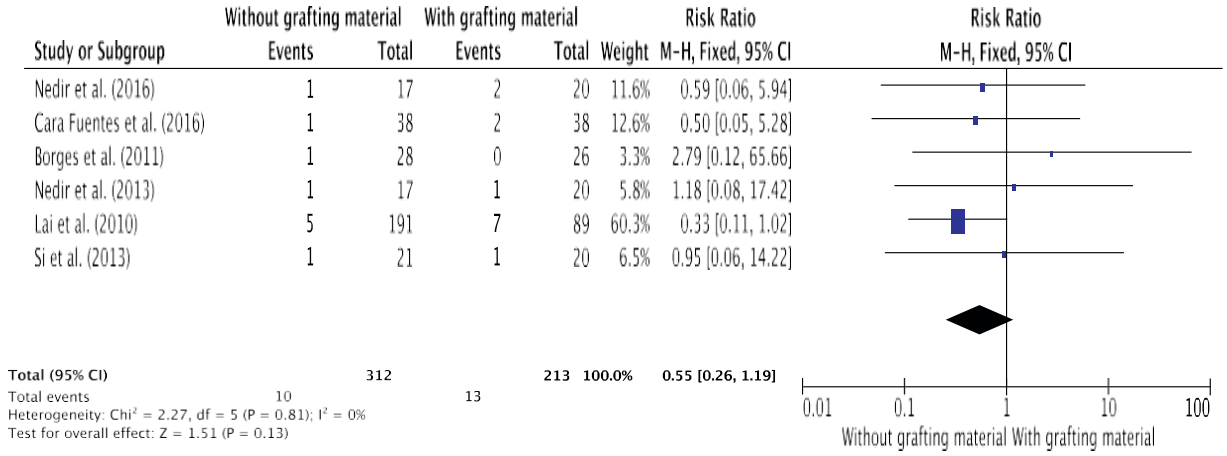


Fig. 3. Forest plot for the event 'bone gain in height' (millimetres).

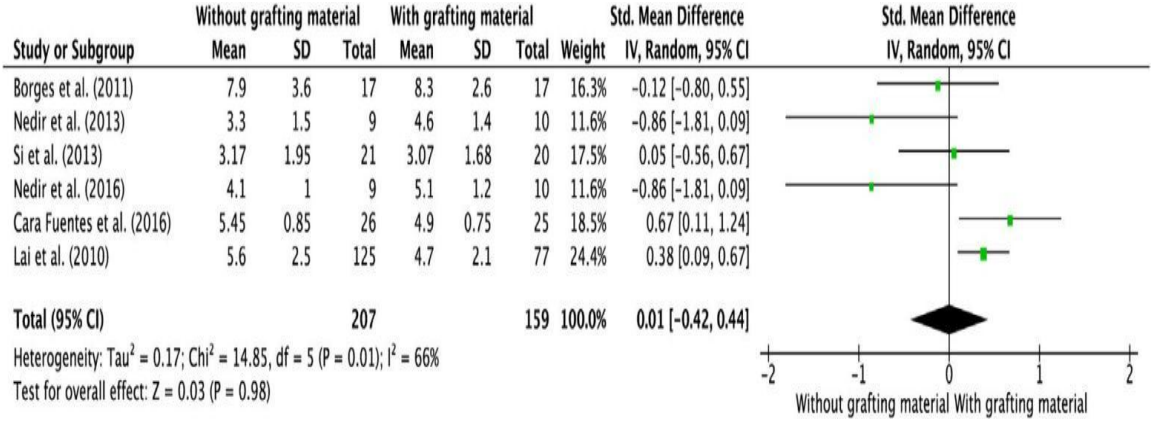
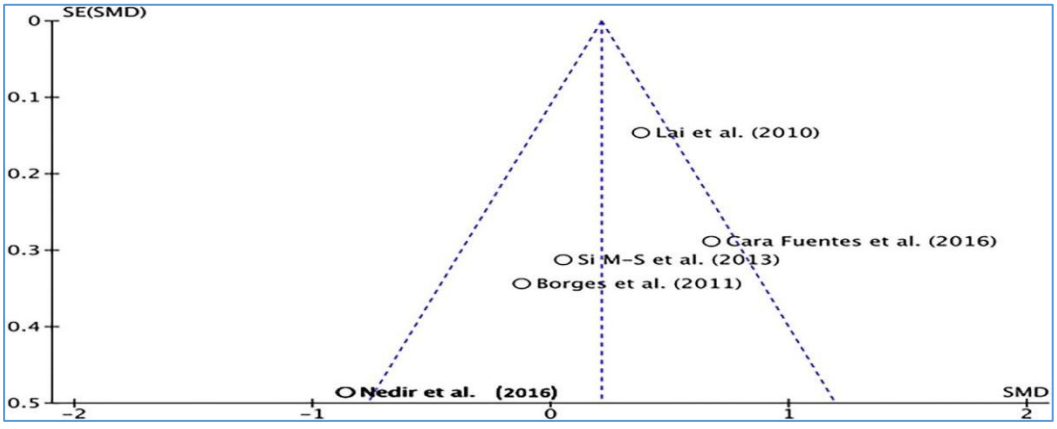


Fig. 4. Funnel plot for the studies reporting the outcome 'bone gain in height' (SE, standard error; SMD, standard mean differences.



DISCUSSION

The bone formation within the maxillary sinus can be induced by simple lifting of the Schneiderian membrane.[2,8–11,28,31,36] Yet, no consensus has yet been reached long-term success rate. Hence in our study we evaluated the effectiveness of sinus lifting with immediate implant placement with/ without the use of grafting material. A comprehensive search for studies was performed. There are only few RCTs available with this type of the study. We took into account experimental clinical trials, and the various surgical techniques. The OSFE technique proposed by Summers in 1994[41] is less invasive and more conservative and needs a residual bone height ≥4–5 mm for the implant stability.[42] Nedir et al. in their study stated a mean residual bone height of 2.4 mm.[27,36] A recent systematic review demonstrated that residual bone ridges of <4 mm height negatively predisposed the success of implants placed immediately with sinus lifting by OSFE technique.[43] In our study 5 reported the smoking habit. [6,10,29,30,34] Higher implant failure is seen in smokers.[44] Considering studies with the smoking habit may have contributed to confounding factor and may have impacted the outcomes in our study. The mean implant survival rate was 97% for mean period of 39.4 months follow-up. Similar results were seen with the immediate and delayed implant placements.[45] In the studies considered for the analysis only the implants mean survival was considered. The periodontal condition was not considered. This may need to be taken into account to know the quality of the survival of the implant. No significant changes were seen when the pairwise meta-analysis was done in the survival of implants placed in sinuses lifted with or without grafting material. (P = 0.13) the success of the implant depend on the remaining bone. [36,45] The sinuses with clots helps in the speedy stabilization of the implants. This may be attributed to the clots that help in inducing the cytokines and growth factors that act as osteoinductive forces and help in implant survival.[6] In a study done by Mordenfeld et al, the sinuses lifted with deproteinized bovine bone or autogenous bone may show even after twenty years ~20% of residual grafting particles.[46] In our analysis we observed that the increase in height of the bone of 4.7±1.82 mm over an average 39.4 months of follow-up for sinuses lifted without the presence of grafts. However no significant difference was seen with/ without the graft. (P = 0.98) The implant success can be dependent on the remaining bone tissue, implant's length and the habits. The implants length is seen to be proportional with the area that creates greater framework between the remaining internal cortical bone and the Schneiderian membrane.[25] In the systematic review done by Pérez-Martínez et al the maxillary sinus lifts without the grafts by OSFE were considered.[47] Only 3.43 mm of the mean gain in residual crestal bone height was seen, with the survival rate of implants 95.4%, for a mean follow-up of 10.4 years. This is in contrast with our study as the other techniques were not considered in their review. We observed that the perforation of the Schneiderian membrane was the most commonly reported complication. Similar observations were made in the studies of Tan et al and Al-Dajani et al.[48,49] In OSFE transalveolar technique, it's difficult to see the perforation of the Schneiderian membrane.[41] The perforation may happen due to the roots and septa, along with a thin membrane.[42,49] Contrary to what is expected the perforation of the Schneiderian membrane may not impact the outcome if it is addressed correctly.[49,50] We observed that there were two studies in our analysis that had a publication bias.[27,36] A funnel plot is a simple scatter plot of the intervention effect estimates from individual studies against some measure of each study's size or precision.[13] In common, the estimated effect is related with the horizontal axis and the sample size to the vertical axis. In the study by Nedir et al. the greatest variation between the effect estimates and the sample size.[27,36] There were few limitations in our study like the more observational studies over RCTs that might have led to the risk of bias. Few studies had confounding factors of habit like smoking that might have led to the deteriorated outcome of the implant.

CONCLUSION

From our study it can be concluded that the rate of implant success with the sinus lift is high with an average

bone height increase of 4.7 mm over an average follow-up period of 39.4 months and the implant survival rate of 97%. In our study no significant alteration was found in the amount of bone formation and the survival of implants between sinuses lifted with or without grafting material. There was no impact of the perforation of the Schneiderian membrane on the implant success. Further studies are advised with larger studies and RCTs

REFERENCES

1. Valiense H, Barreto M, Resende RF, Alves AT, Rossi AM, Mavropoulos E, Granjeiro JM, Calasans-Maia MD. In vitro and in vivo eval- uation of strontium-containing nanostructured carbonated hydroxyapatite/sodium alginate for sinus lift in rabbits. J Biomed Mater Res B Appl Biomater 2015; 104:274–82.
2. Bassi AP, Pioto R, Faverani LP, Canestraro D, Fontão FG. Maxillary sinus lift without graft- ing, and simultaneous implant placement: a prospective clinical study with a 51-month follow-up. Int J Oral Maxillofac Surg 2015;44:902–7.
3. Schaaf H. Sinus lift augmentation using au- togenous bone grafts and platelet-rich plasma: radiographic results. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2008;106:673–8.
4. Calasans-Maia MD, Mourão CF, Alves AT, Sartoretto SC, Uzeda MJ, Granjeiro JM. Max- illary sinus augmentation with a new xeno- graft: a randomized controlled clinical trial. Clin Implant Dent Relat Res 2014;17:e586– 93.
5. Marković A, Miic T, Calvo-Guirado JL, Del- gado-Ru´ız RA, Janjic B, Abboud M. Two- center prospective, randomized, clinical, and radiographic study comparing osteotome si- nus floor elevation with or without bone graft and simultaneous implant placement. Clin Implant Dent Relat Res 2016;2016(18):873– 82. http://dx.doi.org/10.1111/cid.12373.
6. Si MS, Zhuang LF, Gu YX, Mo JJ, Qiao SC, Lai HC. Osteotome sinus floor elevation with or without grafting: a 3-year randomized con- trolled clinical trial. J Clin Periodontol 2013;40:396–403.
7. Lundgren S, Andersson S, Sennerby L. Spon- taneous bone formation in the maxillary sinus after removal of a cyst: coincidence or conse- quence. Clin Implant Dent Relat Res 2003;5:78–81.
8. de Oliveira GR, Olate S, Cavalieri-Pereira L, Pozzer L, Asprino L, de Moraes M, de Alber- gar´ıa-Barbosa JR. Maxillary sinus floor aug- mentation using blood without graft material: Preliminary results in 10 patients. J Oral Maxillofac Surg 2013;71:1670–5.
9. Gabbert O, Koob A, Schmitter M, Rammels- berg P. Implants placed in combination with an internal sinus lift without graft material: an analysis of short-term failure. J Clin Period- ontol 2009;36:177–83.
10. Leblebicioglu B, Ersanli S, Karabuda C, Tosun T, Gokdeniz H. Radiographic evalua- tion of dental implants placed using an osteotome technique. J Periodontol 2005; 76:385–90.
11. Thor A, Rasmusson L, Wennerberg A, Thomsen P, Hirsch JM, Nilsson B, Hong J. The role of whole blood in thrombin gener- ation in contact with various titanium sur- faces. Biomaterials 2007;28:966–74.
12. Moher D, Shamseer L, Clarke M, Ghersi D, Liberati A, Petticrew M, Shekelle P, Stewart LA, PRISMA-P Group. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. Syst Rev 2015;4:1.
13. Higgins JP, Green S. Cochrane handbook for systematic reviews of interventions 4.2.6 [updated September 2006]. The Cochrane Library 2016;2006:4.
14. Moher D, Liberati A, Tetzlaff J, Altman DG, PRISMA Group. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. Ann Intern Med 2009;151:264–9.
15. Shea BJ, Grimshaw JM, Wells GA, Wells GA, Boers M, Andersson N, Hamel C, Porter AC, Tugwell. Moher D, Bouter LM. Development of AMSTAR: a measurement tool to assess the methodological quality of systematic reviews. BMC Med Res Methodol 2007; 7:10.

16. Schardt C, Adams MB, Owens T, Keitz S, Fontelo P. Utilization of the PICO framework to improve searching PubMed for clinical questions. BMC Med Inform Decis Mak 2007;15:7–16.
17. HigginsJP, Altman DG, Gøtzsche PC,Ju¨ni P, Moher D, Oxman AD, Savovic J, Schulz KF, Weeks L, Sterne JA, Cochrane Bias Methods Group. Cochrane Statistical Methods Group. The Cochrane Collaboration's tool for assessing risk of bias in randomised trials. BMJ 2011;18:d5928.
18. Glass GV. Primary, secondary, and meta- analysis of research. Educ Res 1976;5:3–8.
19. Egger M, Smith GD. Principles of and pro- cedures for systematic reviews. In: Egger M, Smith GD, Altman DG, editors. Systematic reviews in health care: meta-analysis in context. London: BMJ Books; 2003 . p. 23–42.
20. Sani E, Veltri M, Cagidiaco MC, Balleri P, Ferrari M. Sinus membrane elevation in combination with placement of blasted implants: a 3-year case report of sinus aug- mentation without grafting material. Int J Oral Maxillofac Surg 2008;37:966–9.
21. Atef M, Hakam MM, ElFaramawey MI, Abou-ElFetouh A, Ekam M. Nongrafted sinus floor elevation with a space-maintain- ing titanium mesh: case-series study on four patients. Clin Implant Dent Relat Res 2014;16:893–903.
22. Nedir R, Nurdin N, Vazquez L, Szmukler- Moncler S, Bischof M, Bernard JP. Osteo- tome sinus floor elevation technique without grafting: a 5-year prospective study. J Clin Periodontol 2010;37:1023–8.
23. Sohn DS, Lee JS, Ahn MR, Shin HI. New bone formation in the maxillary sinus with- out bone grafts. Implant Dent 2008;17: 321–31.
24. Schmidlin PR, Mu¨ller J, Bindl A, Imfeld H. Sinus floor elevation using an osteotome technique without grafting materials or membranes. Int J Periodontics Restorative Dent 2008;28:401–9.
25. Lai HC, Zhuang LF, Lv XF, Zhang ZY, Zhang YX, Zhang ZY. Osteotome sinus floor elevation with or without grafting: a prelim- inary clinical trial. Clin Oral Implants Res 2010;21:520–6.
26. Borges FL, Dias RO, Piattelli A, Onuma T, Gouveia Cardoso LA, Salomão M, Scarano A, Ayub E, Shibli JA. Simultaneous sinus membrane elevation and dental implant placement without bone graft: a 6-month follow-up study. J Periodontol 2011;82: 403–12.
27. Nedir R, Nurdin N, Khoury P, Perneger T, Hage ME, Bernard JP, Bischof M. Osteo- tome sinus floor elevation with and without grafting material in the severely atrophic maxilla. A 1-year prospective randomized controlled study. Clin Oral Implants Res 2013;24:1257–64.
28. Fornell J, Johansson L.Å ., Bolin A, Isaksson
29. S, Sennerby L. Flapless, CBCT-guided osteotome sinus floor elevation with simul- taneous implant installation. I: radiographic examination and surgical technique. A pro- spective 1-year follow-up. Clin Oral Implants Res 2012;23:28–34.
30. Cricchio G, Sennerby L, Lundgren S. Sinus bone formation and implant survival after sinus membrane elevation and implant placement: a 1- to 6-year follow-up study. Clin Oral Implants Res 2011;22:1200–12.
31. Cricchio G, Imburgia M, Sennerby L, Lundgren S. Immediate loading of implants placed simultaneously with sinus membrane elevation in the posterior atrophic maxilla: a two-year follow-up study on 10 patients. Clin Implant Dent Relat Res 2014;16: 609–17.
32. Volpe S, Lanza M, Verrocchi D, Sennerby L. Clinical outcomes of an osteotome technique and simultaneous placement of Neoss implants in the posterior maxilla. Clin Im- plant Dent Relat Res 2013;15:22–8.
33. Bruschi GB, Crespi R, Capparè P, Bravi F, Bruschi E, Gherlone E. Localized man- agement of sinus floor technique for im- plant placement in fresh molar sockets. Clin Implant Dent Relat Res 2013;15: 243–50.
34. Brizuela A, Martin N, Fernández-Gonzales FJ, Larrazábal C, Anta A. Osteotome sinus floor elevation without grafting material: results of a 2-year prospective study. J Clin Exp Dent 2014;6:e479–84.
35. Riben C, Thor A. Follow-up of the sinus membrane elevation technique for maxillary sinus implants without the use of graft material. Clin Implant Dent Relat Res 2016;18:895–905. http://dx.doi.org/

10.1111/cid.12360.

36. Nedir R, Nurdin N, Vazquez L, Abi Najm S, Bischof M. Osteotome sinus floor elevation without grafting: a 10-year prospective study. Clin Implant Dent Relat Res 2016;18:609–17. http://dx.doi.org/10.1111/ cid.12331.
37. Nedir R, Nurdin N, Khoury P, Bischof M. Short implants placed with or without graft- ing in atrophic sinuses: the 3-year results of a prospective randomized controlled study. Clin Implant Dent Relat Res 2016;18:10–8.
38. Cara-Fuentes M, Machuca-Ariza J, Ruiz- Martos A, Ramos-Robles MC, Mart´ınez- Lara I. Long-term outcome of dental implants after maxillary augmentation with and without bone grafting. Med Oral Patol Oral Cir Bucal 2016;21:e229–35.
39. Falah M, Sohn DS, Srouji S. Graftless sinus augmentation with simultaneous dental im- plant placement: clinical results and biolog- ical perspectives. Int J Oral Maxillofac Surg 2016;45:1147–53.
40. Schulz KF, Altman DG, Moher D. CON- SORT 2010 statement: updated guidelines for reporting parallel group randomised trials. BMC Med 2010;8:18.
41. Fleming PS, Lynch CD, Pandis N. Random- ized controlled trials in dentistry: common pitfalls and how to avoid them. J Dent 2014;42:908–14.
42. Summers RB. A new concept in maxillary implant surgery: the osteotome technique. Compendium 1994;15:152–62.
43. Pjetursson BE, Lang NP. Sinus floor eleva- tion utilizing the transalveolar approach. Periodontol 2000 2014;66:59–71.
44. Cällin C, Petre A, Drafta S. Osteotome-me- diated sinus floor elevation: a systematic review and meta-analysis. Int J Oral Max- illofac Implants 2014;29:558–76.
45. Pjetursson BE, Tan WC, Zwahlen M, Lang NP. A systematic review of the success of sinus floor elevation and survival of implants inserted in combination with sinus floor elevation. J Clin Periodontol 2008;35: 216–40.
46. Moraschini V, Poubel LA, Ferreira VF, Bar- boza Edos S. Evaluation of survival and success rates of dental implants reported in longitudinal studies with a follow-up period of at least 10 years: a systematic review. Int J Oral Maxillofac Surg 2015;44:377–88.
47. Mordenfeld A, Hallman M, Johansson CB, Albrektsson T. Histological and histomor- phometrical analyses of biopsies harvested 11 years after maxillary sinus floor augmentation with deproteinized bovine and autogenous bone. Clin Oral Implants Res 2010;21:961–70.
48. Pérez-Martínez S, Martorell-Calatayud L, Peñarrocha-Oltra D, García-Mira B, Peñar- rocha-Diago M. Indirect sinus lift without bone graft material: systematic review and meta-analysis. J Clin Exp Dent 2015;7: e316–9.
49. Tan WC, Lang NP, Zwahlen M, Pjetursson BE. A systematic review of the success of sinus floor elevation and survival of implants inserted in combination with sinus floor elevation. Part II: transalveolar tech- nique. J Clin Periodontol 2008;35(Suppl): 241–54.
50. Al-Dajani M. Incidence, risk factors, and complications of Schneiderian membrane perforation in sinus lift surgery: a meta- analysis. Implant Dent 2016;25:409–15.
51. Becker ST, Terheyden H, Steinriede A, Behrens E, Springer I, Wiltfang J. Prospec- tive observation of 41 perforations of the Schneiderian membrane during sinus floor elevation. Clin Oral Implants Res 2008;19: 1285–9.