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Ahmed Abozekrya
abozekryahmed@gmail.com

Ragia Mounir
ragiammounir@hotmail.com

Waleed Ragab El-Beialy
wbeialy@yahoo.com

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Open sinus lift surgery and augmentation with (SCPC versus H.A): A systematic review

Ahmed Kamal Abo zekry*, Ragia Mounir, Waleed Ragab El-Beialy

Faculty of Oral and Dental Medicine, Future University in Egypt, 90th Street New Cairo- Cairo, Egypt

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A B S T R A C T

open sinus lift is used to augment the maxillary sinus prior to implant Placement in patients with sinus pneumatization due to early extraction of upper molars Where the remaining available bone length is from zero to 6 mm which will not accommodate for implant placement and not sufficient for implant initial stability so we will need to do Sinus lift and augmentation of the sinus with various bone grafts either (alloplast, allograft, Autogenous). Search is conducted electronically on line in pub med & Cochrane and manual Search was also done from 2007 to 2018 the articles included assisting &evaluating various types of bone substitute used in open sinus lift surgeries.197 papers are identified through data base searching 37 Additional records identified through manual search, after duplication removal the remaining papers are 187,187 paper were reviewed&152 were excluded by title &abstract, 35 article were reviewed as full text, 27 articles were excluded by reason, 8 articles were included in this study, Eight included articles have revealed new bone formation with percentage ranges from 48%as the highest percentage&16.4 as the lowest percentage, residual material ranges from 6.3%to 34.8% which differs according to type of bone graft used, histological evaluation is performed in 7 articles in addition to radiological evaluation only one article used radiographic evaluation only This systematic review supported the fact that bone substitute act as a scaffold for new bone formation with different percentages according to type of bone substitute used.

1. Introduction

After extraction of teeth in posterior maxilla alveolar bone resorption takes place as well as maxillary sinus pneumatization results in bone loss. Long term survival and success of dental implant requires primary stability and appropriate bone volume [1]. It was clearly demonstrated that implants placed in poor bone quality have higher failure rates than implant placed in higher bone quality [2,3]. Implants placed in posterior region of maxilla showed the lowest success. The poorest bone density exists in posterior region of the maxilla therefore it is associated with the highest failure rates [3,4].Misch has revealed that bone density of the implant bed is an important factor in determining the treatment plan; implant design, surgical approach, healing time and initial progressive bone loading during prosthetic reconstruction.

He classified bone density: D1: Dense cortical bone. D2:Thick dense to porous cortical bone on the crest and coarse trabecular bone within. D3: Thin porous cortical bone on the crest and fine trabecular bone within. D4: Fine trabecular bone. D5: Immature, non-mineralized bone [5,6].Bone quality is classified into 4 categories according to lecholm and zarb [7] Type I: composed of homogenous compact bone. Type II: composed of thick layer of compact bone surrounding a core of dense trabecular bone. Type III: composed of thin layer of cortical bone surrounding dense trabecular bone. Type IV: composed of a thin layer of cortical bone surrounding a low density core of trabecular bone. Gaffin and Berman reported 55% of all implant failure occurred in type IV bone [8]Increasing bone volume in posterior maxilla and bone quality has been achieved by combining various procedures and materials [9]. Elevation and augmentation of the maxillary sinus can increase the bone height in the posterior area of the maxilla [10].

At the Consensus Conference on Maxillary Sinus Elevation in 1996 [11] the members made the following recommendations which depend on the residual bone height (RBH):

- Category A (RBH ≥ 10 mm): classic implant procedure
- Category B (RBH ≥ 7–9 mm): osteotome technique with simultaneous placement of implants
- Category C (RBH ≥ 4–6 mm): maxillary sinus elevation with lateral access and bone graft and immediate or deferred placement of

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* Corresponding author.
E-mail addresses: abozekryahmed@gmail.com (A.K. Abo zekry), ragiammounir@hotmail.com (R. Mounir), wbeialy@yahoo.com (W.R. El-Beialy).

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implants
- Category D (RBH ≥ 1–3 mm): maxillary sinus elevation with lateral access and bone graft and deferred placement of implants

During the maxillary sinus floor elevation procedure, the space created between the residual maxillary ridge and the elevated Schneiderian membrane is usually filled with grafting material ([12] [13]). In this way, a bone fraction is created that may allow for reliable implant placement, either simultaneously with the elevation procedure when the residual ridge allows for primary implant stability or as a second stage after healing of the grafted site [14].

Bone grafting materials are generally classified as autografts, allografts, xenografts and alloplasts. Out of these, autografts harvested from the patient's own body (chin, hip, ribs etc) are regarded “gold standard” [15,16]. Because of the lack of antigenicity of the graft material osteoconduction&osteoinduction. Allografts are transplants from a genetically non identical individual of same species which are “converted” to self by the host [16,17].

Xenografts are transplants from one species to another. Bovine derived bone is a good example of xenograft. Alloplasts are synthetic chemically derived bone substitute. Most often this material is a form of calcium phosphate. Although autograft material is currently the material of choice, there are limitations associated with its use, including donor site morbidity, limited donor bone supply, anatomical and structural problems, Band elevated levels of resorption during healing [18].

The use of allografts has the disadvantage of eliciting an immunological response due to genetic differences and the risk of inducing transmissible diseases [18,19]. Calcium phosphate ceramics and bioactive glasses were introduced more than 30 years ago as bone substitutes. These materials are considered bioactive because they bond to bone and enhance bone tissue formation.

The forms of calcium phosphate ceramics most widely used are tricalcium phosphate (B-TCP)and hydroxyapatite (HA). These materials have a similar structure to the mineral phase of bone and have been shown to be osteoconductive, i.e., enhance bone cells growth and direct bone deposition on their surfaces. The availability of HA and TCP in porous shapes has encouraged many investigators to evaluate the ability of these biomaterials to serve as tissue engineering scaffolds for cell and drug delivery.

However, there were setbacks. Hydroxyapatite is known to exhibit limited osteoconduction and has a slow rate of degradation in physiological solutions because of its chemical stability [20,21]. On the other hand, B -TCP is plagued by an unpredictable, fast rate of dissolution that may lead to an immunological response [22].

Bioactive glass (BG), which contains (45 wt %) of silica in addition to calcium and phosphorous, is known to have the most stimulatory effect on bone cell function [23,24].

Unfortunately, there is a limited opportunity to synthesize a porous BG and improve its mechanical and physicochemical properties without decrements in bioactivity.

Recently, a novel porous silica–calcium phosphate nanocomposite (SCPC) has been proposed as a candidate for bone tissue engineering scaffold. The new resorbable porous bioactive silica-calcium phosphate composite has the ability to absorb high quantities of serum protein and stimulate rapid bone generation. The high porosity of the SCPC enhanced cell colonization and bone formation on and within the graft material. The high rate of silica dissolution from SCPC promoted rapid bone regeneration and graft material resorption. Thermal treatment of the SCPC induced ion substitution and formation of solid solutions at significantly low temperature. These ultra structural modifications facilitated protein adsorption and controlled SCPC solubility [25,26].

It has been demonstrated that SCPC has a superior bone regenerative capacity and resorbability when compared to HA and bioactive glass.

The nanoporous structure, superior bioactivity, controlled dissolution kinetics, and strong stimulatory effect on osteoblast differentiation suggest wide applications of SCPC in the field of bone tissue reconstruction in maxillofacial surgeries.

The current study reviews the literature of application various types of bone substitute used for augmentation of the maxillary sinus by searching on Electronic Search engines are Pub Med and Cochrane. Manual search was done in the libraries of the Faculty of Oral & Dental Medicine, Cairo University; Faculty of Oral and Dental Medicine, Al-Azhar University; and the Faculty of Oral & Dental Medicine, Future University in Egypt.

2. Materials & methods

Publications on the subject were searched up to.2018on electronic database (Cochrane & pub med) the keywords used are

1 "Sinus floor augmentation" [Mesh]
2 (((Calcium phosphate ceramics))) or ((Bioceramics)) and (Bone Augmentation)
3 (((Bone augmentation))) and ((Hyd\roxyapatite))
4 (((Hydroxyapatite))) and ("Sinus floor augmentation") Mesh
   - The Manual search was done in the libraries of the Faculty of Oral & Dental Medicine, Cairo University; Faculty of Oral and Dental Medicine, Al-Azhar University; and the Faculty of Oral & Dental Medicine, Future University in Egypt.

2.1. Study selection

The PRISMA flow diagram in (Fig. 1) presents an overview of the selection process. The titles of identified reports were initially screened. The abstract was assessed when the title indicated that the study fulfilled the inclusion criteria. A full-text analysis was performed when the abstract was unavailable or when the abstract indicated that the inclusion criteria were fulfilled. The references of the identified papers were cross-checked for unidentified articles.

Screening process showed in the prisma chart: two independent reviewers screened187papers retrieved from electronic and manual search for possible inclusion in the review. 151 articles are excluded on the base of title and abstract. 27 articles are excluded on the base of exclusion criteria.8 articles are included according to the inclusion criteria.

2.2. Study eligibility

- Inclusion criteria: randomized control trial or retrospective studies on open sinus lift and bone grafting. Adult, Medically Free, Sinus approximation 2–6 mm and In English
- The following exclusion criteria were applied: Pediatric, Medically Compromised, Invitro, Autogenous Graft, metanalysis.

3. Results

Initial search reviewed 197 paper from electronic search (pup med & Cochrane)&37 papers from manual search, 187 paper is present after filtration &duplication removal, 152 paper were excluded from title & abstract, remaining 35 articles were reviewed as full text articles, 27 paper were excluded according to the exclusion criteria, 8 articles were included in the study according to the inclusion criteria(Fig. 1) (Tables 1 and 2).

3.1. Reviewing & data extraction

Two independent researchers reviewed the selected 8 full text articles. 139 patients were included in all reviewed articles. The articles were analyzed as per overall study design and data mining of the articles included the collection of the following data: number of patients

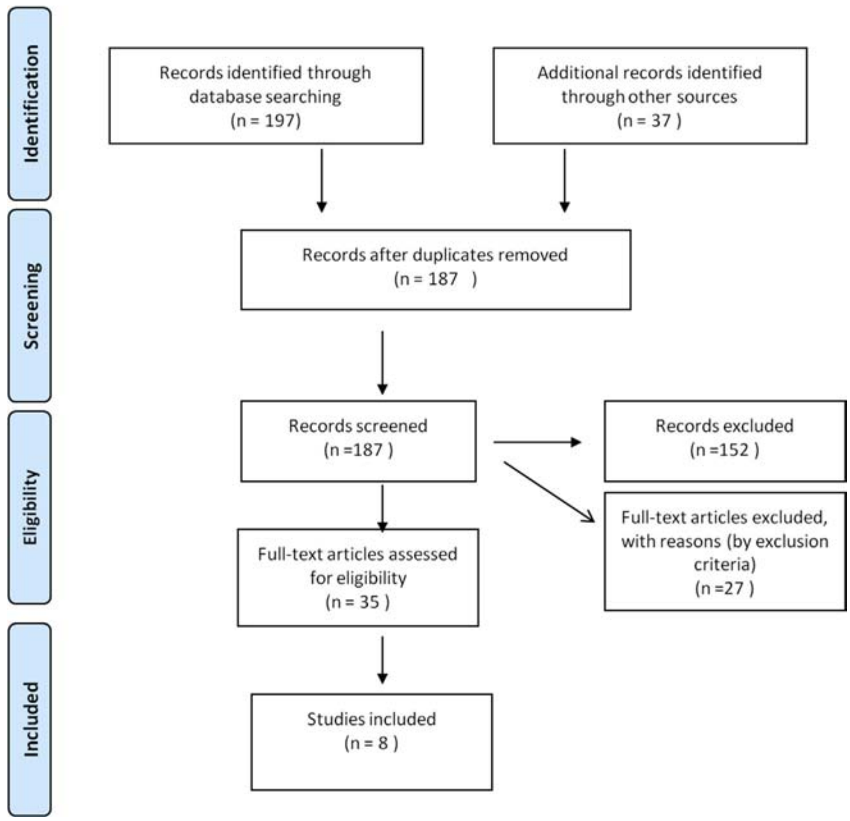

Fig. 1. The prisma flow diagram.

in each article, age, gender, amount of residual alveolar bone (< 7 mm), type of graft used, time of implant placement and core bone biopsy retrieval and the amount of bone gain (as percentage or in millimeters).

Histological evaluation of newly formed bone showed 26.4% newly formed bone, 27.3% residual graft material, and 46.3% bone marrow in Kolerman et al. (2012) article [27]; while Stavropoulos A. et al. (2011) had an average of 28–31.8% newly formed bone, 6.3–16.5% residual graft, and the new bone was primarily woven and characterized by slender trabeculae and narrow osteoid zones, and in many instances bone was in contact with residual biomaterial particles [28]. On the other hand, Martinez et al. (2010) documented average newly formed bone of 35%, and residual graft of 32.6–34.8 ± 6.2–10.5%. Englrbert A et al. (2013) demonstrated 19–24% bone gain with a 19% residual bone [31]. Contrary to the reported high regenerated bone levels of 48% reported by Canullo L et al. (2009) at 6 months and 28% residual graft and 24% bone marrow. Histomorphometric analysis of different bone grafts by Susanna Annibali et al. (2014) reported newly formed bone ranging from as low as: 16.4% using mineralized solvent-dehydrated bone allograft (MSDBA) and as high as: 21.9% using equine bone (EB) [33]. On contrary, were the recent results of Claudio Stacchi et al. (2017) that demonstrated 34.9 ± 15% (NHA) 38.5 ± 17% (ABB) of vital bone and 20.6 ± 13% (NHA). ± 12% (ABB) of residual graft material & an overall 12 months loading success rate of 96.4% [34].

Radiographic studies as that of Jae-Kook Cha et al. (2011) reported sinus floor heights of a mean3to4mm42 months with an insignificant loss of 0.83 ± 0.38 mm [29].while Kolerman et al. (2012)augmented sinus floor of remaining alveolar height of 5 mm up to18 mm he used C.T scan to evaluate height in mm & area in mm^2 [27] englrbert A et al., 2013 reported increase in bone height ranges from 7.2 to 7.8 mm when sinus floor of less than 7 mm he used panoramic x ray for evaluation of bone height gain [31].

4. Discussion

Bone resorption following tooth extraction or due to advanced periodontal disease, and/or pneumatization of the maxillary sinus may result in insufficient bone in horizontal and/or more frequently, vertical dimension for the placement of dental implants in the posterior maxilla. Augmentation of the maxillary sinus floor (or sinus lift) with bone grafts and/or substitutes is nowadays a standard treatment approach for re-establishing an adequate bone volume in the posterior maxilla. Bone resorption following tooth extraction or due to advanced periodontal disease, and/or pneumatization of the maxillary sinus may result in insufficient bone in horizontal and/or more frequently, vertical dimension for the placement of dental implants in the posterior maxilla.

Prosthodontic rehabilitation through dental endosseous implants in the area of the posterior maxilla often fails due to an insufficient bone supply. To improve bone volume to support dental implants, tissue formation is commonly enhanced by autologous bone grafting, often combined with synthetic, resorbable materials.

In the present systematic review 8 articles were included according to the inclusion criteria, these articles were reviewed at which 139 patient were included in this review, these patients have open sinus lift procedure, with bone graft to augment the sinus followed by implant placement in a second surgery after a period from 3 to 6 months, radiological analysis were performed using C.B.C.T or C.T scan or panorama, during implant placement core bone biopsy were retrieved & analyzed either for histological and histomorphometric analysis, the sinuses for the 139 patients were augmented with various grafting materials.

7 articles have histological results in percentages for the newly formed bone &the amount of residual graft material, the highest level of bone gain was reported of 48% reported by Canullo L et al. (2009) after 6 months of grafting who used nanocrystalline hydroxyapatite silica gel [32] & the lowest level of bone gain was reported Susanna Annibali et al. (2014) reported newly formed bone of 16.4% using (MSDBA)

Table 1
List of excluded articles after reviewing.

Authors	Article name	Reason for exclusion
1 Walter C, Mang WL Daculsi G et al.	Artificial bone (tricalcium phosphate) in facial surgery (author's transl).	1 Artificial bone
Daculsi G, Bouler JM, LeGeros RZ	1 Adaptive crystal formation in normal and pathological calcifications in synthetic calcium phosphate and related biomaterials..	2 Synthetic calcium phosphate
2 Kim SM, Park JW, Suh JY, Sohn DS, Lee JM	2 Bone-added osteotome technique versus lateral approach for sinus floor elevation: a comparative radiographic study..	3 Bone marrow concentrate and bovine bone mineral
3 Cortes AR, Cortes DN, Arita ES	Cone beam computed tomographic evaluation of a maxillary alveolar ridge reconstruction with iliac crest graft and implants.	2 Sinus lift techniques
4 Arasawa M, Oda Y, Kobayashi T, Uoshima K, Nishiyama H, Hoshina H, Saito C	Evaluation of bone volume changes after sinus floor augmentation with autogenous bone grafts.	Autogenous Graft, ridge reconstruction
5 Nery EB, Pflughoeft FA, Lynch KL, Rooney GE.	Functional loading of bioceramic augmented alveolar ridge–a pilot study.	Autogenous Graft
6 Nery EB, Pflughoeft FA, Lynch KL, Rooney GE.	Functional loading of bioceramic augmented alveolar ridge–a pilot study.	Autogenous Graft
7 Degidi M, Piattelli A, Perrotti V, Iezzi G.	Histologic and histomorphometric evaluation of an implant retrieved 8 years after insertion in a sinus augmented with anorganic bovine bone and anorganic bovine matrix associated with a cell-binding peptide: a case report.	augmented alveolar ridge
8 Cricchio G, Palma VC, Faria PE, de Olivera JA, Lundgren S, Sennerby L, Salata LA	Histological outcomes on the development of new space-making devices for maxillary sinus floor augmentation..	Different bone graft
9 Kolerman R, Samorodnitzky-Naveh GR, Barnea E, Tal H.	3 Histomorphometric analysis of newly formed bone after bilateral maxillary sinus augmentation using two different osteoconductive materials and internal collagen membrane.	Different bone graft
10 Schmelzeisen R, Gutwald R, Oshima T, Nagursky H, Vogeler M, Sauerbier S	Making bone II: maxillary sinus augmentation with mononuclear cells–case report with a new clinical method.	1 Different bone graft
11 Jensen T, Schou S, Stavropoulos A, Terheyden H, Holmstrup P	1 Maxillarysinusflooraugmentation with Bio-Oss or Bio-Oss mixed with autogenous bone as graft in animals: a systematic review.	2 Different bone graft
12 Özkan Y, Akoğlu B, Kulak-Özkan Y	Maxillary sinus floor augmentation using bovine bone grafts with simultaneous implant placement: a 5-year prospective follow-up study.	1 Autogenous Graft
13 Lee DZ, Chen ST, Darby IB.	4 Maxillary sinus floor elevation and grafting with deproteinized bovine bone mineral: a clinical and histomorphometric study.	Different bone graft
14 Antonaya-Mira R, Barona-Dorado C, Martínez-Rodríguez N, Cáceres-Madroño E, Martínez-González JM	Meta-analysis of the increase in height in maxillary sinus elevations with osteotome.	1 Different bone graft
15 Cabezas-Mojón J, Barona-Dorado C, Gómez-Moreno G, Fernández-Cáliz F, Martínez-González JM	5 Meta-analyticstudy of implant survival following sinus augmentation.	Sinuslift without bone graft
16 Esposito M, Cannizzaro G, Soardi E, Pistilli R, Piattelli M, Corvino V, Felice P	Posterior atrophic jaws rehabilitated with prostheses supported by 6 mm-long, 4 mm-wide implants or by longer implants in augmented bone. Preliminary results from a pilot randomized controlled trial.	sinus lift without bone graft
.17 Hart KL, Bowles D	6 Reconstruction of alveolar defects using titanium-reinforced porous polyethylene as a containment device for recombinant human bone morphogenetic protein.	Sinuslift without bone graft
18.Perelli M, Abundo R, Corrente G, Saccone C	1 Short (5 and 7 mm long) porous implants in the posterior atrophic maxilla: a 5-year report of a prospective single-cohort study.	Sinuslift without bone graft
19 Butz F, Bächle M, Ofer M, Marquardt K, Kohal RJ	1 Sinus augmentation with bovine hydroxyapatite/synthetic peptide in a sodium hyaluronate carrier (PepGen P-15 Putty): a clinical investigation of different healing times.	Without sinus lift
21 Schuller-Götzburg P, Entacher K, Petutschnigg A, Pomwenger W, Watzinger F	7 Sinus elevation with a cortical bone graft block: a patient-specific three-dimensional finite element study.	Autogenous bone graft
22.Petruzzi M, Ceccarelli R, Testori T, Grassi FR	Sinus floor augmentation with a hydropneumatic technique: a retrospective study in 40 patients	1 Autogenous bone graft
23 Sauerbier S, Rickert D, Gutwald R, Nagursky H, Oshima T, Xavier SP, Christmann J, Kurz P, Menne D, Vissink A, Raghoebar G, Schmelzeisen R, Wagner W, Koch FP.	8 Bone marrow concentrate and bovine bone mineral for sinus floor augmentation: a controlled, randomized, single-blinded clinical and histological trial–per-protocol analysis.	Different bone graft
24 Szivek JA, Anderson PL, Dishongh TJ, DeYoung DW.	1 Evaluation of factors affecting bonding rate of calcium phosphate ceramic coatings for in vivo strain gauge attachment.	Different bone graft
25 Sijeet singh, hemant gupta, deepka kumar	Immediate implant placement along with bone graft and delayed implant placement in grafted socket:comparative study	No sinus lift
26 J. Mehta, A. El-Ghannam, C. Q. Ning.	Cyclosilicate nanocomposite: A novel resorbable bioactive tissue engineering scaffold for BMP and bone-marrow cell delivery	Invitro
27 AEl-Ghannam,LarryCunningham, David Pienkowski.	Bone Engineering of the Rabbit Ulna	experimental

mineralized solvent dehydrated bone allograft [33], while the lowest amount of residual material was reported in Stavropoulos A. et al. (2011) was 6.3% residual graft in the recombinant human growth factor and differentiation factor-5-coated tricalcium phosphate (rhGDF-5/b-TCP)/4-month group [28] & the highest amount of residual material 34.8 ± 10.5.% for anorganic bovine-bone derived (ABB) reported by Martinez et al. (2010) [30].

So it is clear that the rate of new bone formation & the amount of residual material depends on the type of material used& its rate of resorption as the technique of sinus lift is similar in the patients included in the 7 articles & methods of histological evaluation is almost the same.

On the other hand radiographic evaluation was conducted in 2 articles beside the histological evaluation Kolerman et al. (2012) & (englrbert A et al., 2013) measured increase in height in term of mm. The increase in height ranges from 7 up to 18 mm [27,31].

While only one article used the radiographic evaluation without histological evaluation (Jae-Kook Cha et al., 2011) this study use Osteon, as a bone graft material, and to assess the height of the grafted material through radiographic evaluation. In this study the author used panoramic and intraoral films for evaluation of the rate of resorption of the grafted material this radiograph is a two dimensions tool which is not accurate to determine the rate of bone changes, the three dimension C.T scan is the recommended method for evaluation of bone changes [29].

Table 2
List of included articles.

Article	Sample size	Gender		Age	Residual alveolar bone	Material used&particle size	Time of implant placement	Outcome Measures (bone gain)		Device, Unit of measure			Study design
		M	F					Mm	%	CT	Alizarin	pa	
Kolerman et al. [27]	12	5	**7**	42–80 years	5 mm	HA:_-TCP 0.5–1 mm	9 months	6–18 mm	26.4% newly formed bone **27.3% residual graft**	Height, Width (in mm) Area (in mm2)	Image J software Signal intensity		R.C.T
Stavropoulos A et al. [28]	31	16	15	41–65.9 years	5 mm	rhGDF-5/b-TCP. β-TCP/AB.	3–4 months	31.4% in the rhGDF-5/b-TCP. 28% in the rhGDF-5/b-TCP. 31.8% in the b-TCP/AB group. The proportion of remaining b-TCP averaged 12.6% in the rhGDF-5/b-TCP/3-month group, 6.6% in the rhGDF-5/b-TCP/4-month group, and 16.5% in the b-TCP/AB group.			Alizarin red stain using Image J software Signal Intensity		R.C.T
Jae-Kook Cha et al. [29]	20	–		–	4-3 mm	Osteon 0.5–1 mm 1–2 mm	6 months	S0.81 ± 0.43 mm L0.85 ± 0.33 mm				mm	R.C.T
Martineza et al. [30]	16	-		38–67y	3.8 mm	ABB, TCP 1.6 ± 0.4 cm^2	8 months	35% of new bone formed for both groups remaining presence of TCP particles was 32.6 ± 6.2% and 34.8 ± 10.5.% for APP			Alizarin red stain using Image J software Signal Intensity		R.C.T
englrbert A et al. [31]	12	-		36–73y	≤7 mm	βTCP 60% 0.7–1.4 mm, Resorbablecollagenous membrane 25 × 25 mm		24% bone gain with membrane&19% without Residual bone 19% (without membrane: 7.8 ± 1.9 mm; with membrane: 7.2 ± 1.5 mm; mean ± SD).		High resolution micro CT		mm	R.C.T
Canullo L et al. [32]	16	- -			1–3 mm	nanocrystalline hydroxyapatite silica gel	6 months	48 ± 4.63% newly formed bone 28 ± 5.33%, residual material			Alizarin red stain using Image J software Signal Intensity		
Susanna Annibali et al., 2014 [33]	4 patients	3	1	mean age 52 years, range 36–70	Atrophied maxilla Less than 3 mm	(HA-..-TCP 30/70), anorganic bovine bone (ABB), mineralized solvent-dehydrated bone allograft (MSDBA), and equine bone (EB),	After 6 months	30.2% newly formed bone for Ha-.-TCP 30/70, 20.1% for ABB, 16.4% for MSDBA, and 21.9%for EB. Residual material (HA-..-TCP-30/70). 29.1%, (ABB). 19.1%, (MSDBA) 18.5%, (EB)23.2%.		computerized tomography (CT) SCAN H.U Touldine blue			R.C.T
Claudio Stacchi et al. [34]	28 patients	18	10		3–6mm	Nanohydroxyapatite, anorganic bovine bone	6 months	Newly formed bone 34.9 ± 15% (NHA) 38.5 ± 17% (ABB) and residual graft 20.6 ± 13% (NHA) 22.3 ± 12% (ABB)		C.B.C.T. HU Toulodine blue			R.C.T

5. Conclusion

For the clinical point of view the present systematic review supported the fact that open sinus lift with grafting with bone substitute act as scaffold for a new bone formation leading to formation of new bone but we need further research on different types of bone grafts to improve its character and to improve the nature of the newly formed bone.

Conflicts of interest

No conflict of interest.

Disclosure statements

The authors declare that there are no financial or other conflicts of interest related to this publication.

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References

[1] Sennerby L, Roos J. Surgical determinants of clinical success of osseointegrated oral implants: a review of the literature. Int J Prosthodont (IJP) 1998;11(5):408–20.
[2] Simunek A, Vokurkova J, Kopecka D, Celko M, Mounaijed R, Krulichovea I, Shrabkova Z. Evaluation of stability of litanium and hydroxyapatite coated osseointegrated dental implants : a pilot study clin. Oral Impl.Res. 2002;13:75–9.
[3] Adell R, Lekhalm U, Rockier B, Branemark PL. A 15 year study of osseointegrated implants in the treatment of edentulous jaw. Int J Oral Surg 1981;10:378–416.
[4] Minsk L, Posion A, Weisgold A. Outcomes failures of endossous implants from a clinical training center. Compendium 1996;17(9):848–50.
[5] Mish CE. Bone character: second vital implant criterion. Dent Today 1988;4:39.
[6] Mish CE. Dentist of bone ;effect on treatment plans surgical approach healing and progressive bone loading. Int J Oral Implant 1990;6(2):230–1.
[7] Lekholm U, Zarb G. Patient selection and preparation. Osseointgration in clinical dentistry. Chicago: Quintessence pub.Co.; 1985. p. p199.
[8] Jaffin R, Berman C. The excessive loss of Branemark fixtures in Types IV bone: a 5-year analysis periodontal 62. 1991. (1)2-4.
[9] Mangano C, Scarano A, Perrotti V, Iezzi G, Piattelli A. Maxillary sinus augmentation with a porous synthetic hydroxyapatite and bovine-derived hydroxyapatite: a comparative clinical and histologic study. Int J Oral Maxillofac Implants 2007;22(6):980–6.
[10] Boyne PJ, James RA. Grafting of the maxillary sinus floor with autogenous marrow and bone. J Oral Surg 1980;38(8):613–6.
[11] Jensen OT, Shulman LB, Block MS, Iacono VJ. Report of the sinus Consensus conference of 1996. Int J Oral Maxillofac Implants 1998;13(Suppl):11–45.
[12] Del Fabbro M, Testori T, Francetti L, Weinstein R. Systematic review of survival rates for implants placed in the grafted maxillary sinus. Int J Periodontics Restor Dent 2004;24:565–77.
[13] Wallace SS, Froum SJ, Cho SC, Elian N, Monteiro D, Kim BS, Tarnow DP. Sinus augmentation utilizing an organic bovine bone (Bio-Oss) with absorbable and nonabsorbable membranes placed over the lateral window: histomorphometric and clinical analyses. Int J Periodontics Restor Dent 2005;25:551–9.
[14] Raghoebar GM, Schortinghuis J, Liem RS, Ruben JL, van der Wal JE, Vissink A. Does platelet-rich plasma promote remodeling of autologous bone grafts used for augmentation of the maxillary sinus floor? Clin Oral Implants Res 2005;16:349–56.
[15] Hallman M, Caderlund A, Lindscog S, Lundsgren S, Sennerby L. A clinical histologic study of bovine hydroxyapetite in combination with autogenous bone and fibrin glue for maxillary sinus augmentation. Clin Oral Implants Res 2001;12:135–46.
[16] Norton RM, Odell EW, Thompson ID, Cook RJ. Efficacy of bovine bone mineral for alveolar augmentation: a human histologic study. Clin Oral Implants Res 2003;14:775–83.
[17] Mellonig IT, Bovers GM, Baily R. Comparison of bone graft materials. Part 1. New bone formation with autografts and allografts determined by Strontium 85. J Periodontol 1991;52:291–6.
[18] Mellonig IT, Bovers GM, Cotton W. Comparison of bone graft materials. Part 2. New bone formation with autografts and allografts: a histologic evaluation. J Periodontol 1981;52:297–304.
[19] Glowacki J, Mulliken JB. Demineralized bone implants. Clin Plast Surg 1985;12. 233–233.
[20] Buck BE, Malinin TI, Brown MD. Bone transplantation and human immunodeficiency virus. An estimate of risk of acquired immunodeficiency syndrome (AIDS). Clin Orthop Relat Res 1989;240:129–36.
[21] den Hollander W, Patka P, Klein CP, Heidendal GA. Macroporous calcium phosphate ceramics for bone substitution: a tracer study on biodegradation with 45Ca tracer. Biomaterials 1991;12:569–73.
[22] El-Ghannam A. Bone reconstruction: from bioceramics to tissue engineering. Expet Rev Med Dev 2005;2:87–101.
[23] Eggli PS, Muller W, Schenk RK. Porous hydroxyapatite and tricalcium phosphate cylinders with two different pore size ranges implanted in the cancellous bone of rabbits. Clin Orthop 1988;232:127–37.
[24] Schepers E, de Clercq M, Ducheyne P, Kempeneers R. Bioactive glass particulate material as a filler for bone lesions. J Oral Rehabil 1991;18:439–45.
[25] El-Ghannam A, Ducheyne P, Shapiro IM. Serum protein adsorption on bioactive ceramics and glasses and the effect on osteoblast adhesion. The 21st Annual Meeting of the Society for Biomaterials, San Francisco, CA. 1995.
[26] El-Ghannam A, Ducheyne P, Shapiro IM. Effect of serum proteins on osteoblast adhesion to surface modified bioactive glass and hydroxyapatite. J Orthop Res 1999;17:340–5.
[27] Kolerman R, Joseph N, Shetty S. Histomorphometric analysis of maxillary sinus augmentation using an alloplast bone substitute. J Oral Maxillofac Surg 2012;70:1835–43.
[28] Stavropoulos AS1, Andreas Stavropoulo Becker J, Capsius B, Yahya A, W Wagner W, Terheyde H. Histological evaluation of maxillary sinus floor augmentation with recombinant human growth and differentiation factor-5-coated b-tricalcium phosphate: results of a multicenter randomized clinical trial. J Clin Periodontol 2011;38:966–74.
[29] Cha Jae Kook, Park Jung Chul, Jung Ui Won, Kim Chang Sung, Cho Kyoo Sung, Choi Seong Ho. Case series of maxillary sinus augmentation with biphasic calcium phosphate: a clinical and radiographic study. J Periodontal Implant Sci 2011;41:98–104.
[30] Martineza A, Francob J, Saizb E, Guitianc F. Maxillary sinus floor augmentation on humans: packing simulations and 8 months histomorphometric comparative study of an organic bone matrix and β-tricalcium phosphate particles as grafting materials. Mater Sci Eng C Mater Biol Appl 2010 June 15;30(5):763–9.
[31] Engelbert A, Prins H, Overman J, Helder M, Bruggenkate C, Nulend J. A novel approach revealing the effect of a collagenous membrane on osteoconduction in maxillary sinus floor elevation with tricalcium phosphate. Eur Cell Mater 2013;25:215–28.
[32] Canullo L, Dellavia C. Sinus lift using a nanocrystalline hydroxyapatite silica gel in severely resorbed maxillae: histological preliminary study. Clin Implant Dent Relat Res 2009;11(Supplement 1):e7–13.
[33] Annibali Susanna, Iezzi Giovanna, Sfasciotti Gian Luca, Cristalli Maria Paola, Polimeni, Vozza Iole, Mangano Carlo, LaMonaca Gerardo, Antonella. Clinical study histological and histomorphometric human results of HA-beta-TCP 30/70 compared to three different biomaterials in maxillary sinus augmentation at 6 Months:A preliminary report. BioMed Res Int 2015:7. Volume.
[34] Stacchi Claudio, Lombardi Teresa, Oreglia Traini Francesco, Maltoni Andrea Alberghini, Trani Tonino. Histologicl and histomorphometric comparison between sintered nanohydroxyapatite and anorganic bovine xenograft in maxillary sinus grafting: a split-mouth randomized controlled clinical trial. BioMed Res Int 2017:10.