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Review Paper: Osseo Densification, A New Approach in Trans-crestal Sinus Lift: A Narrative Review

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ABSTRACT

Maxillary sinus floor elevation is one of the most common methods to provide sufficient height for the placement of dental implants, which can be conducted by various techniques such as the lateral window, the use of osteotomes, Osseo densification (OD), smart lift technique, VES technique, etc. Accordingly, this study concerns reviewing the existing journal articles in the related literature about the usage of OD burs for antrum floor elevation as well as the merits and demerits of this newly-given technique in comparison to other techniques for sinus lift and elevation. In particular, the special design of the flute in Densah burs, in non-cutting mode, compacting by counterclockwise rotation and irrigation pushes the sinus membrane upwards, and by grafting materials, causes the Schneider membrane to elevate. In this technique, by reducing the surgery time and post-surgery complications, the patient's post-operation comfort and bone density increases. The OD technique enhance the implant initial stability and success rate in low-density maxillary bone. Recently this method is considered as an alternative technique to invasive and time-consuming open sinus lift, especially in cases where the maxillary residual bone height is too low.

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1. Introduction

It is worth mentioning that patients with partial edentulism may have difficulty managing removable dentures due to phonetic problems and lack of comfort as well as aesthetics (1). Therefore, dental implants with higher success rate and function have replaced removable dentures and are considered the gold standard for replacing lost teeth in edentulous ridges (2). Despite this fact, there is convincing evidence that partial or complete edentulous posterior maxilla is one of the most common treatment areas in implant dentistry. More importantly, it is one of the most challenging areas in the oral cavity to be treated. Due to this area's unique and demanding conditions in implant dentistry, over the years, the highest rate of implant failure has been reported in this issue (3). Furthermore, loss of bone and tissue as a result of periodontal disease, bone loss after tooth extraction, pneumatization of maxillary sinuses, low bone density, and high occlusal forces are the central factors that lead to this problem (4). As well as poor bone quality, crestal bone loss of the posterior maxilla and the maxillary sinus pneumatization impress dental implant insertion in the upper jaw.

Accordingly, to overcome this problem short implants, pterygoid implants, zygomatic implants, and sinus lift were introduced. More precisely, sinus lift is a predictable method to increase the survival rate of the dental implants by creating vertical dimensions (5). For the reason that the primary stability of dental implant is an essential factor in peri-implant bone healing (osseointegration) and implant success rate and also owing to the soft and poor quality of maxillary bone, so it is necessary to use an appropriate length of implants to increase the implant's stability in the upper jaw. In this situation, it is required to elevate the maxillary sinus floor (6).

At present, sinus lift is performed through a window in the maxillary sinus lateral wall (lateral approach) or through a cavity in the edentulous alveolar ridge (trans-crestal approach) (7). More precisely, these procedures can be predicted with high success rates and various reported side effects such as membrane perforation, bleeding, etc. These complications result in longer operative time, blood supply reduction, graft displacement, and delayed wound healing. Subsequently, a bone grafting (drilling) concept called Osseo densification (OD) gained popularity (8). The aim of this study is to review the literature related to elevation of the antrum floor using OD burs and the advantages and disadvantages of this new technique.

2. Materials and Methods

Reviewers searched the MEDLINE/PubMed, EBSCO, and Cochrane Library databases and the Google Scholar Search engine for clinical trials, cross-sectional studies, systematic reviews and metha-analysis, case reports and case series published from 2000 to 2024 to identify relevant studies evaluating increase in bone height in close sinus floor elevation using osseodensification and other new techniques.

3. Results

A total of 8035 titles were obtained by electronic database search and 7945 that were not relevant to the topic were excluded. After the screening of articles, 47 studies were excluded resulting in the inclusion of 43 studies.

4. Discussion

It is worth noting that previous study has shown that the overall survival rate of dental implants after sinus floor elevation procedures is >90% (9). Boyne and James proposed the lateral sinus lift technique in 1980, which comprises visualization and manipulation of the maxillary sinus membrane directly via a lateral window (10). It should be underlined that this surgical method is invasive and can be associated with postoperative complications such as bleeding, inflammation, and membrane perforation.

After that in 1994, Summers proposed an approach to elevate the maxillary sinus floor via the alveolar crest using osteotomes (11). Typically, sinus grafting with a lateral approach is often recommended in highly atrophic posterior ridges. However, in cases that need to increase bone height for implant placement in a more conservative, less invasive, and simpler way, the crestal approach is preferable to the lateral approach (12). Besides,

when the residual bone height (RBH) is ≥5 mm, crestal techniques are safe and show highly predictable results with a success rate of at least 95% (13, 14). Nevertheless, benign paroxysmal vertigo is an uncommon complication of sinus lift with osteotomes, which happen in 2% of treated cases (15). Obviously, reduced visibility during the procedure is one of the main disadvantages of the trans-crestal method which increases the possibility of Schneiderian membrane perforation and unawareness of its occurrence. Yet, the frequency of Schneiderian membrane perforation in this technique is less than that of the lateral window technique. Thus, perforation of the Schneiderian membrane leads to the loss of grafting tissue inside the sinus and the failure of the sinus floor elevation. Compared to the lateral window approach, there is a very limited ability to repair membrane perforation with the crestal approach (16, 17). Trans-crestal methods are Crestal window technique, Piezoelectric ultrasound technique, Smart lift technique, VES technique, Water Lift System, Ballooning technique, and Osseo densification which are explained as follow:

The sinus lift technique employs the crestal window technique introduced by winter et al. (18). This technique has been modified to reduce complications in patients with maxillary atrophy and a bone height of 2 mm (19). The tools and techniques used in this method are similar to the lateral window approach, but have two advantages: the sinus wall can be accessed without the need for undercuts. In this case, during the detachment phase, the tension inside the mucosa decreases and the risk of sinus membrane perforation decreases correspondingly (20). After the membrane is lifted, an implant wider than the osteotomy hole can be placed. If the surgeon is not able to achieve the suitable primary stability, the implant is removed and bone graft is added to the site for later implantation. This technique can be called sinus/alveolar crest tenting (18).

The application of piezoelectric ultrasound has been proposed as an effective method for maxillary sinus lift procedures (21). The ability of this device to select only mineralized structures without damaging soft tissue is one of its important advantages (22). Likewise, during the piezoelectric preparation of the lateral window osteotomy, there is no perforation of schneider's membrane. Therefore, piezo surgery is used to expose the maxillary sinus membrane from the alveolar ridge crest and simultaneously elevate the sinus floor by hydraulic pressure. The advantages of this procedure include less trauma, less perforation of the sinus membrane, no malleating, and less surgery time. However, high hydraulic pressure can cause membrane perforation (23). In this procedure, the first osteotomy is made with a 2 mm twist drill into the cortical bone. Intra-lift tips (tkv 1 to tkv 4) are used to gradually increase the penetration into Schneiderian membrane, a little pressure is applied to the tips to deepen the part, and a sterile spray is used to make the temperature low. The tip diameters of tkv 1, 2, 3, and 4 are 1.35 mm, 2.1 mm, 2.35 mm, and 2.8 mm, respectively. Next, a tkw 5 tip (3 mm) is applied, and the ultrasonic activation is repeated for 5 s with internal irrigation at 40 ml/min, 50 ml/min, and 60 ml/min and hydraulic pressure is used to raise the membrane. In due course, implant drills are used to achieve the planned implant size making osteotomy area prepared for the implant insertion (24).

A minimally invasive technique to elevate the sinus floor, called the Smart Lift technique, was proposed by Trombley et al.(25) It is demonstrated by trans-crestal access to the sinus area using special drills and osteotomes. All manual and rotary instruments are used with an adjustable stop device that limits the operation of the drill and the osteotome to the vertical value of the remaining bone, thus preventing the accidental entry of the instrument into the sinus cavity. The Smart Lifting techniques lead to a predictable elevation of the sinus floor and fewer postoperative complications (7). Using this method, the vertical expansion of the implant location is produced by the condensed trephined bone core that is relocated into the sinus. A penetrating osteotomy procedure elevates the lining of the sinus and thus creates space for the blood clot to form. It is possible that the contribution of bone nuclei to bone formation in the sinus may be related to the amount of bone remaining at the implant site (the more the native bone pushed into the sinus, the more the newly formed bone). When the amount of remaining bone is inadequate based

on the amount of bone needed for suitable implantation, bone formation can be achieved by using additional grafts (26).

Lately, Kadkhodazadeh et al. (27) introduced the "Vertical Expanding Screw" (VES) technique using a threaded expander. In this method, the initial drilling is done 1 mm from the sinusoidal floor. A threaded expander was then used to open the hole and push the floor of the sinus upward. Finally, the desired height and width of the tool area were obtained by gradually increasing the size of the expander screw. VES technology can upsurge the maxillary sinus floor, improve bone quality, and benefit from simultaneous implant insertion (27).

The Water Lift System is a novel sinus surgical instrument designed to minimize the risk of membrane perforation during sinus lifting procedures. This system offers two distinct approaches: crestal and lateral, each tailored for specific surgical needs. The kit comprises an artificial intelligent (AI)-powered drill, a resistance-sensitive tool, and an aqua system, which utilizes hydraulic pressure for membrane elevation. The AI drill's unique feature is its ability to cease drilling when it detects contact with the Schneiderian membrane. In the crestal approach, a conventional drill is first used to create a hole in the crestal cortical bone, followed by the removal of bone voids and residual spongy bone. The AI drill then prepares the hole by drilling through the remaining bone. The aqua system is inserted to elevate the Schneiderian membrane gently, and a radiographic contrast medium is injected to ensure proper elevation. Once confirmed, a spread drill expands the hole, allowing for bone replacement material filling and implant placement. This method significantly reduces the risk of membrane laceration, as evidenced by clinical studies. (28).

Kfir et al.(29) presented an innovative device for the ballooning technique, utilizing a crestal approach. This method offers numerous advantages, including a low complication rate, minimal patient discomfort, and long-term safety and durability. Its accessibility is further enhanced by the requirement of only basic equipment and a brief learning curve, making it a widely applicable clinical procedure. The procedure involves a site osteotomy performed according to Summer's technique, followed by the Valsalva maneuver and gel injection for lubrication. A metal sleeve, measuring 2.6 mm in internal diameter, was carefully screwed in, stopping just 0.5 mm under the sinus floor. Subsequently, an inflatable balloon was inserted, extending 1-2 mm beyond the sleeve's tip. The sleeve's proximal part featured a locking mechanism, securing the balloon in place. Inflation was achieved using an inflator syringe containing a 50% diluted contrast medium, ensuring a gradual expansion process. It was crucial to maintain the inflating pressure below 2 atmospheric pressures. Once the sinus membrane was successfully elevated, the balloon was deflated and extracted along with the sleeve (29).

It has been ascertained that primary stability in implant insertion is one of the most critical factors determining the treatment outcome. Factors that mainly play a significant role in increasing the primary stability of the implant including bone density, surgical protocol, type of implant threads, and geometry (30-33). It should be also explained that mechanical friction between the implant surface and the bony walls of the osteotomy site provides the primary stability of the implant. In particular, the maximum implant torque directly relates to its primary stability and host bone density (33). Furthermore, high implant torque may significantly increase the percentage of initial bone contact with the implant compared to the implant placed with low torque values (34). To be more specific, for every 9.8 Ncm of torque, the failure rate in single-tooth implant restoration decreases by 20% (35).

To tackle the aforementioned issues, a standard drilling process has been employed to prepare and cut bone for fixture implantation. Subsequently, the OD technique, introduced by Huwaise in 2013 (36), has used proprietary high-speed densifying burs to preserve and compress bone in place (37) . In fact, OD is a new surgical technique for the biomechanical preparation of bone for implant insertion, in which the bone is compressed and expanded in lateral directions to the open spaces of the bone marrow and the walls of the osteotomy site (37). In this bone non-extraction technique, new burs (Densah^{TM} burs) provide the possibility of maintaining and increasing bone density

through compression autograft bone during osteotomy preparation, enhance the peri-implant bone density (36) and combine the advantages of osteotomes with speed and the tactile control of the drilling operation. To elaborate on this issue, standard drills remove and extract bone while preparing the implant site. Paradoxically, osteotomes preserve the bone and tend to cause fractures in the trabeculae, necessitating a long time for repair and leading to a delay in achieving the secondary stability of the implant (38). In spite of this, the new OD burs provide the possibility of maintaining and increasing bone density through compression autografts during osteotomy preparation. According to laboratory studies, an increase in the peri-implant bone density and the mechanical stability of the implant has been reported using this method (39). Additionally, the OD process also helps osteoblastic nucleation in the edentulous area (36).

Most significantly, contrary to the usual drilling processes in which each flute with a positive rake angle extracts a small thickness of bone every time it passes and leaves an osteotomy site without bone particles, osteotomy in OD is performed using tapered and multi-fluted burs. As a matter of fact, each OD bur has four tapered flutes with a negative rake angle and creates a layer of dense and compressed bone in the walls of the osteotomy site. More exactly, burs have a cutting chisel and a conical shank that gradually increase the diameter of the osteotomy and control the expansion process by penetrating deeper into the bone. This expansion happens at high speeds (800–1500 rpm) (40) and in both clockwise and counterclockwise directions. However, counterclockwise rotation is more effective for increasing bone density; as a result, clockwise and counterclockwise directions are indicated for high and low-density bones, respectively (41). Practically, when standard drills extract enough bone, the stresses in the remaining bone reach or exceed the bone micro-damage threshold, and the bone remodeling unit requires more than three months to repair the damaged area. Therefore, maintaining the bone volume increases the healing quality and decreases the recovery period (42).

The previous studies used OD approach to elevate the maxillary sinus floor. The data of these studies were extracted and summarized in Table 1. The use of Densah burs to elevate the maxillary sinus floor, was first introduced by Huwais and Meyer in 2018 (43). More importantly, the idea of densified autografts is supported by the design of Densah burs with conical geometry and special flutes designed for bone densification on its walls and apex. That is to say, the special design of the flutes in the non-cutting compactor state by counterclockwise rotation and in the presence of irrigation creates a hydraulic wave at the tip of the bur and pushes the maxillary sinus membrane upwards. Correspondingly, the presence of grafting materials causes the same effect and elevates the Schneiderian membrane with a reduced risk of its perforation. Therefore, like the osteotome or lateral window techniques, this approach is suggested as a safe technique to elevate the maxillary sinus floor, with less invasiveness and limited complications such as membrane perforation (2). For this procedure, the osteotomy is started with a pilot drill rotating clockwise up to a height of 1 mm from the sinus floor. This is followed by a 2.5-mm Densah bur high-speed counterclockwise rotating bur 1 mm shorter than the sinus floor. Predictably, sequential enlargement of the hole has been attained using larger burs in a specific sequence and changing the motor mode to reverse rotation with slow pumping movements according to the manufacturer's instructions. As a consequence, the osteotomy depth increase and sinus membrane elevation have been achieved during this process (44).

According to Lai et al.,(45) in close sinus lift procedures without the use of grafting materials, the amount of implant entering the sinus plays a significant role in the amount of bone formation, and if the implant enters the sinus by 2–3 mm, complete bone regeneration will occur around the implant's entire surface (45). Consistent with the Densah protocol (43), if more than 3 mm of sinus lift is needed, an allograft material can be gently pushed into the sinus to obtain a further 2-mm height increase. For this reason, the well-hydrated graft material is driven into the sinus with a Densah bur with the last diameter according to the size of the osteotomy hole and at a speed of 150–200 RPM, without irrigation and using counterclockwise mode. Conspicuously, the diameter of the final bur should be 0.7–1 mm less than the diameter of the implant (46).

Table 1. The summery of extracted data from the articles

Authors	Study Design	Sample Size	Implant Stability (Isq Scale) For Od Group	Implant Stability (Isq Scale) For Os Group	Mean Bone Height Increase in Od Group (mm)	Eight Increase in Osteotomy Group (mm)	Fallow-Up Time	Conclusion
Arafat and Elbaz (2019) (47)	RCT	24	65.17 ±4.39	52.83 ±6.29	3.33±0.25	2.79±0.30	6 months	For primary Implant stability and bone gain OD was superior to osteotomy technique.
Taha (2019) (53)	RCT	14	–	–	–	–	2, 4, 6 and 8 weeks	For bone gain Densah bur was better than osteotome technique, with reduced morbidity, better postoperative comfort.
Isik (2020) (54)	RCT	54	–	–	3.53 ±0.26	3.54 ±0.24	6 months	OD technique was shown to enhance primary implant stability (45 Ncm).
Hemd and Hamdi (2021) (48)	RCT	20	66 ±8.8	60.3 ±7.2	0.9 ±0.73	2.5 ±0.78	1 week	OD technique is better than osteotome.
Rostom (2021) (55)	RCT	10	–	–	1.8 ±0.4	1.4 ±0.5	6 months	Osseo densification surpass osteotome - lifting procedure.
Ghobashy (2023) (50)	RCT	11	66.17±9.57	54.83 ±7.19	–	–	6 months	OD technique better results than Osteotome technique.
Mahmoud (2024) (56)	RCT	16	93.75 ± 6.2	86.25 ± 3.4	7.19 ± 0.8	7.26 ± 1.8	6 months	OD was superior to the OS technique in that it promoted higher primary stability, less pain, and more apical bone height gain immediately.

OD: Osseo densification; RCT: Randomized Clinical Trial

As an additional noteworthy study, Arafat and Elbaz (2019) compared the clinical and

radiographic characteristics of sinus elevation using osteotomes and OD in ridges with a minimum height of 5 mm. In this study, sinus floor augmentation was performed using the trans-crestal technique with osteotomes on 12 patients. On another 12 patients, the OD technique was used for the trans-crestal sinus floor elevation. In terms of implant stability, the OD group showed a significantly higher Implant Stability Quotient (ISQ) immediately after implant placement and six months after surgery compared to the other group. After six months, the amount of vertical bone gain was significant in both groups, with 3.33±0.25 mm in the OD group and 2.79±0.30 mm in the osteotomy group, and was significantly higher in the OD group. Regarding marginal bone loss, there was no significant difference between the two groups six months after loading (47).

Next, Hemd and Hamdi conducted an RCT study in 2021 to compare two crestal sinus elevation methods using OD burs and osteotomes regarding implant stability, crestal bone loss, bone height gained, and postoperative complications. Twenty patients with a minimum RBH of 5 mm were randomly divided into two groups of OD burs and osteotomes and then treated. In both groups, alloplastic graft materials were used for sinus floor augmentation. The amount of bone height obtained during the follow-up time was similar in the two groups. A Numerical Rating Score (NRS) was used to evaluate the patient's pain immediately and one week after surgery. The NRS for the OD burs group immediately and one week after surgery, with an average of 2.9 and 0.9, respectively, was significantly lower than the osteotome group, with an average NRS of 4.9 immediately and 2.5 one week after surgery. Remarkably, there was no significant difference between the two groups in the stability of the implants immediately after insertion, with an average ISQ of 60.3±7.2 Ncm in the osteotomes group and 8.8±66 Ncm in the OD burs group (P=0.19). However, four months after surgery and at the time of abutment connection, the average ISQ in the OD bur group (ISQ=71.8±5.5) was significantly higher than in the osteotomes group (ISQ=66.9±4.5). Based on the comparison of two periapical radiographs prepared from the implants immediately and four months after surgery, the average marginal bone loss after four months in the OD burs and osteotomes groups was 0.11±0.71 mm and 0.20±0.75 mm, respectively, with no significant difference (48).

In 2021, Salgar used the Osseo densified crestal sinus window technique instead of the lateral window technique in a case report study for treating three cases of sinus elevation with residual ridges of 0.4–1.5 mm. In this study, to access the sinus membrane and its elevation, Osseo densifying burs were used at 800–1200 rpm and in a counterclockwise direction with continuous irrigation. The results showed an increase in height to an average of 10.3–13.6 mm on both buccal and palatal sides (4).

In 2022, Alhayati et al. (49) conducted a study on 17 patients who were candidates for posterior maxillary implants with a residual ridge height of 2–6 mm. The patients were divided into two groups with residual ridge heights of 2–3.9 mm and 4–5.9 mm and underwent the same crestal sinus lift treatment, using Versah drills with an OD protocol and alloplastic grafting material along with simultaneous implant insertion. The average procedure time was calculated at 1.85±11.2 min. The average primary and secondary stability after 24 weeks in the group with lower ridge height was 65.00 and 68.8, respectively, with 74.70 and 79.65, correspondingly, in the group with higher ridge height, significantly higher in the group with greater height (49).

In a case series study by Elsaid et al. (24) in 2022 on seven patients with 4–6 mm of residual posterior maxillary ridge height, trans-crestal sinus elevation was performed using OD burs and deproteinized bovine bone graft material simultaneously with implant insertion. In addition, the duration of surgical procedures was between 25 and 38, with an average of 30.86±4.10 minutes. The height of the ridge after the procedure increased significantly (P<0.0001) with an average of 5.33±0.83 mm six months after surgery. The results showed a significant increase in the stability of implants between the time of their insertion (ISQ=61.43±2.07 Ncm) and after six months (ISQ=80.00±3.11 Ncm). Eventually, bone density increased significantly in six months from

69.89±757.29 HU to 109.63±818.43 HU (24).

In 2023, El-Ghobashy et al., (50) in a randomized clinical trial, compared two crestal sinus floor elevation approach using osteotomes and Densah burs on 11 patients with a residual ridge height of 5–8 mm. The pain level of patients in the first 10 days after surgery in the group treated using OD burs with pain intensity scale of 2.28±3.00, compared to the osteotome group with of 4.17±2.31, was mild to moderate. The degree of edema 10 days after surgery was evaluated by the pitting method, and with a score of 1.33±0.51 in the OD burs and 2.17±0.98 in the osteotomes groups, markedly, there was no significant difference between these two methods. It should be stated that the surgery time was significantly different in the OD burs method, with an average time of 7.33±2.18 minutes, compared to the osteotome approach, with an average time of 14.52±1.45 minutes. The primary and secondary stability of the implants were evaluated six months after the surgery. At both time intervals, a significant difference was seen between the OD bur groups (primary ISQ=66.17±9.57 and secondary ISQ=77.00±3.52) and the osteotome group (primary ISQ=54.83±7.19 and secondary ISQ=65.17±3.06); the average bone density after surgery was 204.19±286.48 HU in the OD bur group and 161.91±342.71 HU in the osteotome group, with no significant difference (50).

Potdukhe et al. (51) performed a systematic review and meta-analysis in 2023 to evaluate the difference in primary implant stability and bone height gain in indirect sinus floor elevation using OD burs and osteotome technique. There was no significant difference between groups regarding increasing bone height (P=0.15, pooled mean difference=0.30). However, the initial stability of the implants showed higher values in the OD bur group. (P<0.001, pooled mean difference=10.61) (51).

In the case report presented by Mohrez et al. (52) in 2023, indirect sinus floor augmentation was performed with immediate implant placement in the area of teeth #16 and #17 using Densah burs and OD technique. The height of the residual ridge in the extraction area of the mentioned teeth was 1–4 mm with a width of 9–12 mm, and two 6×8-mm Bicon sub-crestal implants were placed. It has been revealed that Sinus Floor Elevation (SFE) immediately after surgery and endo Bone Gain (BG) after six months, were calculated as SFE = 6.53±0.942 mm, BG=7.03±0.878 mm, respectively, and in the area of tooth, it was calculated as #17, SFE=8.16±0.959 mm and BG=7.75±1.275 mm (52).

In a 2024 retrospective analysis by Saglanmak et al., (57) 102 samples were divided into two groups to study bone gain in 72 patients. The OD group, with a minimum RBH of 5mm, underwent the Osseo densification procedure, while the other group, with a minimum RBH of 3-4mm, received sinus graft augmentation using a viscoelastic colloidal graft material along with the Osseo densification procedure. The average period between implant insertion and post-operative evaluation was 194.6 ± 24.8 days. The study revealed an endo-sinus bone gain (ESBG) of 3.45 (1.18) and 5.74 (1.31) mm in the OD and the other groups, respectively. This bone gain was found to be statistically significant in both groups compared to the baseline RBH after 6 months. Furthermore, the differences in ESBG between the groups were also statistically significant at the same time point. This suggests that crestal sinus lifting through the Osseo densification technique is a rapid, efficient, and safe approach, offering predictable results even in cases with low RBH (57).

There was a multicenter clinical study in 2024 conducted by Mazor et al. (58) in which maxillary sinus membrane perforation was evaluated fully in 670 sites by means of OD-mediated trans-crestal sinus floor elevation. Most sinus lifts were done in the molar region as well as healed bone sites. Moreover, the mean RBH was 5.1 mm. In addition, sinus membrane perforation occurred in 7.31% of cases. To be more exact, RBH ≤3 mm showed a risk factor for sinus membrane perforations followed by RBH >3 and ≤5 mm. Most significantly, tooth area and implant site were not accompanied by risk factors for sinus membrane perforation. The last but not the least, it has been concluded that OD drilling employed for trans-crestal sinus floor elevation caused low membrane perforation rate (58).

In 2024, Alajami et al. (59) conducted a RCT comparing the efficacy of close sinus floor lift using

Densah burs against the balloon technique, both performed concurrently with implant insertion. Clinical and radiographic evaluations were conducted at regular intervals, specifically immediately post-surgery, as well as at 6 and 12 months thereafter. The results indicated that both techniques yielded favorable clinical and radiographic outcomes for crestal sinus floor elevation procedures. Notably, a statistically significant difference in implant primary stability was observed between the two groups, favoring the Densah burs technique; however, no significant difference was noted at the 6-month mark. Radiographic assessments revealed that the balloon group exhibited a statistically significant increase in vertical bone height immediately after surgery, followed by a notable decrease in vertical bone height at the 6-month follow-up. The antral membrane balloon technique resulted in superior immediate postoperative vertical bone gain, whereas the Densah burs technique demonstrated enhanced implant primary stability and greater bone density (59).

In 2024, Foad et al. (60) conducted a comparison between the Hydrodynamic Piezoelectric technique and Osseo densification for evaluating Internal Sinus Lifting. A total of 20 patients from both groups received bone grafting beneath the sinus membrane. Both methods yielded successful outcomes, demonstrating excellent clinical results 12 months post-implant insertion. The Densah group exhibited superior implant stability, increased bone gain, reduced surgical time, and fewer complications. Additionally, the Osseo densification technique proved to be a reliable approach for promoting rapid healing, preserving marginal bone integrity after loading, minimizing the risk of cross-infection, and lowering treatment costs (60).

Summarizing the above-mentioned studies, it can be stated that Osseodensification has no membrane perforation according to CBCT examinations (49,57,58), provides higher primary and secondary implant stability (48-51,53,56,59,60), results in more bone gain (48,52,56,60), enhance the bone density (56,58-60), consumes shorter surgery times (53,58), and increase the patient's comfort and satisfaction (55).

5. Conclusion

From an overall perspective, the closed sinus lift technique is recommended due to its minimal invasiveness, the possibility of placing implants of standard length simultaneously, less need for bone removal, more comfort after the operation, and maintaining the integrity of the sinus cavity compared to the open techniques. One of the new methods for this type of sinus floor elevation is the use of special OD burs, which, in addition to minimal invasiveness, does not cause postoperative complications such as, benign paroxysmal vertigo that can occur following the use of osteotomes. Recent research indicates that this approach may serve as a viable alternative to invasive and lengthy open sinus floor augmentation procedures, particularly in instances where there is a significantly low RBH in the posterior maxilla. An additional benefit of Densah burs is their capacity to enhance bone density in the vicinity of the implant osteotomy site. This enhancement contributes to improved initial stability of the implant and elevates its success rate, particularly in low-density bone regions of the posterior maxilla. This characteristic is unique to this technique and is not present in other contemporary minimally invasive methods. Furthermore, this approach requires minimal equipment and is user-friendly when utilizing the OD burs kit. Due to such features, the use of this new method is expected to increase daily and replace invasive and time-consuming sinus lift methods in the clinic.

Ethical Considerations

Compliance with ethical guidelines**.**

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Authors'contributions

Ashkan Salari: initiated, conceptualized, Writing, and supervised the review work, **Maryam Zohary:** wrote the manuscript, **Neshat Kanani:** performed data collection.

Conflict of Interests

None.

Availability of data and material

Not applicable.

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