ORIGINAL RESEARCH PAPER

Dental Science

KEY WORDS:

AN INSIGHT TO VARIOUS SINUS LIFT TECHNIQUES: A SYSTEMATIC REVIEW

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INTRODUCTION

The main reasons for loss of teeth are caries and periodontal disease. Periodontal disease is often bilaterally symmetrical and with a predictable order of likelihood of tooth loss according to position in the arch with greater loss of maxillary premolars and molars and least loss of mandibular cuspids [1-2]. Caries and its sequale remain the principal reason for all tooth loss other than for lower incisors which are extracted mainly for periodontal reasons [3].

After tooth loss the alveolar process of the maxilla resorbs vertically and horizontally to become progressively smaller (Fig. 1). Reich and coworkers[5] studied a historical skeletal material from a population without modern prosthetics. They found that atrophy of the jaw evidently does occur, displaying similar patterns of resorption in a population without modern prosthetics, where the negative effect of ill-fitting dentures was excluded. According to Wolff's Law and the Mechanostat Model[6], disuse and a loss of mechanical stimulation results in the reduction of bone mass.Whether a lack of mechanical strain has the same impact on the alveolar process of the jaw and other skull bones remains to be studied in detail. The magnitude and pattern of alveolar bone loss shows great individual variation .The duration of edentulousness has a significant influence on the rate of residual ridge resorption with significantly higher amounts of alveolar bone height decrease in those patients who had lost the last remaining teeth more recently.

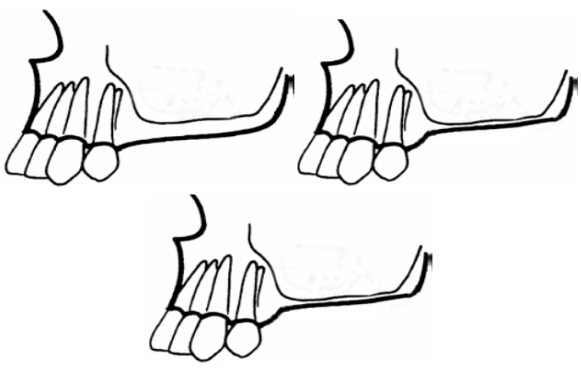

Figure 1. After tooth loss the alveolar process of the maxilla resorbs vertically and horizontally to become progressively smaller.

To overcome this loss of bone height, sinus lift techniques have been used (Boyne and James) (which increase the availability of bone in the posterior maxilla and thus achieve successful implant treatment. Tatum[7] subsequently developed a sinus lift via a lateral approach with osteotomy of the vestibular cortex, so that the space gained after raising the membrane was filled with augmentation material that would maintain a space for the time necessary for the bone defect to be filled by the subject's own bone material. Different graft materials with autologous bone as a benchmark have been studied successively by different authors. Esposito et al.[8], in a review conducted within the Cochrane Collaboration organisation concluded that bone substitutes, Bio-Oss™ (Geistlich Biomaterials, Germany) or Cerasorb™ (Curasan AG, Germany) could be used to replace autologous bone in sinus lift procedures in cases of extremely atrophic sinuses.Another step in the search for less invasive techniques was the use of compressive osteotomes (Summers) to lift the sinus membrane with a closed technique using a crestal approach and additional filling of the sinus with different graft materials. Soltan and Smiler[9] proposed a balloon technique (Antral Membrane Balloon Elevation, AMBE), consisting in gently detaching the membrane using a latex balloon inflated with saline solution. This technique offers advantages such as reduced postoperative pain, bleeding and wound infection rates. This dissertation describe various lift techniques their advantages and disadvantages[10]

ANATOMICAL AND PHYSIOLOGIC CONSIDERATIONS

The antral floor is formed by the maxillary alveolar process and partly by the hard palate. In completely dentate maxillae, the antral floor constitutes the strongest bony wall of the maxillary sinus but exhibits recesses and depressions (alveolar recesses) in the premolar and molar regions.The cancellous bone between and above the alveoli can dehisce with age, so that the root tips project into the maxillary sinus and are covered only by the schneiderian membrane, except for a very thin, sometime absent, bone lamella. The deepest point of the maxillary sinus is normally located in the area of the molar roots; the next deepest area is at the premolar roots.[10] Therefore, the risk of exposing the maxillary sinus intraoperatively is greatest when molar teeth are extracted.Because the mucous membrane lining the maxillary sinus, also referred to as the schneiderian membrane, is direct contact with breathing air, it constitutes a kind of immunologic barrier, although to a markedly lower degree than the nasal mucous membrane. Because of this "frontline" position, frequent mild inflammation and reactive swelling associated with respiratory tract infections are not regarded as something uncommon[11].

HISTOLOGY OF SCHNEIDERIAN MEMBRANE

The schneiderian membrane is formed by a multilayered cylindrical epithelium that consists of a surface layer of ciliated and unciliated cylindrical cells, basal cells, muciparous beaker(goblet) cells, an underlying basal membrane, and the tunica propria. It is between 0.13 and 0.5 mm thick.Beaker cells produce the phlegm that keeps the

membrane moist, protects the ciliated epithelium, and maintains the mucociliary activity. In the schneiderian membrane, seromucous and tubuloalveolar glands are found especially near the ostium. The mainly serous secretion consists of water; small amounts of nonspecific lipids; proteins; and carbohydrates. The mucous portion of the secretion contains either compound glycoproteins or mucopolysaccharides[12].

ANATOMICAL CONSIDERATIONS

Volume of the maxillary sinus of adults ranges between 4.5 and 35.2 cm; the mean volume is about 15.0 cm. This means that the maxillary sinus can vary extremely in size, sinus pneumatization increasing continuously with advancing age and after tooth loss. Anteriorly, the sinus normally extends as far as the area posterior to the roots of the first premolar and sometimes even to the alveolus of the canine tooth Posteriorly, the maxillary tuberosity is sometimes completely filled by an alveolar recess (especially in advanced age). After loss of the maxillary teeth and reduction of the masticatory forces acting on the maxilla, the sinus walls get gradually thinner as a result of the increase in size of the maxillary sinus; however, they are not at risk of being fractured. With advancing age and after tooth loss, the alveolar recesses of the maxillary sinus gradually extend into maxillary regions, including the edentulous alveolar ridge, which have lost their function as a result of progressive sinus pneumatization. This leads to an excavation of the alveolar process from the cranial aspect that varies from one individual to another. Instead of tooth roots initially anchored in this area, the alveolar ridge eventually houses variably deep sinus recesses that are situated at a markedly lower level than the floor of the main nasal cavity and can extend as far as the alveolar margin. [12,13]

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RESORPTION PATTERN AND PNEUMATIZATION OF SINUS

After tooth loss, the maxillary alveolar process undergoes progressive, irreversible resorption that results in a massive loss of substance, both vertically and horizontally. Atrophy-related bone resorption markedly reduces the local host bone available for implant placement over the years.The extent of bone resorption in the maxillary posterior region depends on the duration of edentulism in this area and on the residual dentition anterior to the maxillary sinus, which slows down resorption in the area of terminal gaps.Only rarely is sufficient host bone available between the maxillary sinus and the alveolar ridge after long-term edentulism and progressive resorption of the maxillary alveolar process, particularly because the alveolar recesses tend to expand less into the alveolar ridge in these cases. However, in most cases, the available host bone does not suffice for anchorage of endosseous implants, especially in the molar region. There are many causes of alveolar ridge resorption. The frequency, direction, and intensity of forces acting on the alveolar process play as important a role as the construction and fit of the prosthetic restoration used. Furthermore, resorption can be accelerated and the bone density reduced by systemic factors, such as the patient's age and sex, as well as by hormonal imbalances, metabolic factors, and inflammation.The most severe resorption occurs immediately after tooth loss, as a result of resorptive and remodeling processes affecting the empty alveoli because of an absence of functional loading. Vertical bone loss at the maxillary alveolar process then proceeds at a rate of approximately 0.1 mm per year and can vary greatly from one individual to another[13,14].

SINUS SURGERY TECHNIQUES

1).DIRECT SINUS LIFT TECHNIQUES (LATERAL WINDOW) TYPES:

a).Cardwell luc procedure

b).Antral ballon sinus lift

2).INDIRECT SINUS LIFT (CREASTAL APPROACH)

a).Summers Osteotome Technique

ADVANTAGES OF LWT(DIRECT SINUS LIFT)

- Straight forward technique to get correct amount of bone for dental implant
- Direct visualization of sinus and implant placement and adding the bone are under direct vision
- Highly predictable technique
- Successful regeneration of bone can be expected for placement of the implant
- Implant can be placed simultaneously with the elevation or can also be placed after a healing period (depends on case)
- Immediate placement condenses healing times and eliminates the need for an additional surgical procedure[15]

ADVANTAGES OF THE INDIRECT SINUS LIFT PROCEDURE:

- The procedure is performed on the sites that have < 5mm between the floor of the maxillary sinus and crest of the bone
- Procedure is performed with simultaneous implant placement
- Vertical height of the bone is enough to stabilize the implant
- Indirect sinus lift procedure is less invasive than direct sinus lift
- Damage to the sinus is minimal without affecting the sinus pressure[16,17]

INDICATIONS AND CONTRAINDICATIONS

The maxillary subantral augmentation procedure is a well-established technique for increasing bone volume in the deficient posterior maxilla. As with any surgical procedure, knowledge and understanding of the indications and contra indications are vital. Understanding of the medical and surgical risk factors should always be paramount in the decision to proceed with surgery. Risks and benefits are also important and must be weighed along with those surgical risks that can be counted. The maxilla presents with a variety of anatomic structures. Understanding the structures and their function is critical in performing sinus bone grafting.These structures, such as the maxillary sinus, lateral nasal wall, pterygoid plates, associated vasculature, and teeth, are discussed in other chapters of this text. The function of the maxillary sinus and the effect of sinus bone grafting have not been clearly identified in long-term studies. However, grafting does not appear to cause significant long-term negative changes in sinus function. Rosenlicht and Tarnow described long-term, 2-year postoperative neuralgic changes to the maxilla. There have been various reports of graft infections, with subsequent erosion of bone and oroantral fistulas, lack of graft consolidation, and non integration of implants.[18,19]

INDICATIONS FOR MAXILLARY SUBANTRAL AUGMENTATION

Whether or not a sinus floor augmentation bone graft is indicated is a matter of clinical judgment by the surgeon. Both general factors, such as medical conditions, and local factors, such as periodontal disease and/or infection, can affect this decision. There are numerous procedures to increase the dimension of the posterior maxilla; onlay grafting, including lateral, buccal, and occlusal applications, has its indications, as does interpositional bone grafting The following are some of the indications for sinus bone grafting.

1. Implant placement in areas of insufficient bone volume or decreased inter arch space
2. Oroantral fistula repair
3. Alveolar cleft reconstruction
4. Le Fort I downfracture with interpositional grafting
5. Cancer reconstruction for craniofacial prostheses

Guidelines to follow for sinus grafting for dental implants may also include the following:

1. Alveolar residual bone height of less than 10 mm.

2. Lessthan 4 mm of residual bone width
3. No history of pathosis
4. No significant history of sinus disease
5. No anatomic limitations presented by anatomic structures or scarring after previous surgery[20]

CONTRAINDICATIONS TO MAXILLARY SUBANTRAL AUGMENTATION

General medical contraindications

1. Radiation treatment to the maxillary region
2. Sepsis
3. Severe medical fragility
4. Uncontrolled systemic disease
5. Excessive tobacco abuse
6. Excessive alcohol or substance abuse
7. Psychophobias

Local factors that may contraindicate subantral augmentation

1. Maxillary sinus infections (empyema)
2. Chronic sinusitis
3. Alveolar scar ablation (from previous surgical procedure)
4. Odontogenic infections
5. Inflammatory or pathologic lesions
6. Severe allergic rhinitis

This systematic review was based on PRISMA (Preferred Reporting Items For Systematic Reviews and Meta Analyses)

FOCUSED QUESTION :

1.What are different techniques of sinus lift ?
2.What are different bone graft used in sinus lift **?**

SEARCH STRATEGY:

Literature was searched systematically and studies were identified based on the-PICO (Glossary of evidence based terms 2007).

1). **P**atients with atrophic posterior maxilla
2). patient in need of dental implant in posterior maxilla
3). **I**ntervention a)**D**irect sinus lift procedure
b)**I**ndirect sinus lift procedure
4). **C**omparison between direct and indirect sinus lift techniques
5). **O**utcomes measured : Analysis of bone formation between two sites .

Electronic database search of Pubmed, Medline, Google cholar performed using MeSH terms-sinus lift ,sinus lift techniques, bone graft in sinus lift,atrophic maxilla ,posterior maxilla , maxillary snus elevation,augmentation of maxillary sinus.

Articles published between year 2000-2016 were reviwed. The selected titles were reviewed by following inclusion and exclusion criteria.

INCLUSION CRITERIA

1.Retrospective and Prospective studies
2.Case Series
3.Cohort studies
4.Randomised controlled trials

EXCLUSION CRITERIA

1. Incomplete studies
3. In Vitro studies
4. Publications in language other than english

RESULTS

A systematic review methodology was followed and database searching was done which yielded 640 records. Additional sources yielded 14 more records.42 duplicate records were removed from total of 654,leaving 612records to be screened further records from year 2000-2016 were taken into consideration.92 records were found out to be from years before 2000. 520 records were further reviewed and 142 records were excluded on the basis of language other than English. From total of 378 records,7 animal studies,5 In-Vitro studies and 260 studies which included patients other than dental implant were excluded. A total of 272 studies were further evaluated on the basis of exclusion and inclusion criteria and 89 recorded were removed. Total studies to be systematically reviewed came out to be **13**

RESEARCH QUESTION:

Different techniques of sinus lift
Different bone graft used in sinus lift

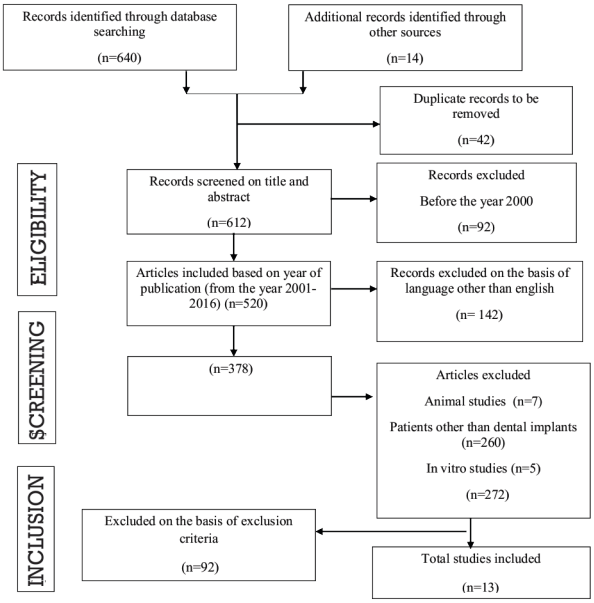

Table 2

CONCLUSION

This dissertation is addressing the survival and complication rates of grafts and implants placed in sinus augmentation sites via the different techniques.The main indication for maxillary sinus floor elevation utilizing a lateral approach is the reduced residual bone height, neither allowing standard implant placement nor placement of implants in combination with minor sinus floor elevation using the transalveolar approach. It is shown in the review that the potential of the maxillary sinus to heal and to form new bone without bone grafts or substitutes is of high nature. The different techniques presented proved to be reliable for bone augmentation of the maxillary sinus floor depending on situation .Every technique have his own advantage and disadvantage, as the exact mechanisms of action on how the bone formation in the sinus occurs, it is not fully cleared. More clinical studies need to be carried out to clarify the bone formation mechanism and predictability in the maxillary sinus after sinus lift with different techniques using any bone graft materials.

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