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## **Influence of perforation of the sinus membrane on the survival rate of implants placed after direct sinus lift. Literature update**

**José Viña-Almunia<sup>1</sup>, María Peñarrocha-Diago<sup>2</sup>, Miguel Peñarrocha-Diago<sup>3</sup>**

<sup>1</sup> Student of Master of Oral Surgery and Implantology. Valencia University Medical and Dental School. Valencia, Spain

<sup>2</sup> Assistant professor of Oral Surgery. University Medical and Dental School. Professor of Master of Oral Surgery and Implantology. Valencia University Medical and Dental School. Valencia, Spain

<sup>3</sup> Professor of Oral Surgery. Director of the Master of Oral Surgery and Implantology. Valencia University Medical and Dental School. Valencia, Spain

*Correspondence:*

*Cirugía Bucal. Clínicas Odontológicas  
Facultad de Medicina y Odontología  
Universidad de Valencia  
Gascó Oliag 1  
46021 Valencia, Spain  
Miguel.Penarrocha@uv.es*

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### **Abstract**

The aim of this paper was to review the procedures adopted when a perforation of the sinus membrane takes place during a direct sinus lift for filling with bone graft; and the survival of implants in those cases in which perforation of the sinus membrane occurred.

A bibliographical search in PUBMED was carried out of articles published from 1997 to 2008, with the key words "sinus perforation" and "membrane perforation". All articles specifying the two following criteria were included: (a) procedure in the case of perforation of the sinus membrane during direct sinus lift; and (b) the number and survival rate of implants placed in direct sinus lift with perforated and non perforated membrane.

Six articles fulfilled the inclusion criteria. In all the articles the sinus lift was continued when a perforation of the sinus membrane took place. In maxillary sinus lift procedures with perforation of the membrane a 88.6% implant survival rate was obtained, and in maxillary sinus lifts with intact membrane the survival rate rose to 98%.

In case of small perforation of the sinus membrane, it is possible to continue with the procedure; there is no consensus on the procedure when a perforated membrane is to be repaired, but the method of choice according to the majority of authors is to use a resorbable membrane. In the case of large perforation, there is no consensus either, although the majority of authors choose to abandon the procedure. The survival of the implants diminishes when they are placed in sinus lifts with perforated membrane.

**Key words:** *Sinus lift, dental implants, membrane perforation, sinus perforation, sinus membrane repair.*

### Introduction

Sinus membrane perforation is the most common complication of maxillary sinus lift for filling with bone graft (1-3). According to Vlassis et al. (4), perforation occurs more frequently during osteotomy than during the reflection of the membrane. More perforations have been referred among smoking patients (5), presence of antral septa (6), narrow maxillary sinus (7) and presence of small residual bone height (5); for all these parameters there is a statistically significant relationship. The perforation of the sinus membrane occurs in between 10 and 35% of the procedures (8,9), although this percentage may be reduced to 7% when performing the osteotomy with the piezoelectric technique (10).

When a perforation exists, some authors choose to repair the membrane and to proceed with the intervention (11,12), and others to abandon the procedure (13-15). Regarding the method of membrane repair there is also some disagreement among authors; in the case of small perforations, Van den Bergh et al. (7) continues with the procedure without repairing the membrane, Fugazzotto et al. (11) place a membrane to seal the perforation, Engelke et al. (16) suture the membrane with resorbable material. According to some authors the perforation of the sinus membrane does not influence survival of the implants (5,17), for others, perforation of the Schneiderian membrane is a negative factor for survival (14,18,19).

The aim of this paper was to review literature on: (a) procedure when a perforation of the sinus membrane takes place during a direct sinus lift for filling with bone graft; and (b) to compare implant survival in cases in which perforation of the sinus membrane occurred with those where it was not perforated.

### Bibliographical methodology search and inclusion criteria

A bibliographical search in PUBMED was carried out for articles on perforation of the sinus membrane, published between 1997 and 2008. The key words used were ‘sinus perforation’ and ‘membrane perforation’.

Inclusion criteria for the analysis were for the article to specify: (a) the procedure followed when a perforation of the sinus membrane during direct sinus lift occurred; (b) the number and the survival rate of implants placed in direct sinus lift with perforated and non perforated membrane. The study of corpses and those in animals were not included in this study.

We found 59 articles with the key word “sinus perforation” and 74 articles with the key word “membrane perforation”. We analyzed six articles that fulfilled all the inclusion criteria (Table 1).

In the case of sinus membrane perforation, we analyzed whether the authors continued with the sinus lift, and if so, how the perforated membrane was repaired. The

| Authors                      | Number of patients | Number of sinus lifts | Number of perforations | Perforation of the membrane | Number of implants placed | Number of implants failed | Survival rate (%) | Follow-up in months |
|------------------------------|--------------------|-----------------------|------------------------|-----------------------------|---------------------------|---------------------------|-------------------|---------------------|
| Proussaefs et al. 2003       | 5                  | 10                    | 5                      | Yes                         | 11                        | 5                         | 54.5              | 6-9                 |
|                              |                    |                       |                        | No                          | 10                        | 0                         | 100               |                     |
| Proussaefs et al. 2004       | 12                 | 24                    | 12                     | Yes                         | 21                        | 5                         | 69.5              | -                   |
|                              |                    |                       |                        | No                          | 22                        | 0                         | 100               |                     |
| Shlomi et al. 2004           | 63                 | 73                    | 20                     | Yes                         | 68                        | 7                         | 90                | 24                  |
| Engelke and Capobianco 2005  | 6                  | 8                     | 1                      | Yes                         | 2                         | 0                         | 100               | 7-12                |
|                              |                    |                       |                        | No                          | 19                        | 1                         | 94.8              |                     |
| Karabuda et al. 2006         | 91                 | -                     | 12                     | Yes                         | 26                        | 2                         | 92.3              | 8 - 72              |
|                              |                    |                       |                        | No                          | 233                       | 9                         | 96.2              |                     |
| Hernandez-Alfaro et al. 2008 | 338                | 474                   | 104                    | Yes                         | 272                       | 25                        | 90.8              | 6                   |
|                              |                    |                       |                        | No                          | 894                       | 0                         | 100               |                     |
| Total (weighted mean)        | -                  | -                     | -                      | Yes                         | 400                       | 44                        | 88.6              | -                   |
|                              |                    |                       |                        | No                          | 1363                      | 26                        | 98                |                     |

Table 1. Comparison of implant survival rate in sinus lifts with perforated and non perforated membrane.

survival rate of implants placed in the sinus lift in which perforation of the Schneiderian membrane occurred, was compared with those placed in sinus lifts in which the membrane remained intact. The weighted average of the implants survival rate was calculated.

**Action to be taken in case of sinus membrane perforation**

In the case of small perforations, many authors chose to seal the perforation with a collagen membrane (5,7,8,11,20,21), either suturing with resorbable material (Vicryl®) (14,15), using fibrin glue (14,15), or leaving the membrane folding over itself when lifting thus obviating the need for repair (6,7). In the case of large perforations, many authors chose to abandon the sinus lift (7,13-15,20,22-25), others opted to continue the procedure using a resorbable membrane in the perforation (8,11,20), or placing a lamellar bone sheet (4,6). Vlassis et al. (4) classified the types of perforations and their respective treatment. Later they published a simplification of this classification based on 19 cases (11), according to which, it is possible to proceed with the sinus lift using a resorbable membrane in all types of perforation (Table 2).

In the 6 studies analyzed, when sinus membrane perforation occurred, the intervention was continued independently of its size.

Proussaefs et al. (18,19) placed a collagen membrane in the area of the perforation before placing the graft material. Shlomi et al. (26), had a case of a perforation larger than 5 mm, and placed a freeze-dried human lamellar bone sheet (Lambone®). Engelke et al. (16) used a polyglyctine suture (Vicryl®). Karabuda et al. (17), placed a resorbable collagen membrane in small perforations, and in larger perforations they sutured the sinus membrane with resorbable material, placed a collagen membrane in the area of the perforation, and fixed it with tacks. Hernandez-Alfaro et al. (12) distinguished 3 types of perforations based on their size: in those smaller than 5 mm, they sutured the membrane with resorbable material (Vicryl®) or placed a collagen membrane, in the perforations between 5 and 10 mm, they sealed the perforation placing a collagen membrane and the lamellar bone from the sinus window, and in those larger than 10 mm they acted in one of the following 3 ways: placing the wall of the sinus window into the perforation, covering the perforation with a pediculate buccal fat pad flap, or placing a block bone graft from the symphysis of the mandible or of the retro-molar area. According to these authors, the perforation of the sinus membrane is not an absolute contraindication to continuing with the intervention.

**Table 2.** Fugazzotto PA & Vlassis J simplified classification of perforation and treatment.

| Type of perforation | Description of the perforation  | Method of repairing the perforation  | Instructions on implant placement   |
|---------------------|---|--|---|
| Type I              | Produced in the most apical part of the window  | They seal spontaneously but a collagen membrane may be placed  | Continue with the sinus lift. It is possible to place simultaneous implants     |
| Type IIA            | Produced along the lateral or coronal walls of the window. The sinus extends 4 to 5 mm proximal to the perforation  | Enlarge the osteotomy until intact membrane is exposed. If the Perforation is smaller of 3 mm, it is sealed with a collagen tape, and if larger than 3 mm, a synthetic membrane or a resorbable membrane of porcine origin is placed | Continue with the sinus lift. It is possible to place simultaneous implants     |
| Type IIB            | Differs from the above is based on the perforation which is located at the limit of the maxillary sinus, therefore the osteotomy can not be amplified to expose intact membrane | A resorbable membrane is placed so that its limits extrude around the window in order to fix it to the bone around the preparation   | Continue with the sinus lift. It is not possible to place simultaneous implants |
| Type III            | Produced in any part within the window extension  | A resorbable membrane is placed so that its limits extrude around the window in order to fix it to the bone around the preparation   | Continue with the sinus lift. It is not possible to place simultaneous implants |

## Implant Survival

Some authors considered that tearing the Schneiderian membrane was a factor that diminished the implant survival rate: Proussaefs et al. (19) obtained a lower implant survival rate when they were placed in the sinus lifts with perforated membrane (69.5%), than when they were placed in sinus lifts with intact membrane (100%). Khoury (14) also found a lower survival rate for implants in the interventions in which perforation of the sinus membrane took place. Some authors (5,17) did not consider the tearing of the membrane a negative factor in the survival rate of the implant. Schwartz-Arad et al. (20) considered that the tearing of the membrane influenced the occurrence of post-surgical complications, but did not influence the survival rate of the implants. Hernandez-Alfaro et al. (12) observed an implant survival rate inversely proportional to the size of the perforation.

In the 6 papers included in this review, 400 implants were placed in sinus lifts where sinus membrane perforation occurred, of which 44 failed, thus obtaining 88.6% survival. In the sinus lifts where perforation of the sinus membrane did not occur, 1363 implants were placed, of which 26 failed, obtaining a 98% survival (Table 1).

## Conclusions

When a small perforation of the sinus membrane occurs, sinus lift may be continued; there is no consensus on the technique when a perforated membrane is to be repaired, but the method of choice according to the majority of authors is to use a resorbable membrane. In the case of large perforations, there is no consensus either, although the majority of authors choose to abandon the procedure. Survival rate decreases when implants are placed in sinus lifts with perforated membrane.

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