EurAsian Journal of Oral and Maxillofacial Surgery
Official publication of AÇBİD (Association of Oral and Maxillofacial Surgery Society)

RESEARCH ARTICLE

Comparison of Primary Stability of Sinus Implants and Standart Implants

Nur ALTIPARMAK,DDS,PhD[1], Cem CETINSAHIN,DDS,PhD[2], Tolga KENCER,DDS[1]

[1] Baskent University, Faculty of Dentistry, Department of Oral and Maxillofacial Surgery, Ankara, Turkey
[2] Baskent University, Faculty of Dentistry, Department of Prosthodontics, Ankara, Turkey

Abstract

Background

The BoneTrust® Sinus implant (BTSI) enables optimal primary stability by its special design with reduced thread section in cases of reduced vertical bone availability, thus allowing in many cases a one-step operative procedure even if less than 5mm of the bone level is available in the sinus region. The aim of this in vitro study was to analyze the primary stability of BoneTrust® Sinus implant in comparison with standart implants.

In the years 2015-2017, partially edentulous patients were consecutively provided with implant-supported fixed restorations with the use of 11 BoneTrust® Sinus implants of the Medical Instinct® System (Medical Instinct Production GmbH, Bovenden, Germany) (Group A) and the 11 standard OXY implants of Biomec System (Biomec system Italy) (Group B) at Baskent University, Department of Oral and Maxillofacial Surgery.In this study, measurements were conducted with the Resonance Frequency Analysis method by using Osstell device on 11 BoneTrust® Sinus implants of the Medical Instinct® System (Medical Instinct Production GmbH, Bovenden, Germany) and 11 standart OXY implants of Biomec System (Biomec system Italy).

Results

Primary and secondary ISQ values implants were compared and there was no statistically significant difference between these two groups in terms of these parameters.No significant difference was found between the two groups in terms of bone loss after 6 months.

Conclusion

This present study did not demonstrate a statistically significant difference, between the primary and 6th-month ISQ values of the standard implants group and sinus implants group.

None of the authors have any competing interests in the manuscript.

Keywords: sinus implant, ISQ, primary stabilty, lateral sinus lifting

Introduction

Sinus augmentation is performed when the floor of the sinus is too close to an area where dental implants are to be placed. This procedure is performed to ensure a secure place for the implants, while also protecting the sinus at the same time[1,2].

In the literature, it has been shown that the initial bone height, fixture diameter, and fixture length are the factors that influence the implant stability on the posterior edentulous maxilla. On the other hand, the initial bone width, bone graft and sinus elevation procedure, graft material, and the approach method for sinus elevation do not affect the implant stability on the posterior edentulous maxilla[3]. Although postoperative stability is independent of the initial bone width; the implants on the posterior edentulous maxilla are more stable with a longer fixture length and a wider fixture diameter. Bone graft or sinus elevation procedure does not create a difference in stability, so it is recommended to install the fixtures accurately in a larger diameter and longer length by performing bone graft and sinus elevation[3].

The Osstell instrument measures the implant stability by assessing the bone-implant unit's own resonance characteristics when a screwed-on transducer transfers specific vibration frequencies onto it. This is termed resonance frequency analysis (RFA).[4]

Corresponding Author: Tolga Kencer
Baskent Universitesi Dishekimligi Fakultesi
11. Sok No: 26 06490 Bahcelievler, Ankara, Turkey
e-mail: tolgakencer@icloud.com

Resonance Frequency Analysis (RFA) is a noninvasive intraoral method designed to assess bone-implant interface and may therefore provide clinical evidence of implant stability[5]. Due to its high reproducibility and soundness, this technique has progressively, in the last years, outperformed the all techniques previously proposed to monitor implant stability[5].

The BoneTrust® Sinus implant (BTSI) which was developed in cooperation with Dr. Kay Pehrsson at Haranni Clinic, Herne, in Germany, was introduced by Medical Instinct® (Medical Instinct Production GmbH, Bovenden, Germany) in 2011. According to the information provided by the manufacturer, the BoneTrust® Sinus implant enables optimal primary stability by its special design (Figure 1) with reduced thread section in cases of reduced vertical bone availability, thus allowing in many cases a one-step operative procedure (augmentation and simultaneous implantation), even if less than 5mm of the bone level is available in the sinus region[6].

To the best of our knowledge, in 2006 an experimental study on bone trust sinus implants was published but no controlled clinical studies on bone trust sinus implants exists in the literature[6]. The aim of this present study was to analyze the primary stability of BoneTrust® Sinus implant (BTSI) which enables optimal primary stability by its special design with reduced thread section in cases of reduced vertical bone height, in comparison with standard implants.

BoneTrust® Sinus implant

Patients And Method

This study was approved by Baskent University Institutional Review Board (Project No: D-KA19/36) and supportted by Baskent University Research Found the years 2015-2017, partially edentulous patients were consecutively provided with implant-supported fixed restorations with the use of 11 BoneTrust® Sinus implants of the Medical Instinct® System (Medical Instinct Production GmbH, Bovenden, Germany) (Group A) and the 11 standard OXY implants of Biomec System (Biomec system Italy) (Group B) at Baskent University, Department of Oral and Maxillofacial Surgery. Before implant placement, patients were treated for periodontal diseases (in case it was needed to achieve periodontal health). Systemic antibiotics were prescribed to all patients for 7–10 days, starting from the day of the implant insertion.

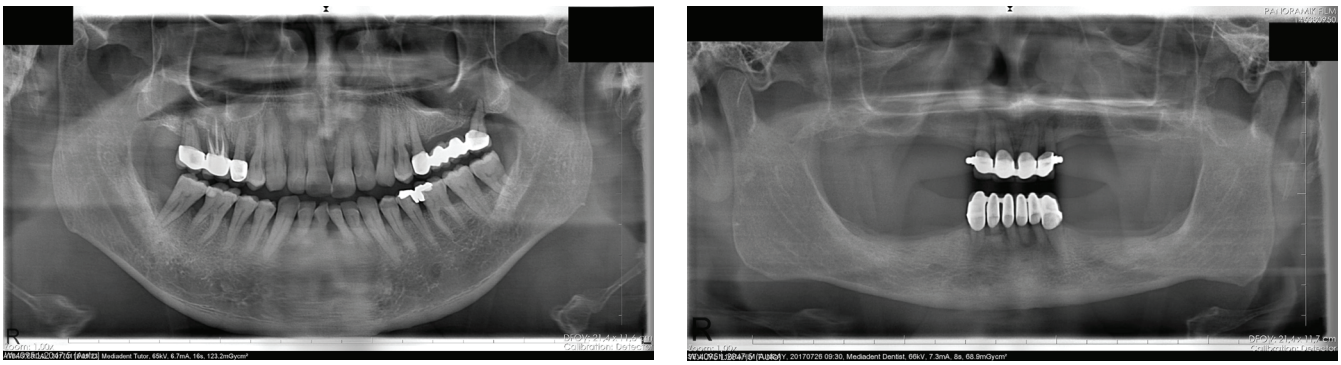
A computer tomography scan was used to evaluate the amount of bone at individual implant sites under the maxillary sinus to see whether the patient could be included in the study. Patients who had a residual bone height of less than 2 mm were excluded. The other exclusion criteria were sinus pathologies, systemic diseases, smoking habits, alcohol consumption and poor oral hygiene.

Surgical Procedure: Sinus lifting and implant insertion procedures were performed under local anesthesia. After mucoperiosteal flap elevation, five or six holes were drilled using a round bur in order to outline the planned window. Lateral window osteotomies were created to allow good access for dissection, as well as for sinus membrane elevation, and insertion of graft materials. No perforation of the sinus membrane was observed. The particulate graft materials Geistlich Bio-Oss®, North America were inserted in the cavity and a collagen membrane (Geistlich Bio-Gide®, North America) was placed over the grafted site. Thereafter, simultaneous insertion of dental implants was performed (Figure 2). Care was taken not to lacerate the sinus membrane with the tip of the implants during the insertion. The implant stability quotient (ISQ) was measured after the implant surgery. Mucosa was re-adapted and sutured with restorable sutures.

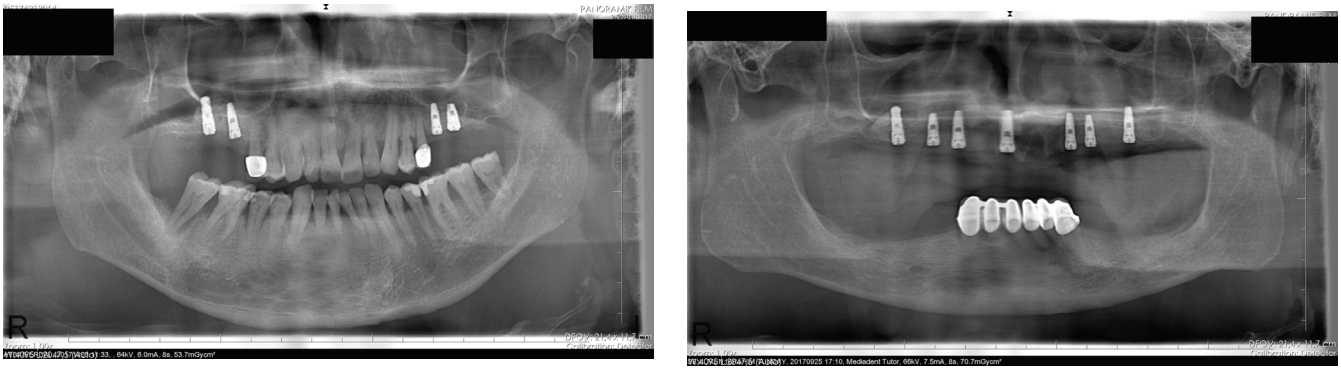
ISQ measurements were repeated 6 months after the surgery. All the measurements were taken twice in each direction (in the buccolingual direction from the buccal side and from the palatinal side). The average of the two measurements was recorded.

The success rates of the implants were analyzed based on the criteria of the Pisa Consensus Conference. In both groups, pain, exude history, mobility and radiographic bone loss were assessed[7].

For the evaluation of radiographic bone loss, a control radiograph was taken at the time of patient recall. Linear distance between the implant shoulder and bone crest were recorded in mesial and distal aspect of the implants. The average values were used as a single measurement for each implant.



a,c: Preoperative Radiographic View



b.d: Postoperative Radiographic View

Results

Table 1 shows the data of 11 patients with 11 standard implants. The age of the patients, the height and width of the residual bone, and the diameter and height of the 11 implants placed, the primary ISQ values measured at the time of the first implantation of the implants, the ISQ values measured in the postoperative period, the amount of bone loss occurring 6 months after implant placement and classifications of the success criterion of the implants informations are shown on the table. The same parameters are shown for 11 cases in which 11 standard implants were placed in Table 2. (Group B)

There was no statistical difference between the two groups in terms of age distribution of the patients. The residual alveolar bone width and height were compared between the two groups and the result was not statistically significant.

When the implant diameters were examined, the length of the implants placed in the first group (in the group of sinus implants) was longer than the second group and this difference was statistically significant. The diameter distribution of the implants was similar between the two groups.

Primary and secondary ISQ values of Group A placed implants and primary and secondary ISQ of implants included in Group B were compared and there was no statistically significant difference between these two groups in terms of these parameters.

No significant difference was found between the two groups in terms of bone loss after 6 months.

The results of the t test were given in the Table 3.Implant length (12 ± 0,00) in the group B implants was statistically higher than the implants in group A (10,36 ± 0,81) ($p \leq 0,001$).

For the other parameters, there was no significant difference between experimental and control groups ($p \leq 0.05$).

Table 1 Sinus implants

	Age	Residuel alveolar bone height	Residuel alveolar bone width	Primer ISQ	6.month ISQ	Implant diameters	Amount of bone loss mm	Success Criteria I SUCCESS II Satisfactory survival IIICompromised survival IV FAİL
1.	55	4, 3 mm	6 mm	55	76	4,0 12	1-1	1
2.	62	4,5 mm	6,3 mm	57	81	4,0 12	0-0	1
3.	57	4,5 mm	5,8 mm	58	78	4,0 12	0,8-07	1
4.	43	5mm	7,2 mm	53	88	4,0 12	1.4-1,3	1
5.	67	5,5 mm	6,3mm	54	89	4,0 12	1.1-1	1
6.	45	4mm	7mm	45	82	4,0 12	0-0	1
7.	71	3,75mm	6,5mm	48	75	4,0 12	0,9-08	1
8.	64	4, 3 mm	6,1mm	55	78	4,0 12	0-0,5	1
9.	65	4mm	8mm	69	88	5,0 12	0-0	1
10.	58	5mm	8,8mm	55	75	4,0 12	0-0	1
11.	67	5,8 mm	9mm	50	80	5,0 12	0-0,1	1

Table 2 Standart implants

	Age	Residuel alveolar bone height	Residuel alveolar bone width	Primer ISQ	6.month ISQ	Implant diameters	Amount of bone loss mm	Success Criteria I SUCCESS II Satisfactory survival IIICompromised survival IV FAİL
1.	49	5,8 mm	6 mm	54	75	4,5 10	0-0	1
2.	67	4,7 mm	6,3 mm	50	80	4,0 10	0,2-0	1
3.	47	4mm	5,8 mm	45	78	4,0 12	1-0	1
4.	53	5,8 mm	7,2 mm	56	73	4,0 10	0,3-0,5	1
5.	59	6 mm	6,3mm	49	85	4,5 12	0-0,4	1
6.	53	4,5 mm	7mm	51	75	4,0 10	0,8-07	1
7.	71	4 mm	6,5mm	58	84	5 10	1-1,5	1
8.	64	5,3 mm	6,1mm	53	78	4,5 10	0-1	1
9.	67	5,8 mm	9mm	68	85	5 10	0-0	1
10.	68	5mm	8,6mm	54	78	4,5 10	0-0,2	1
11.	55	5mm	9mm	51	84	5 10	0,2-0	1

Table 3. Results of t tests between Group A and Group B

		N	Mean	Standart Deviation	p
Residual bone height	Group A	11	5,08	0,73	0,120
	Group B	11	4,60	0,65	
Residualbone weight	Group A	11	7,07	1,23	0,886
	Group B	11	7,00	1,13	
Primer ISQ	Group A	11	53,55	5,96	0,730
	Group B	11	54,45	6,20	
6.Month ISQ	Group A	11	79,55	4,37	0,517
	Group B	11	80,91	5,28	
Implant diameter	Group A	11	4,45	0,42	0,135
	Group B	11	4,18	0,40	
Implant length	Group A	11	10,36	0,81	0,000*
	Group B	11	12,00	0,00	
Bone loss	Group A	11	0,35	0,38	0,522
	Group B	11	0,48	0,52	

*p<0,001

Discussion

Lateral window sinus lifting surgery with simultaneous implant insertion procedures in posterior atrophic maxillae are well-documented techniques in the literature for the rehabilitation of cases with a presence of 5 mm bone between the alveolar crest and the maxillary sinus[8,9]. Furthermore, the recent articles in the literature have reported that these simultaneous implant placement techniques have provided quite successful outcomes even when the residual alveolar bone was shorter than 5 mm. The recent publications have emphasized that the successful outcomes of the sinus lift surgeries, which were performed using the lateral window technique along with the implant placement, have been associated with the alveolar bone width and primer stability rather than the vertical distance between the alveolar crest and the sinus[10].

While the implant survival rates associated with this procedure are over 90% routinely [sinus paper 26,27], the lateral window sinus technique still remains to be a highly sensitive and delicate procedure due to the high risk of complications including Schneiderian membrane perforation and bleeding[11,12].

In 2011, Dr. Kay Pehrsson introduced BoneTrust® Sinus implants. It is estimated that, until today, more than 2000 BoneTrust® Sinus implants have been placed worldwide. BoneTrust® Sinus implants are specifically designed and produced only in a limited variety of sizes, that is, 12 mm long implants with diameters of 4.0 mm or 5.0 mm[6]. The main advantage provided by this special design is that the implant does not detract the graft materials in the region when it is simultaneously placed with the lateral sinus procedure. All clinicians performing this procedure aware of the fact that the implants detract the graft materials with their threads, therefore, they re-apply the graft material after the placement of the implant. Then they perform the graft adaptation through the lateral window again to finalize the augmentation procedure.

Due to its special design in the apical region, bone trust sinus implants are predicted to be friendly to the Schnider membrane and prevent the membrane from being damaged by the implant grooves. Furthermore, thanks to this particular design, it is also claimed that the apical region without a groove will be less aggressive to the graft materials placed through the lateral sinus lift window and will not remove the particles away from the region during insertion of the implant.

The question to which the authors mainly focused on while planning this study was to see how the primary and secondary stability of bone trust sinus implants (which are recommended for use in sinus augmentation regions) will be affected by the presence of the non-grooved apical region of the implant. This study compared primary and secondary stabilities of sinus implants and standard implants by RFA measurements.

Since 1996, numerous works have proven that the RFA analysis system is useful for obtaining an objective assessment of implant stability[13,14]. RFA allows implant monitoring through sequential stability measurements, as well as indirect assessment of the influence of osseous remodeling around the implant on secondary implant stability.

A previous experimental study was planned by inserting bone trust sinus implants. In this study, a total of 88 implants were inserted. The ISQ values were in the ranges of 71-84 for 4-mm-diameter sinus implants, 64-80 for the 4-mm-diameter standard implants, 63-78 for 5-mm-diameter sinus implants, and 64-80 for 5-mm-diameter standard implants. Within the limitations of this in vitro experimental study using cattle ribs, a higher primary implant stability was demonstrated for 4-mm-diameter BoneTrust® Sinus implants compared to Standard BoneTrust® implants[6].

To the best of our knowledge, no controlled clinical studies on bone trust sinus implants have been published yet in the literature.
Our study did not demonstrate a statistically significant difference, between the primary and 6th-month ISQ values of the standard implants group (group A) and sinus implants group (group B).

Despite the short follow-up period, the implant success rates of both groups were 100%. No pain, no findings of exudate, no mobility, or no radiographic bone losses were observed in any of the groups. As regards to mean bone loss, no statistically significant difference was noted between the two groups.

Conclusion

As a conclusion within the limitations of this clinical study, the use of BoneTrust® Sinus implants could present optimal ISQ values during simultaneous implant placements simultaneously with lateral sinus floor augmentation, as suggested by the manufacturer. There is a need for further studies with larger sample sizes and longer follow-up periods to fully evaluate this subject. In addition, the use of this specifically designed implant concurrently with the sinus lift osteotomy technique, which is a frequently used surgical technique, requires further evaluation as regards to the risk of membrane perforation and long-term success rates.

Source of Finance:
None declared

Conflict of Interest:
The authors declare that there are no conflicts of interest.

Authorship Contributions:
CC and TK analyzed and interpreted the patient data NA performed the surgeries and was a major contributor in writing the manuscript. All authors read and approved the final manuscript.

References

1. Morand M, Irinakis T. The challenge of implant therapy in theposterior maxilla: providing a rationale for the use of short implants.J Oral Implantol. 2007;33:257–266
2. Roos J, Sennerby L, Lekholm U, et al. Qualitative and

quantitative method for evaluating implant success: a 5-yearretrospective analysis of the brånemark implant. Int J Oral MaxillofacImplants.1997;12:504–514
3. Yun-Ho K, Na-Rae C, Yong-Deok K. The factors that influence postoperative stability of the dental implants inposterior edentulous maxilla. Maxillofacial Plastic and Reconstructive Surgery 2017; 39:2
4. Stefan L, Johannes YL, Detlef A, et al. Influence of Implant Geometry on Primary Insertion Stability and Simulated Peri-implant Bone Loss:An In Vitro Study Using Resonance FrequencyAnalysis and Damping Capacity Assessment.Int J Oral Maxillofac Implants. 2011;26:347-55.
5. Lachmann S, Jager B, Axmann D, Gomez-Roman G, et al. Resonance frequency analysis and dampening capacity assessment. Part 1: an in vitro study on measurement reliability and a method of comparison in the determination of primary implant stability. Clinical Oral Implants Research. 2006;17:75–79.
6. Aydin G, Mustafa A, Hakan G, et al. A. In vitro assessment of primary stability of Bone trust® sinus implant design: An in-vitro study. International Journal of Periodontics & Restorative Dentistry. 2016;36:731-735.
7. Misch CE, Perel ML, Wang HL, et al. Implant success, survival, and failure: The International Congress of Oral Implantologists (ICOI) Pisa Consensus Conference. Implant Dent 2008;17:5-15.
8. Kutsuyama H, Jensen SS, Chen S, et al. Treatment options for sinus floor elevation. In: ITI treatment guide volume 5: Sinus floor elevation procedures. Chicago: Quintessence Publishing Co. Ltd 2011:33-57.
9. Boyne PJ, James RA. Grafting of the maxillary sinus floor with autogenous marrow and bone. J Oral Surg. 1980; 38:613-616.
10. Soydan SS, Cubuk S, Bayrak B et al. Comparative evaluation of simultaneous maxillary sinus floor elevation and implant placement with residual bone heights greater or less than 5 mm. International Journal of Oral Maxillofac Implants. 2015;30:179-83.
11. Solar P, Geyerhofer U, Traxler H, et al. Blood supplyto the maxillary sinus relevant to sinus floor elevation procedures. Clin Oral Implants Res. 1999;10:34-44.
12. Vercellotti T. Technological characteristics and clinical indications of piezoelectricbone surgery. Minerva Stomatol. 2004;5:207-214
13. Meredith N, Book K, Friberg B, et al. Resonance frequency measurements of implant stability in vivo. A cross-sectional and longitudinal study of resonance frequency measurements on implants in the edentulous and partially dentate maxilla. Clin Oral Implants. 1997;8:226–233.
14. Herrero-Climent M, Albertini M, Rios-Santos JV, et al. Resonance frequency analysis-reliability in third generation instruments: Osstell mentor®. Med Oral Patol Oral Cir Bucal 2012;17:801–806.