Brånemark System Implant Lengths in the Pterygomaxillary Region: A Retrospective Comparison

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Purpose: *Implants that engage the cortical bone of the pterygomaxillary region help restore dentition to the posterior maxilla. However, proper implant length is required. The purpose of this study was to determine if there is a statistically significant difference in the survival rates between different sized implants placed in the pterygomaxillary region.*

Materials and Methods: *All Brånemark System 4.0-mm-diameter implants delivered into the pterygomaxillary region in a single private practice were separated into 7- to 13-mm and 15- to 18-mm groups by retrospective patient chart review. Cumulative survival rates (CSR) were calculated.*

Results: *Of all implants delivered, 930 of the 992 osseointegrated for a CSR of 93.75%. Fifty-nine of the 67 implants in the 7- to 13-mm grouping and 871 of the 925 implants in the 15- to 18-mm grouping osseointegrated for CSRs of 88.06% and 94.16%, respectively. The results were statistically significant (*$P < 0.05$*).*

Conclusions: *The results suggest that increased implant length in the pterygomaxillary region may result in higher osseointegration rates. The implant apex better engages the cortical bone between the medial and lateral pterygoid plates and therefore increases primary and secondary stability. (Implant Dent 2013;22:610–612)*

Key Words: posterior maxilla, pterygoid, implant apex, implant stability, osseointegration

Engagement of an implant apex into the dense bone of any anatomical region is of utmost importance for initial implant stability and longevity.[1] According to Adell,[2] the cortical linings of the midface—the canine, zygomatic, and pterygoid areas—provide the best conditions for initial implant stabilization. One study[3] demonstrated the use of the very thin cortical lining of the nasal cavity and maxillary sinus to deliver implants to that region. Although the implants penetrated the bone wall of the nasal cavity, strong initial stabilization was achieved.

The pterygomaxillary "region" consists of 3 separate anatomical landmarks: the tuberosity of the maxilla, pyramidal process of the palatine, and the lateral pterygoid process of the sphenoid.[1] Only the pyramidal and pterygoid processes consist of dense cortical bone.[4] Thus, these 2 areas are the ideal implant receptor sites to achieve initial implant stability and provide the foundation for fixed posterior dentition.[5]

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Over the years, clinicians have been experimenting with various different implant sizes in the pterygomaxillary region. Implants of the proper length that achieve osseointegration are able to provide adequate support to restore posterior dentition. This replaces alternate treatment methods such as posterior cantilevers,[6] supplemental bone grafts, the use of a large number of implants,[7] and sinus augmentations.

The purpose of this retrospective study was to examine all Brånemark System (NobelBiocare, Yorba Linda, CA) 4.0-mm-diameter implants placed in the pterygomaxillary region in a single private center and to determine if there is a statistically significant difference in the cumulative implant survival rates between the different 4.0-mm-diameter lengths. It is hypothesized that longer implants will be able to fully engage the dense cortical bone that exists in and near the pterygoid plates, thereby producing higher cumulative survival rates (CSRs).

MATERIALS AND METHODS

A retrospective chart review was performed with all patients who received the 4.0-mm-diameter Brånemark System implants (NobelBiocare) into the pterygomaxillary region in a single

private practice (PI Dental Center, Philadelphia, PA). Inclusion criteria consisted of any 4.0-mm-diameter Brånemark System implant placed in the practice since the clinical inception of the pterygomaxillary implant protocol (September 1985). All implants were classified into 2 different length groups: 7 to 13 mm and 15 to 18 mm. Separation into each group was conducted by the observation of postoperation radiographs and clinical notes. Life tables were constructed to determine the CSR. Analysis of variance was performed to compare the significance in the CSRs between the length groups. Implant surface and loading protocol were neglected as variables in this study. The investigators of this report desired to solely analyze the influence of implant length on implant survival in the pterygomaxillary region.

Table 1. CSRs for the 7- to 13-mm Group

Period	Implants	Failures	Survival Rate, %	CSR, %
0–3 mo	67	0	100.00	100.00
3–6 mo	66	2	96.97	97.01
6–9 mo	64	1	98.44	95.52
9–12 mo	63	1	98.41	94.03
1 y	62	1	98.39	92.54
2 y	58	0	100.00	92.54
3 y	58	0	100.00	92.54
4 y	58	0	100.00	92.54
5 y	58	0	100.00	92.54
6 y	43	3	93.02	88.06
7 y	37	0	100.00	88.06
8 y	34	0	100.00	88.06
9 y	32	0	100.00	88.06
≥10 y	25	0	100.00	88.06

Table 2. CSRs for the 15- to 18-mm Group

Period	Implants	Failures	Survival Rate, %	CSR, %
0–3 mo	925	5	99.46	99.46
3–6 mo	920	27	97.07	96.54
6–9 mo	888	9	98.99	95.57
9–12 mo	875	3	99.66	95.24
1 y	855	7	99.18	94.49
2 y	768	1	99.87	94.38
3 y	723	1	99.86	94.27
4 y	638	0	100.00	94.27
5 y	524	0	100.00	94.27
6 y	402	0	100.00	94.27
7 y	286	0	100.00	94.27
8 y	207	0	100.00	94.27
9 y	148	1	99.32	94.16
≥10 y	119	0	100.00	94.16

RESULTS

Of the 4.0-mm-diameter Brånemark System implants placed in the pterygomaxillary region, 930 of the 992 successfully osseointegrated, resulting in a CSR of 93.75%. When separated by implant length, the 7- to 13-mm grouping (Table 1) had 59 of the 67 (88.06%) pterygomaxillary implants osseointegrate. The 15- to 18-mm grouping (Table 2) had a survival rate of 94.16% ($n = 925$), approximately six percentage points higher than the 7- to 13-mm division. This difference was found to be statistically significant ($P < 0.05$).

DISCUSSION

Posterior maxillary support for a fixed prosthesis can be achieved by placing implants into the cortical bone of the pterygomaxillary region. Multiple factors need to be taken into account to achieve initial stabilization, rapid osseointegration, and long-term support for the restored dentition. Previous research[4,5,8–10] has proven the importance of factors such as implant surface and the protocol used for delivery. Apical engagement into the dense cortical bone also plays a crucial role in initial implant stability and the ability to immediate load said implant. However, penetrating these cortical plates requires the proper implant length.[2] Thus, proper understanding of the anatomical region and identification of the dense cortical bone structures in each patient will allow the operator to choose an implant length that will achieve stability in the pterygomaxillary region.

This study found that implants in the 15- to 18-mm group had a CSR six percentage points higher (94.16%) than and statistically significant to the 7- to 13-mm group (88.06%). These results suggest that longer implants, which are better able to fully engage the cortical plates found in the pterygomaxillary region, may play a role in increased survival rates of implants in this region.

The findings of this study are justified because the anatomy of the pterygomaxillary region favors a longer implant. The pyramidal process of the

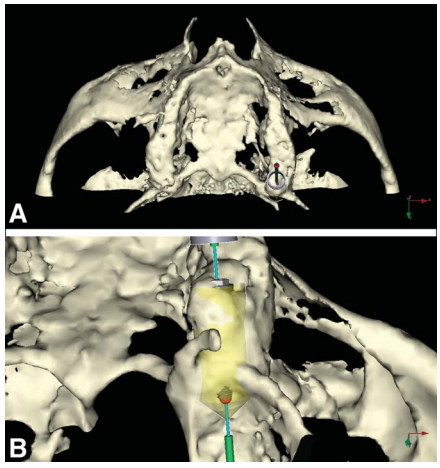

Fig. 1. A, Occlusal view of maxillary arch depicting a Brånemark implant placed in the pterygomaxillary region (Nobel Clinician; NobelBiocare). **B**, Zoomed-in view of the pterygomaxillary region depicting apical penetration through the cortical plates (Nobel Clinician; NobelBiocare).

palatine and lateral pterygoid plate of the sphenoid are located behind and slightly medial to the maxillary tuberosity.[11] To achieve the desired stability, an implant must transverse the tuberosity for the apex to engage the cortical plates. Implants that are placed solely in the tuberosity usually require a wider diameter implant for more support because there is a high presence of cancellous bone in that region.[1] Yet, only engaging the tuberosity is not a recommended treatment plan for achieving stability in the posterior region.

Penetration through the cortical pterygoid plates with the implant apex should also be considered as a proper method to achieve high osseointegration rates. In a 1984 study,[3] Brånemark et al noted that implants that encroach upon the nasal or sinus floor cause no undesirable side effects during healing and maintain their anchorage during load. The investigators of this report believe that similar conclusions can be made for the pterygomaxillary region. The apex of a Brånemark implant is narrower in diameter than the rest of the body. As the apex is driven 1 to 2 mm through the dense plates (Fig. 1, A and B) and exposed, the implant surface area increases in the limited dense bone that exists. Thus, the increased bone to titanium interface should produce higher primary and secondary stabilization.

With regard to biomechanical forces, all the pterygomaxillary implants placed in this single private center were splinted with other implants. This splinting effect causes a distribution of the functional loads between all implants in the prosthesis. Loading the pterygomaxillary implant alone would provide a biomechanically unfavorable advantage due to the angulation of implant placement in relationship to the occlusal plane.

Surgical safety issues in this region also need to be addressed as they are often misconceived. According to Graves,[4] there are no anatomically significant structures found in the pterygomaxillary region. The maxillary nerve and terminal branches of the internal maxillary artery travel through the sphenopalatine fossa,[12] located approximately 10 to 15 mm superior and lateral to the intended implant apex location. Thus, no vital structures are threatened when implants are placed inferior to the sphenopalatine fossa. This study had no surgical complications aside from implant failures that were due to the loss of osseointegration.

CONCLUSION

Engagement of an implant apex into dense cortical bone is necessary to provide strong initial stability. The medial and lateral cortical plates in the pterygomaxillary region allow such stability in the maxillary posterior but require the proper implant length. The Brånemark System 4.0-mm-diameter 15- to 18-mm implant group had a statically higher CSR than the 7- to 13-mm group in the pterygomaxillary region. This implies that a longer implant fully engages the cortical plates, producing the ideal biomechanical scenario to restore posterior dentition to the patient.

DISCLOSURE

T. J. Balshi and S. F. Balshi disclose that they have received payments and honoraria for lectures from NobelBiocare.

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