Original Research

Clinical Parameters and Crestal Bone Loss in Internal Versus External Hex Implants at One Year after Loading

HamidReza Arab [1], Amir Moeintaghavi [2], Naser Sargolzaei [1], MajidReza Mokhtari [3], Mohammad Derhami [4], Sepideh Arab [5], Javad Moosavi [5]

[1] Associate Professor of Periodontics, Dental Research Center, Mashhad University of Medical Sciences, Mashhad, Iran
[2] Professor of Periodontics, Dental Materials Research Center, Mashhad University of Medical Sciences, Mashhad, Iran
[3] Assistant Professor of Periodontics, Dental Research Center, Mashhad University of Medical Sciences, Mashhad, Iran
[4] Prosthodontist
[5] Dentist

Received 9 December 2015 and Accepted 6 March 2015

Abstract

Introduction: The survival of an implant system is affected by the choice of antirotational design, which can include an external or internal hex. Implant success also is affected by the maintenance of the crestal bone around implants. The aim of present study was to evaluate the crestal bone loss and clinical parameters related to bone loss in patients loaded with an external or internal hex 3i implant (3i Implant Innovation, Palm Beach Gardens, FL, USA). The evaluations were performed one year after loading. **Materials and Methods:** A total of 39 implants (23 external hex, 16 internal hex) were placed randomly in 23 patients (10 male, 13 female) by a submerged approach. None of patients had compromised conditions or parafunctional habits. At placement and at one year after loading, periapical radiographs were taken via the parallel method from the implant sites. **Results:** Crestal bone loss was -0.712±0.831 mm in implants with an internal hex connection and -0.139±0.505 mm in implants with an external hex connection ($P \leq 0.05$). No correlation was found between crestal bone loss and parameters such as age, gender, jaw, implant location (anterior, premolar, or molar), implant diameter, or implant length. **Conclusions:** Crestal bone loss was greater in patients with internal hex 3i implants than in those with external implants. Similar results in other clinical factors were found between the groups.

Key words: Implant, crestal bone loss, internal and external hex connections.

Arab HR, Moeintaghavi A, Sargolzaei N, Mokhtari MR, Derhami M, Arab S, Moosavi J. Clinical Parameters and Crestal Bone Loss in Internal Versus External Hex Implants at One Year after Loading. J Dent Mater Tech 2015; 4(3): 151-4.

Introduction

The use of dental implants has completely changed dental treatment restorative modalities. Dental implants can avoid natural teeth preparation adjacent edentulous areas, preserve residual hard and soft tissues, and ensure acceptable functions and aesthetic outcomes. One structural parameter among various implant systems is the choice of antirotational design, which may appear as an external or internal hex. These designs affect the implant survival rate. Another important factor influencing implant success is the maintenance of the crestal bone around implants (1,2). The aim of the present study was to evaluate the crestal bone loss one yearafter loading and clinical parameters related to bone loss in patients loaded with external or internal hex implants.

Materials and Methods

Patients

In this retrospective study which was performed in a private office in Mashhad ,Iran from 2010-2011, a total of 39 implants (3i Implant Innovation, Palm Beach Gardens, FL, USA), including 23 external and 16 internal hex, were placed randomly in 23 patients (10 male, 13 female) aged 18-66 years. A 2-stage approach was used for all patients.

Inclusion criteria:

1. Patients with single, partial, or full-mouth edentulous areas;

2. All Patients provided with written informed consent.

Exclusion criteria:

History of systemic disease, such as diabetes, cardiovascular disorder, autoimmune disease, or malignancy;

History of radiotherapy or chemotherapy;

Smoking, alcohol, or drugs;

Any parafunctional habit, such as bruxism or clenching.

Patients were evaluated clinically and radiographically at the time of implant placement and at one year after loading. Patients were referred to a private radiology center. The parallel method was used for all patients. The X-ray source was Planmeca (Finland), and radiographs were exposed at 64 KV (p), 8 µA, for 0.32 s. Agfa number 2, E-F speed was used. The developer was automatic Peri-Pro air. A Kerr film holder (Germany) was used to provide the same film position and X-ray angulation for all radiographs.

To evaluate crestal bone loss, the distance between the implant shoulder and the first contact between the implant and bone was measured at the mesial and distal locations by means of a caliper, which had a rated accuracy of 0.1 mm and the mean number was recorded. Negative scores were interpreted as bone loss and positive scores as bone gain. To minimize any elongation or shortening, all image measurements were calibrated with the original implant length. Measurements were performed by a radiologist who was blinded to the hex implant type.

Statistical Analysis

A statistical software package (SPSS16) was used for the statistical analysis. Independent *t*-test was conducted to assess the mean difference of bone loss and the effect of gender and jaw type between the 2 groups. One-way analysis of variance (ANOVA) was used to determine the effect of implant location, implant length, and diameter of crestal bone loss between the 2 groups. Since it was found that diameter had no significant effect on bone loss of either internal or external hex implants, for the comparison of internal and external hex implants the diameter factor was not entered and an independent sample t test was judged to be sufficient. Chi square test was conducted to assess the relationship between gingival tissue inflammation and the implant type (internal\external).

Results

Table 1 presents the amount of bone loss relative to various parameters (gender, jaw type, and implant location, length, and diameter). Table 2 shows mean and standard deviation of bone loss among internal hex and external hex implants.

The mean bone loss in the internal hex group was 0.712±0.831 mm and in the external hex group was 0.139±0.505 mm ($P \leq 0.05$).The BOP Index(Bleeding on Probing) was 52.6% in the internal hex group and 46.2% in the external hex group respectively(P=0.7). The mean plaque index alterations in the internal and external hex groups were 0.750±0.577 and 0.782±0.736, respectively ($P \geq 0.05$). The mean keratinized tissue changes in the internal and external hex groups were 0.469±0.464 mm and 0.217±0.364 mm, respectively ($P \geq 0.05$) and the mean probing depth in the internal hex implants was 2.63±0.45 mm and in the external hex 2.38±0.44 mm respectively(P=0.1).

Table 1. Relationship between crestal bone loss and different variations in patients treated with internal or external hex implants

Variation	Subgroup	Internal Hex			External Hex		
		Mean	S.D	*P*-value	Mean	S.D	*P*-value
Gender	Female	-0.575	0.910	0.41	-0.140	0.520	0.99
	Male	-0.941	0.692		-0.138	0.516	
Jaw	Maxilla	-1.05	0.992	0.16	-0.144	0.262	0.97
	Mandible	-0.450	0.616		-0.337	0.606	
Implant location	Upper anterior	-0.958	1.054	0.49	-0.87	0.118	0.87
	Lower anterior	----	----		-0.129	0.614	
	Upper premolar	-1.6	0		-0.425	0.460	
	Lower premolar	-0.367	0.34		0.2	0.212	
	Upper molar	----	----		0.025	0.035	
	Lower molar	-0.492	0.745		-0.258	0.711	
Implant length	1o mm	-1.35	1.310	0.16	0	0	0.77
	11.5mm	-1.225	1.025		-0.145	0.517	
	13 mm	-0.445	0.578		----	----	
Implant diameter	3.25mm	-0.5	0.443	0.11	-0.308	0.354	0.59
	3.75 mm	----	----		-0.111	0.626	
	3.4 mm	-1.2	0.687		-------	----	
	4 mm	-0.271	0.527		0.025	0.029	
	4.5 mm	-1.6	1.697		----	----	

Table 2. Comparison of crestal bone loss in internal and external hex implants

	Internal	External
Mean Bone Loss	-0.712	-0.139
Standard Deviation	0.831	0.505
Independent t test	*P* value = 0.01; t =-2.46	

Discussion

Several studies have compared internal and external hex designs, revealing that stresses with the internal hex implant are more pronounced in the apical region (1) and abutment structure (1,4) and less pronounced in the bone compared to the external hex implant (1,3). No significant difference in abutment loosening has been found between internal and external hex implants (5,6). The present study showed that crestal bone loss in the internal hex implants was greater than that in the external hex group. This result may be related to greater stress concentrations in the internal hex implants; however, further investigations need to be conducted to confirm or reject this association.

Consistent with our findings, Dao et al. found no relationship between crestal bone loss around implants with age or gender (7). We observed no relationship between peri-implant mucositis and plaque index alterations in either group, consistent with previous investigations (8,9). In contrast to our findings, Teixeira et al. showed that tissue inflammation can affect the amount of bone loss, (10) while Van Steenberghe et al. reported a correlation between implant failure and plaque index (11). Tang et al. also reported a relationship between factors inducing bone loss and plaque-induced inflammation (12).

In agreement with the present study results, Romeo et al. reported no relationship between the jaw (maxilla and mandible) and bone loss in either group (13). However, Block et al. indicated that the second molar region has more complications after implant insertion, (2) and Becker et al. reported poorer cumulative success rates for posterior than for anterior implants (14). We found no difference in bone loss around implants placed in different regions. Consistent with the present results, Quirynen et al. showed no relationship between implant length and bone loss (9), while Strong et al. found that bone loss was greater around implants with narrow bodies.

Conclusion

Crestal bone loss was greater in patients treated with internal hex 3i implants than in patients with external implants, although the two groups showed similar results in other clinical factors.

References

1. da Silva EF, Pellizzer EP, Quinelli Mazaro JV, Garcia Junior IR. Influence of the connector and implant design on the implant - tooth - connected prostheses. Clin Implant Dent Relat Res 2010;12(3):254-62.
2. Balfour A, O'Brien GR. Comparative study of antirotational single tooth abutments. J Prosthet Dent 1995; 73(1):36-43.
3. Chun HJ, Shin HS, Han CH, Lee SH. Influence of implant abutment type on stress distribution in bone under various loading conditions using finite element analysis. Int J Oral Maxillofac Implants 2006; 21(2):195-202.
4. Maeda Y, Satoh T, Sogo M. In vitro differences of stress concentrations for internal and external hex implant-abutment connections: A short communications. J Oral Rehabil 2006; 33(1):75-8.
5. Piermatti J, Yousef H, Luke A, Mahevich R, Weiner S. An in vitro analysis of implant screw torque loss with external hex and internal connection implant systems. Implant Dent 2006; 15(4):427-35.
6. Pessoa RS, Muraru L, et al. Influence of implant connection type on the biomechanical environment of immediately placed implants - CT - nonlinear, three-dimensional finite element analysis. Clin Implant Dent Relat Res 2009 May 7. [Epub ahead of print].
7. Dao TT, Anderson JD, Zarb GA. Is osteoporosis a risk factor for osseointegration of dental implants?. Int J Oral Maxillofac Implants 1993; 8(2):137-44.
8. Abreu MH, Bianchi MA, Magini RS, Rosing CK. Clinical and radiographic evaluation of periodontal and peri - implant conditions in patients with implant - supported prosthesis. Acta Odontol Latinoam 2007; 20(2):87-95.
9. Quirynen M, Naert I, et al. Periodontal aspects of osseointegrated fixtures supporting on overdenture. A 4 - year retrospective study. J Chin Periodontol 1991; 18(10):719-28.
10. Teixeira ER, Sato Y, Akagawa Y, Kimoto T. Correlation between mucosal inflammation and marginal bone loss around hydroxyapatite - coated implant: A 3 - year cross sectional study. Int J Oral Maxillofac Implants 1997; 12(1):74-81.
11. Van Steenberghe D, Klinge B, et al. Periodontal indices around natural and titanium abutments: A longitudinal multicenter study. J Periodontol 1993; 64(6):538-41.
12. Tang Z, Sha Y, et al. Peri - implant mucosal inflammation and bone loss. Clinical and radiographic evaluation of 108 dental implants after 1 year- loading. Chin J Dent Res 2002; 3(2):15-20.
13. Romeo E, Lops D, Margutti E, Chisilfi M. Long term survival and success of oral implants in the treatment of full and partial arches: A 7-year prospective study with ITI dental implant system. Int J Oral Maxillofac Implants 2004; 19(2):247-59.
14. Becker W, Becker BE, Alsy wyed A. Long term evaluation of 282 implants in maxillary and mandibular molar positions: A prospective study. J Periodontol 1999; 70(8):896-901.
15. Strong JT, Misch CE, Bidez MW, Nalluri P. Functional surface area: Thread form and diameter optimization for implant body design. Compendium Special Issue 1998; 19(3):4-9.

Corresponding Author:
Majid Reza Mokhtari,
Assistant Professor of Periodontics, Dental Research Center,
Mashhad University of Medical Sciences, Mashhad, Iran
E.mail: Mokhtarimr@mums.ac.ir