CORPUS PUBLISHERS

Corpus Journal of Surgery (CJS)

Volume 1, Issue 1, 2022

Article Information

Received date : 03 January, 2022

Published date: 19 January, 2022

*Corresponding author

Carlos M. Cobo Vázquez , Plaza Ramón and Cajal, Department of Medicine and Circuit Bucofacial. Faculty of Odontología, Universidad Complutense of Madrid, 28040 Madrid, Spain.

Key Words

Dental Implant; Internal Connection; External Connection; Marginal Bone Loss

Review Article

Management of Fixed Rehabilitation of Single Implants in the Aesthetic Sector: A Systematic Review

Francesco D'Auria[1], Pedro Molinero-Mourelle[2], Gianmario Schierano1, Cristina Meniz-García[3], Juan López-Quiles[3], Carlos M Cobo-Vázquez[3,4*]

[1]*Assistant Dentist, DDS, MSc, Department of Surgical Sciences. Faculty of Dentistry. University of Turín, Italy.*

[2]*Assistant Dentist, DDS, MSc, Department of Reconstructive Dentistry and Gerodontology, School of Dental Medicine, University of Bern, Bern, Switzerland.*

[3]*Associate Professor, DDS, MSc, PhD, Department of Medicine and Orofacial Surgery. Faculty of Dentistry. Complutense University of Madrid, Madrid, Spain.*

[4]*Associate Dentist, Department of Dentistry and Stomatology, Gregorio Marañón University General Hospital, Madrid, Madrid, Spain.*

Abstract

Introduction

When dental implants are installed and subjected to functional loads, marginal bone resorption is frequent, also in sites not affected by peri-implantitis, and it can be a critical factor that will affect the aesthetics and longevity of the implant because it is associated with an increased risk of peri-implantitis and soft tissue collapse.

Objective

To assess the peri-implant marginal bone loss and the survival percentage of implant restorations that present internal and external prosthetic connections.

Material and methods

A systematic review of the literature was carried out. Various information sources were consulted such as PubMed, Embase, Ovid, Scopus databases. For the search process, the methodology approved by the PRISMA Guide was followed.

Results

5 articles were found that met the established criteria. In these articles, 2,866 patients rehabilitated by means of 6,455 implants were registered, of which 3,057 were restored with an external hexagonal prosthetic connection and 3,398 with an internal connection of the hexagonal or conometric type. The 3,057 implants prosthetized by connection to an external hexagon showed a mean peri-implant marginal bone loss of 0.986 ± 0.58mm. The 3,398 implants prosthetized by means of an internal hexagon or conometric type connection highlighted a mean peri-implant marginal bone loss of 0.86 + - 0.43mm.

Conclusion

Taking into consideration the individual characteristics of each patient and each situation, the literature seems to indicate that on the intensity of the mechanical stress and the tensions emitted to the peri-implant region, the conical connection and the cylindrical design of the implant transmit less stress to the cortical bone. Bone with respect to the external hexagonal connection and the conical design of the implant, which transmit less stress and tension to the trabecular bone and more to the cortical bone.

Introduction

An implant treatment can be considered successful only if it reaches a certain range of physiological, functional and aesthetic criteria, of which the stability and duration of osseointegration, the absence of pathological processes and an aesthetic that satisfies the expectations of the patient. Have developed thousands of new implant designs, materials and surface technologies to further improve the outcome of implant-prosthetic treatment. When dental implants are installed and subjected to functional loads, marginal bone resorption is frequent, also in sites not affected by peri-implantitis, and it can be a critical factor that will affect the aesthetics and longevity of the implant because it is associated with a risk increased peri-implantitis and soft tissue collapse. According to the literature, marginal bone resorption, after implant positioning, is noteworthy to be influenced by the implant design and the surrounding environment and is estimated to be approximately 0.9-1.5mm throughout the first year of loading and 0.1-0.2mm each following year. The variations in the marginal bone level around the implant are considered as a multifactorial phenomenon that has not yet been fully clarified. Among the correlated factors, the biomechanics related to the implant head have been actively analyzed, among them the type of implant (one-piece vs. two-pieces), the change of platform (platform switching), the position of the microgaps and the type of implant connection. The presence of a microgap present at the implant-prosthetic abutment interface is an important factor from a mechanical and bacteriological point of view; marginal bone resorption is verified due to micromotion at the microgap site resulting from an insufficient amount of mucosa adhered by A self-defense mechanism against external stimuli, this dynamic can be considered similar to the problems caused by insufficient biological amplitude of a natural tooth. Once the implant has received its functional load, due to the absence of the periodontal ligament, the marginal bone area that surrounds the implant neck suffers a high concentration of stress that causes micro-injuries and represents the first step in the beginning of bone reabsorption. Considering the type of implant connection, an implant can generally be classified into two types: implant with external connection and implant with internal connection. External connection is the most frequent and performant form is that of a hexagon placed above the implant platform. This design was developed to facilitate the positioning of prosthetic components such as prosthetic abutments and transfers, providing an antirotational capacity of the elements. The weak point of this system is attributed to the limited height of the hexagon, which when subjected to high occlusal loads can cause micro movements of the prosthetic abutment, loosening, and in some cases fracturing, the screw, but it allows to cushion the stress of chewing. Due to the internal as well as the external connection, the most frequent and performant is the hexagonal one located inside the implant. In the family of internal connections there is the conical connection design (Morse cone) which, as the name suggests, is characterized by an inverted internal cone geometry that leads to a self-locking mechanism between the implant and the abutment. prosthetic. It was introduced by the International Team for Implantology (ITI) and has attracted many professionals over the years for its mechanical stability. It has been shown that with the internal conical connection the stress is transmitted to the most apical area of the implant while the stress on the marginal bone is reduced with respect to that caused by the sternal connection [1]. Recent studies have shown that with the internal connection the axial compression forces could increase the axial displacement of the prosthetic abutment causing complications such as the fracture of the coronal portion of the implant if subjected to significant occlusal loads [1]. Additional factors such as an unsuitable implant dimension, imprecise screwing, fatigue of the implant material or manufacturing defects can play a very important role in the failure of the implant connection. Implant success depends on biomechanical and aesthetic factors that often depend on the type of connection chosen. Once the osseointegration procedure has been carried out, the success of prosthetic rehabilitation will depend on the stability of the implant connection system. As previously explained, it has been established that other factors, behind the connections, can contribute to the increase in the extent of marginal bone loss, such as surgical trauma at the time of implant insertion, biological width, lack of an adaptation passive of the prosthetic structures on the implant, microgap between implant and prosthetic abutment, occlusal overload and implant surface. Although the two types of connection have different characteristics, both systems show a similar success rate considering all mechanical, biological and aesthetic factors;

However, the maintenance of the marginal bone level is higher around an internal connection, in addition, among the types of internal connection, the conic seems to be the most efficient in terms of bacterial sealing, bone loss and prosthetic stability. The literature indicates that the type of implant-prosthetic abutment connection can affect the stresses and stress induced in the peri-implant crestal bone [2]. In vitro experiments were carried out with implant bodies incorporated in resin blocks using external hexagons, internal hexagons and internal Morse taper systems. It was found that the mechanical stress transmitted to the peri-implant bone varied significantly based on the type of implant-prosthetic abutment connection [1]. The analyzes of the finished elements foresee that the distribution of stress in the periimplant bone differs with the type of implant-prosthetic abutment connection, and it has been shown that increasing the thickness of the internal wall of the implant body or reducing the width of the implant-prosthetic abutment connection reduces stress on the peri-implant bone [3]. The crestal bone change did not differ significantly between the types of implant prosthetic abutment connections, but was slightly greater when an external hexagon connection was used with respect to the internal hexagon and internal morse cone, during the healing phase (before surgery). functional load) with respect to the load phases. These results are similar to those of Enkling et al. (2011), who found that peri-implant crestal bone modification was slightly greater during the healing phase relative to implant loading. Different factors could ipothetically induce alterations in the crestal bone, including surgical trauma, occlusal overload, peri-implantitis, microgap, biological space, and the crest module of the implant used [4]. The factor tested in the present study was the connection of the secondary healing component in the second phase. It is very likely that changes in the crestal bone prior to occlusal loading derive from surgical trauma to the bone surrounding the implant when a healing screw is installed in the second phase of the intervention. It is well noted that crestal bone resorption during the first year should be less than 1.5mm.

The biological space is significantly greater for two-piece implants compared to one piece implants, and this has been attributed to the existence of a microgap (interface) at or below the bone crest [5]. Some scientists have indicated that the peri-implant bone level can be affected by the biological space and that this dimension varies according to the implant design. Future research would have to conduct randomized controlled clinical trials with customized perpendicular supports and test the effects of the type of connection between implant and prosthetic abutment at the level of the peri-implant bone to determine if the biological width around the implants exerts significant effects on bone changes. The biomechanical behavior of implants has been the object of research both in the dental and engineering fields with the aim of offering a high success rate in partially or totally edentulous rehabilitation of patients. Although the success rate varies in different areas of the oral cavity and in different patients, the lowest success rates have been associated with implants installed in the posterior maxilla and in sites characterized by a thin cortical bone or by low trabeculation. Density.

The challenge to improve this scenario highlights how scientific research attempts to identify the macro implant design parameters involved in the magnitude of stress and tensions. Excessive occlusal loads can induce micro-damages along the bone-implant interface, implant fracture, screw loosening or bone resorption. In this context, the prosthetic connection and the shape of the implant body would play a highly relevant role in dissipating stress and tension that compromise osseointegration [5].Depending on the type of load, the bone tissue will respond differently. Mechanical stress is considered the most damaging force on the bone. Stresses damage the bone-implant interface because they cause micro movements that lead to failure of osseointegration. By varying the prosthetic connection and the shape of the implant body, the force can change in intensity, concentration and distribution. Studies have been carried out to analyze these parameters in high-density bone, others to assess the parameters of implant macro-design in low-quality bone. The type of prosthetic connection affects mechanical stress and tension in both the cortical and cancellous bone, while the implant body shape only affects the trabecular bone. The type of connection to the external hexagon has been associated with greater resorption of the crestal bone due to greater stress generated in the cervical area of the implant, greater micromotion of the prosthetic abutment and formation of microgaps that lead to inflammation of the peri-implant tissue [5,6]. This microgap present at the crestal bone level is subject to bacterial colonization of the implant-prosthetic abutment interface of the external hexagon. Inflammation acts as a chronic factor that causes an apical movement of the biological space by the crestal bone and the external hexagonal connection provides three times more mechanical stress and tensions to the cortical marginal bone with respect to the Morse conometric connection, with consequent risk of loss. Bone around the implant neck especially in the posterior regions of the maxilla with low bone quality. This type of connection system would produce repeated micro movements between the parts during clinical function, contributing to an accumulation of bacteria, localized inflammation and bone reabsorption [6]. The micro movements that are produced are due to the reduced height of the hexagon and the screw of the prosthetic abutment responsible for himself to maintain the implant-abutment interface. The lower values of tension and mechanical stress produced by the conometric internal connection can be explained by the differences between the surface of the internal conical interface and the straight interface with reduced dimensions of the hexagon of the external connection system. The conometric connection better dampens the mechanical friction between the internal wall of the implant and the external wall of the prosthetic abutment, also avoiding the rotation of the latter, therefore the lateral wall of the prosthetic abutment helps to dissipate the vertical forces on the implant, transmitting less Stress and tension in the cervical area contributing to crestal bone preservation [7]. Implants restored with the concept of platform switching, using a conometric connection such as the Morse cone design, produce a better adaptation of the prosthetic abutment, better stability and sealing, and less concentration of stress on the peri-implant bone 8. This biomechanical performance would explain the differences between the external and conometric hexagon connection with the relative models of bone loss in clinical situations. The mechanical stress and the tensions are transmitted with a greater concentration to the apex of the implant and in the trabecular bone with a conometric connection, while the external hexagon contributes greater stress in the cervical area of the implant and then transmits greater tensions in the cortical bone, independently. implant body shape [1]. The type of design of the implant body affects stress only in the trabecular bone, cylindrical implants induce less mechanical stress and tensions with respect to the conical ones that, although they present a better primary stability, increase the stress on the surrounding bone and can cause greater bone loss when installed with a high torque [1]. Cylindrical implants are more associated with low stress transmitted to the trabecular bone and with greater bone preservation. Also, the threads of the implant body play an important role in the bony changes around the implant, which according to the design could disguise the real effects of the implant body shape in the dissipation of stress. Very deep threads in a conical implant body can reduce the stress transmitted to the trabecular bone by increasing the interface between bone and implant.

Biomechanical studies have also shown that non-axial loads on a restoration supported by a single implant affect stress distribution when compared to axial loads, with a greater increase in stresses and strains in the peri-implant bone due to the components of the implants. lateral forces and at the moment of the latter. Among the mechanical properties, resistance to fracture or in other words load capacity is considered one of the most important characteristics of implant components. Static fracture tests are commonly performed to determine the strength of prosthetic abutments but they do not actually simulate chewing function because certain factors such as time and environment are locks in these tests. Ideally an in vitro test should simulate the clinical situation in the most similar way possible then it would have a high significance. These requirements are best met by fatigue tests where implant components are subjected to cyclic loads, although the dental literature does not present controlled and standardized cases for such load conditions in implantology. Although static fracture tests can help verify the durability of implant components, one of the main causes of structural failure in implantology is often the consequence of fatigue. Regarding the type of material of the prosthetic abutment, it seems that titanium and zirconia show similar resistance to fracture after cyclical loads, while the prosthetic abutments internally connected to the implant seem to highlight greater resistance to fracture with respect to those provided with external connection.

Methods

We followed the guidance from the PRISMA (Preferred Reporting Items of Systematic Reviews and Meta-Analyses) Checklist to report this systematic review (Hutton et al.
2015).

Inclusion Criteria & Focused question

1. Types of Studies. Previous systematic reviews, Meta-analyses, controlled clinical trials, perspectives, retrospective and case-control studies.
2. Population. Edentulous patients with dental implants.
3. Intervention. Implant-prosthetic rehabilitation with internal or external implant connection.
4. Comparison. Internal implant connection and external implant connection.
5. Results. Evaluation of peri-implant bone resorption according to implant connection. The focused question of this systematic review was: what is the best dental implant connection for rehabilitations, in terms of peri-implant bone resorption.

Exclusion Criteria

Studies with patients with follow up lower than 5 years. Studies in smokers of more than 10 cigarettes per day, with deficient plaque control (O'Leary plaque index> 25%), presence of active periodontal disease, presence of systemic disease affecting oral mucosa, presence of parafunctional habits, uncontrolled diabetes, presence of acute infection on the extracted tooth, a history of radiotherapy or osteoradionecrosis or any other condition that affects bone metabolism.

Search Strategy

Studies were identified by entering the following search terms: ("2009/06/05"[PDat]

"2019/06/02"[PDat] AND "humans"[MeSH Terms]) ("dental implants"[MeSH Terms] OR

("dental"[All Fields] AND "implants"[All Fields]) OR "dental implants"[All Fields] OR ("dental"[All Fields] AND "implant"[All Fields]) OR "dental implant"[All Fields]) AND (internal[All Fields] AND connection[All Fields]) AND (external[All Fields] AND connection[All Fields]) (marginal[All Fields] AND ("bone diseases, metabolic"[MeSH

Terms] OR ("bone"[All Fields] AND "diseases"[All Fields] AND "metabolic"[All Fields]) OR "metabolic bone diseases"[All Fields] OR ("bone"[All Fields] AND "loss"[All Fields]) OR "bone loss"[All Fields])).

The search was complemented by manual search on selected journals such as: *"Journal of Dental Research", "Journal of Oral and Maxillofacial Implants", "Clinical Implant Dentistry and Related Research", "Clinical Oral Implants Research", "The journal of Oral and Maxillofacial Surgery", "The International Journal of Oral and Maxillofacial Surgery",*

"Journal of Craniofacial Surgery", "British Journal of Oral and Maxillofacial Surgery",

"Oral Surgery Oral Medicine Oral Pathology Oral Radiology and Endodonology",

"Medicina Oral Patología Oral y Cirugía Bucal", "Journal of Periodontology", "Implant

Dentistry", "Journal of Clinical Periodontology" y "The International Journal of Periodontics & Restorative Dentistry".

Information Sources

The electronic search was conducted between May and November of 2020, in the major databases of: The National Library of Medicine (MEDLINE/PubMed) via Ovid; SCOPUS and the Cochrane Central Register of Controlled Trials (CENTRAL), including studies published with no time or language restrictions until to the present. The level of agreement between the reviewers was estimated by Kappa statistics on the full-text selection. When the kappa statistic shows an agreement higher than 0.80, it is considered to provide substantial agreement between reviewers.

Study Selection

After we retrieved the references, titles and abstracts were screened in duplicate by 2 reviewers (F.D. & C.C.V.). Once duplicates were removed and we identified potentially included studies, we obtained and screened full-text articles (F.D. & C.C.V.). When agreement was elusive, we discussed eligibility until consensus was achieved. If this was not possible, a third reviewer (C.M.G.) acted as an arbiter. We also searched the reference sections of relevant primary studies, systematic reviews, and guidelines to identify additional studies.

Data Collection & ítems

Pairs of reviewers (F.D. & C.C.V.) conducted data extraction. If there was disagreement between the two reviewers, a third reviewer (C.M.G.) was consulted. The collected data were registered in a table with the main points of interest of each study: the authors of the study, year, country, language of publication, type of study, the total number of patients, total number of implants, type of implant connection and peri-implant bone loss measurement.

Results

It included 82 scientific articles, of which 16 found in PubMed, 1 found in Embase, 47 found in Ovid and 18 found in Scopus. 77 articles were excluded because they were inconsistent with the inclusion and exclusion criteria required or already selected in other databases. Of these 77, 13 articles were found in PubMed, one article in Embase, 47 in Ovid and 16 in Scopus (Figure 1). Those that were ultimately selected for this study were 5: 3 found in PubMed and 2 found in Scopus. Of these 5 articles, 3 were published in 2018, 1 was published in 2016 and 1 was published in 2012 (Table 1 and 2). In these studies, 2866 patients who were at least 18 years of age were treated in total. It was not possible to perform an exact mean of periodontal biotypes due to lack of data precision. All patients underwent single or multiple extractions. The most frequent causes were: dental fracture, endodontic failure, cavities and root resorption (Table 3). A total of 6455 implants were inserted, of which 3057 were restored with an external hexagonal prosthetic connection and 3398 with an internal hexagonal or conometric connection. The 3057 implants rehabilitated with external connection had a cylindrical implant body design. The 3398 implants restored with internal connection had a conical type implant body design with a "Switching Platform" (neck of the implant narrower than the body), and the implants rehabilitated with a conometric connection were equipped with a "Morse taper" (consistent in mechanical friction between two conical surfaces according to engineering trigonometric calculations developed by Stephen Morse in 1863). All implants were installed according to the traditional protocol. Four implants failed. There were complications with 9 implants. The 3057 implants prosthetized by external hexagon connection showed a mean periimplant marginal bone loss of 0.986 ± 0.58mm. The 3398 implants prosthetized by an internal hexagon or conometric type connection highlighted a mean peri-implant marginal bone loss of 0.86 + - 0.43mm. Both values were calculated after 5 years from the insertion of the implants.

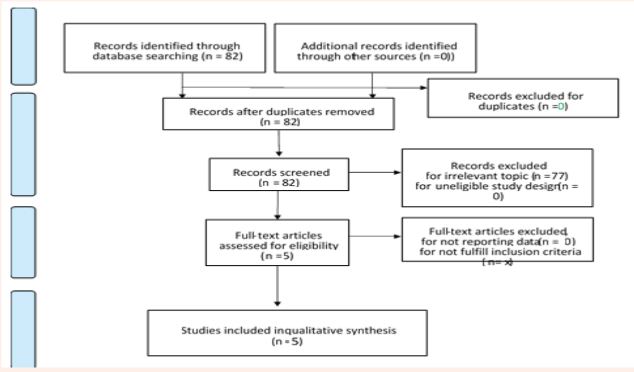

Figure 1: PRISMA systematic search flow chart

Figure 1: PRISMA systematic search flow chart

Flowchart (based on the PRISMA guide) of the search and the selection process of the systematic review.

Table 1: Data extraction of included studies

Study	**Selection**				**Comparability**		**Exposure**			**Number of stars (out of 9)**
	S1	S2	S3	S4	C1	C2	E1	E2	E3	
Tsirlis AT., 2005 (5)	★	0	★	★	★	★	★	★	★	8
Chen ST et al.,2007 (6)	★	0	★	★	★	★	★	★	★	8
De Rouck T et al., 2008 (7)	★	★	0	0	★	★	0	★	★	6
Kanokwan N et al., 2010 (8)	★	0	0	★	0	0	★	★	★	5
Den Hartog L et al., 2013 (9)	★	★	0	0	★	★	★	0	★	6
Mangano F et al., 2013 (10)	★	0	0	★	★	★	★	★	★	7
Krishnappa L et al, 2014 (11)	★	0	0	0	0	0	★	0	0	2
Gungor MB et al., 2014 (12)	★	0	0	0	★	0	★	0	★	4
Chen, S.T al., 2014 (13)	★	★	★	★	★	★	★	★	★	9
Berberi AN et al., 2014 (14)	★	0	0	0	★	★	★	0	★	5
Bruno V et al., 2014 (15)	★	0	0	0	★	★	★	0	★	5
Carrillo de Albornoz A et al., 2014 (16)	★	0	★	★	★	★	★	★	★	8
Ross SB et al., 2014 (17)	★	0	0	0	0	0	★	0	0	2
Ross SB et al., 2014 (18)	★	★	0	★	★	★	★	0	★	7
Vanlioglu BA et al., 2014 (19)	★	★	0	0	★	★	★	0	★	6
Cooper LF et al., 2014 (20)	★	★	★	★	★	★	★	★	★	9
Noelken R et al., 2014 (21)	★	0	0	★	★	★	★	★	★	7
Anderson LE et al., 2014 (22)	★	0	0	★	★	★	★	0	★	6
Mangano FG et al., 2014 (23)	★	0	0	0	★	0	★	0	0	3
Guarnieri R et al., 2015 (24)	★	0	0	0	★	★	★	0	★	5
Furhauser R et al., 2015 (25)	★	★	0	0	★	★	★	0	★	6
De Bruyckere T et al., 2015 (26)	★	0	0	★	0	★	★	0	★	5
Cosyn J et al., 2015 (27)	★	★	0	0	0	★	★	0	★	5
Felice P et al., 2015 (28)	★	★	0	★	★	★	★	★	★	8
Esposito M et al., 2015 (29)	★	★	0	★	★	★	★	★	★	8
Cooper LF et al., 2015 (30)	★	★	0	★	★	★	★	0	★	7
Khzam N et al., 2015 (31)	★	★	0	0	★	★	★	0	★	6
Barone A et al., 2015 (32)	★	0	0	0	★	★	★	0	★	5
Calvo-Guirado JL et al., 2015 (33)	★	★	0	0	★	★	★	0	★	6
Negri B et al., 2016 (34)	★	0	0	0	0	0	★	0	0	2
Weigl, P et al., 2016 (35)	★	★	★	★	★	0	★	★	0	7
Guarnieri R et al., 2016 (36)	★	0	0	0	★	★	★	0	0	4
Motta M et al., 2016 (37)	★	0	0	0	0	★	★	0	★	4
Kolerman R et al., 2016 (38)	★	0	0	0	★	★	★	0	★	5
Kolerman R et al., 2016 (39)	★	0	0	0	★	★	★	0	★	5
Boardman N et al., 2016 (40)	★	★	0	0	0	★	★	0	★	5
ArRejaie A. et al., 2016 (41)	★	0	★	★	0	★	★	★	★	7
Paolantoni G et al., 2016 (42)	★	★	0	★	★	★	★	★	★	8
Hsu YT et al., 2016 (43)	★	0	★	★	★	★	★	★	★	8
Lombardo G et al., 2016 (44)	★	0	0	0	★	★	★	0	★	5

Zhao X et al., 2016 (45)	★	★	0	0	★	★	★	0	★	6
Rieder D et al., 2016 (46)	★	★	★	★	★	★	★	★	★	9
Burgueno-Barris G et al., 2016 (47)	★	0	0	0	0	★	0	★	★	4
Wittneben JG et al., 2017 (48)	★	★	0	★	0	★	★	0	★	6
Furhauser R et al., 2017 (49)	★	0	0	0	★	★	★	0	★	5
Vidigal GM et al., 2017 (50)	★	★	0	0	★	★	★	0	★	6

Table 2: Results of the systematic review. Information about the publication

Bibliographic reference number	Article name	Author	Year of pblication	Review
2	Comparison of Marginal Bone Loss Between Implants with Internal and External Connections: A Systematic Review	Palacios-Garzón N, Mauri-Obradors E, Roselló-LLabrés X, Estrugo-Devesa A, Jané-Salas E, López-López J	2018	Int J Oral Maxillofac Implants.
3	The influence of implantabutment connection to peri-implant bone loss: A systematic review and metaanalysis	Caricasulo R1, Malchiodi L2, Ghensi P3, Fantozzi G4, Cucchi A	2018	Clin Implant Dent Relat Res.
4	Dental implants with internal versus external connections: 5-year post-loading results from a pragmatic multicenter randomised controlled trial.	Marco Esposito, Hassan Maghaireh, Roberto Pistilli, Maria Gabriella Grusovin, Sang Taek Lee, Anna TrullenqueEriksson, Federico Gualini.	2016	Eur J Oral Implantol
5	Comparison of marginale bone loss between internal- and external-connection dental implants in posterior areas without periodontal or periimplant disease.	Dae-Hyun Kim, Hyun Ju Kim, Sungtae Kim, KiTae Koo, Tae-Il Kim, Yang-Jo Seol, Yong-Moo Lee, Young Ku, In-Chul Rhyu	2018	J Periodontal Implant Sci.
6	All-on-three delayed implant loading concept for the completely edentulous maxilla and mandible: A retrospective 5year follow-up study.	. Oliva J1, Oliva X, Oliva JD.	2012	Int J Oral Maxillofac Implants.

Table 3: Results of the systematic review. Information on patients, implants and marginal bone loss.

Bibliographic reference number	Number of patients	Number of implants	Type of connection	Marginal bone loss after 5 years
2	1523 patients	3965 implants	2079 external connection 1886 internal connection	1,25 mm for the external connection 1,21 mm for the internal connection
3	1036 patients	1860 implants	640 external connection 1220 internal connection	1,24+-0,47 mm for the external connection 1,20+-0,64 mm for the internal connection
4	120 patients	203 implants	96 external connection 107 internal connection	1,13 mm for the external connection 1,21 mm for the internal connection
5	170 patients	355 implants	206 external connection 149 internal connection	0,47+-0,65 mm for the external connection 0,15+-0,33 mm for the internal connection
6	17 patients	72 implants	36 external connection 36 internal connection	0,84+-0,62 mm for the external connection 0,53+-0,32 mm for the internal connection

Discussion

With the introduction of new types of interface between implants and prosthetic components, various clinical studies have supported that the internal conical connection provides greater preservation of the marginal bone, although this connection has not been investigated with the same extension of the external connection, and there have been had clinical studies with shorter follow-up periods. In addition, many long-term clinical studies have highlighted the reliability of the external connection. A substantial number of articles indicate the mechanical advantages of internal connection although the evidence was drawn primarily from in vitro studies. In 1999, Astrand et al. They published a prospective randomized study with a 5-year follow-up comparing internal and external connection, in which no significant differences were found in marginal bone loss between the two types of connection. After some years, many of the same patients were included in another longitudinal study with a follow-up of 12 to 15 years, there were no significant differences in bone loss. Smaller differences in bone loss between the connections could be due to the differences between the implants, such as the implant surface or the use of platform switching. Regarding platform switching, many authors of randomized clinical studies, including Canullo et al, and Guerra et al, support platform switching on the basis of the reduced bone loss observed as a result of its use, although studies by Enkling et al and Meloni et al, did not show significant differences in terms of bone loss. According to these authors, whose studies present high methodological quality, more studies with a longer follow-up period are required to determine if the use of platform switching is more effective in terms of bone loss. Differences on the implant surface could affect peri-implant bone loss. Bratu et al, Piao et al and Puchades-Roman et al, confirmed through their studies that the rough implant surface reduces marginal bone loss. This could explain the increase in bone loss around the external connections in the study by Penarrocha-Diego et al where the surfaces of the implant neck were different, smooth due to the external connection and microtreated due to the internal connection. Surgical trauma caused by the implant installation procedure could be another cause of marginal bone loss that would explain why it is significantly higher during the healing phase before occlusal loading. Ravald et al, with a follow-up of 12 to 15 years, obtained a mean marginal bone loss in the Astra Tech group (internal connection) of 0.7mm and in the Branemark group (external connection) of 0.4mm. Jacobs et al, 15 years after functional load, showed a mean bone loss of 0.02 around AstraTech implants and 0.31mm around Branemark implants. Analyzing those same studies with greater follow-up, presenting a higher methodological quality, and a greater number of samples, the external connection did not show significant differences with respect to the internal connection, indicating that the literature still does not have sufficient evidence to confirm that a connection it is better than another in terms of marginal bone loss. Implants with a type of connection other than the external hexagonal were introduced with the aim of reducing both biomechanical and biological complications linked to periimplant bone loss, improving the transfer of occlusal load to the bone and the implant and minimizing micro-gaps. of the implant-abutment interface to reduce bacterial colonization. Some authors claim that these objectives are achievable by adopting a conical connection that leads to the so-called "cold welding". This thesis is not confirmed by long-term randomized clinical trials, of course it has been shown that bacterial colonization occurs also with these types of connection, some studies that have examined conical connections have shown that they can offer good results after 5- 6 years of follow up. In the study carried out by Caricasulo r. et al. Only one systematic review considered the role of the connection itself, concluding that implants with internal connection had less marginal bone loss than those with sternal connection.According to the authors, this difference was probably due to the prevalence of the use of the platform-switching in association with internal connections. The present meta-analysis also took into account the results related to implants with conometric connection. The peri-implant bone loss values observed around implants with internal or conometric connection were lower than those observed around rehabilitated implants with external hexagon connection. In two studies, the conometric would seem to cause less peri-implant bone loss with respect to the internal hexagon connections, that is, it would seem more favorable in keeping the bone crest stable in the short-medium term. As mentioned before, the reason for the better results observed by the conical connections could be due to the biomechanical advantages: many studies in vitro, in fact, demonstrated how the conical prosthetic abutments can minimize the microgap, although not eliminate it, and reduce the micromotion during loading; In addition, the conometric connection seems to better dissipate the loads both on the implant interface and on the peri-implant tissues, reducing the risk of technical complications such as unscrewing or fracture of the prosthetic abutment screw.

Results of a recent review on the yields of these connections are in agreement with the results of the present review, confirming that the in vitro studies are very promising, although there is still a longer follow up (> 5 years) of randomized clinical trials to obtain more significant results. Peri-implant bone loss has been detected with all the implant systems in question, regardless of the positioning and functionalization times. The same can be affirmed by different prosthetic options: Pieri et al, Koo et al, Pozzi et al, Cooper et al and Hsu et al took into account single cemented or screwed elements. One study examined implant-supported fixed partial dentures and implant-retained overdentures and six studies a variety of prosthetic solutions. All results were shown similar in terms of peri-implant success and bone loss percentages. Two studies by Esposito M. et al. Compared two implants with the same macromorphology, differing only by the type of connection, although the implants with internal connection were equipped with platform switching while those with external connection had a platform-matched platform. The conical connection with platform switching did not show better characteristics with respect to the internal one (always equipped with platform. Switching), but both were more performant with respect to the internal or external connections with platform-matched platform. This shows how platform-switching can be a main factor affecting the response of the bone around dental implants as such, moving the implant-prosthetic abutment connection away from the crestal bone, regardless of the type of connection (conical, internal or external). Platform switching could be one of the most important factors, with respect to the type of connection, due to the preservation of the marginal bone, as has been hypothesized by a recent review in the study by De Medeiros RA et al. According to Atieh Ma et al, the degree of marginal bone resorption seems to be inversely related to the extension of the implant-stump discrepancy, revealing that the internal displacement of the implant-prosthetic abutment junction can be considered a desirable morphological characteristic that can preserve the levels. vertical crestal bone, as in external hesagonal connections. In the study by Dae-Hyun Kim et al, marginal bone loss around externally connected implants was greater than around internally connected implants, which is consistent with most of the antecedent studies. Koo et al. have studied bone loss based on the connection modality of the prosthetic pillar of the implant. The mean loss around externally connected implants was 0.61mm until loading and 0.29mm the following year, while that around internally connected implants was only 0.08mm until loading and Marginal bone gain was achieved in the following year. Also Laurell and Lundgren et al. They showed favorable results due to changes in the marginal bone level around implants with internal connection in a meta-analysis.Goiato y cols. reportaron resultados similares en una revision de la literature. Areas of marginal bone loss around implants with internal connection with a Morse cone type structure have shown less bacterial infiltration, suggesting that the type of implant connection could affect bacterial infection and the appearance of inflammation in the peri-implant tissue. The conical structure of the Morse taper has high resistance to distortion and rotation, which could minimize the load on the screw itself and prevent loosening and fracture of the screw. In this study, implants with peri-implantitis or periodontal disease on adjacent teeth were excluded, because the objective was to focus on the marginal bone loss not induced by the inflammatory response caused by bacteria, but rather on the biomechanical factors dependent on the type of connection. Implant-prosthetic abutment. Naert et al reported that implants that retain a mandibular overdenture retained on 2 implants subjected to overload under inflammatory conditions showed accelerated inflammatory bone resorption. In addition to splinting, several studies, including those by Guichet DL et al. and Sailer I et al., reported that cemented implant restorations presented more frequent biological complications correlated to inflammation. It was also evidenced that the cemented restorations showed a more uniform distribution of solecitations with respect to the threaded prostheses, although they had larger marginal openings and showed more frequent biological complications, such as marginal bone loss greater than 2mm. statistically significant differences in this study between cemented and screwed restorations. Galindo-Moreno et al. demonstrated that the length of the prosthetic abutment can affect marginal bone loss and that short prosthetic abutments (<2mm) showed more bone resorption, the length of the prosthetic abutment would have to be taken into account as a contributing factor [8,9].

Conclusion

Taking into account the individuality of each patient for each situation and the limitations due to the degree of heterogeneity between the included studies, both internal and external connections present a high survival rate. Regarding the effects of the types of connections on the levels of peri-implant marginal bone, there are no significant differences between the external hexagon connections and the conometric connections, still less evident, instead between the internal hexagon and the conometric ones. Peri-implant bone loss is generally lower in the short-medium term when internal types of interface are adopted, in particular conometric connections seem to be more advantageous, guaranteeing better sealing performance and stability of the implantprosthetic abutment interface, especially in studies in vitro. Regarding the intensity of the mechanical stress and the stresses placed on the periimplant region, the conical connection and the cylindrical design of the implant transmit less stress to the bone cortex compared to the external hexagonal connection and the conical design of the implant, which transmit less stress and tensions to the trabecular bone and more to the cortical bone.

References

1. Andrade DCL, Carvalho MA, Cury DBAA, Maior BSS (2016) Biomechanical Effect of Prosthetic Connection and Implant Body Shape in Low-Quality Implants Bone of Maxillary Posterior Single Implant-Supported Restorations.. Int J Oral Maxillofac Implants 31(4): e92-7.

2. Garzon NP, Obradors EM, Llabrès XR, Deevesa AE, Salas EJ, et al. (2018) Comparison of Marginal Bone Loss Between Implants with Internal and External Connections: A Systematic Review. Int J Oral Maxillofac Implants 33(3): 580-589.

3. Caricasulo R, Malchiodi L, Ghensi P, Fantozzi G, Cucchi A (2018) The influence of implant-abutment connection to peri-implant bone loss: A systematic review and meta-analysis. Clin Implant Dent Relat Res 20(4): 653-664.

4. Esposito M, Maghaireh H, Pistilli R, Grusovin GM, Lee ST, et al. (2016) Dental implants with internal versus external connections: 5-year post-loading results from a pragmatic multicenter randomised controlled trial. Eur J Oral Implantol

9(2): 129-141

5. Kim DH, Kim HJ, Kim S, Koo KT, Kim T, et al. (2018) Comparison of marginale bone loss between internal- and externalconnection dental implants in posterior areas without periodontal or periimplant disease. J Periodontal Implant Sci 48(2): 103-113.

6. Oliva J, Oliva X, Oliva JD (2012) All-on-three delayed implant loading concept for the completely edentulous maxilla and mandible: A retrospective 5-year follow-up study. Int J Oral Maxillofac implants 27(6): 1584-1592.

7. Lin MI, Shen YW, Huang HL, Hsu JT, Fuh LJ (2013) A retrospective study of implant-abutment connections on crestal bone level. J Dent Res 92(12 Suppl): 202S-207S.

8. Degidi M, Daprile G, Piattelli A (2017) Marginal bone loss around implants with platform-switched Morse-cone connection: a radiographic cross-sectional study. Clin Oral Implants Res 28(9): 1108-1112.

9. Coray R, Zeltner M, Özcan M (2016) Fracture strength of implant abutments after fatigue testing: A systematic review and a meta-analysis. J Mech Behav Biomed Mater 62: 333-346.