



## Analysis of the Peri-implant Soft Tissues in Contact with Zirconia Abutments: An Evidence-based Literature Review

Rodrigo Antonio de Medeiros, Aljomar José Vechiato-Filho, Eduardo Piza Pellizzer, Jose Vitor Quinelli Mazaro, Daniela Micheline dos Santos, Marcelo Coelho Goiato

### ABSTRACT

**Aim:** The aim of this study is to evaluate through a literature review, the soft tissue response in contact with zirconia abutments, including case reports comparing prosthetics rehabilitations with zirconia and titanium abutments upto 3 years of follow-up as well as the factors that should be considered on implant's abutment selection.

**Background:** Metallic abutments can provide grayish color when in contact with thin soft tissues which may lead the implant prosthetic treatment to failure. In this context, the abutments of zirconia stand out because there is an excellent linking between esthetics and the health of peri-implant soft tissues.

**Materials and methods:** A consult of the published researches was made on the PubMed database from 2000 to September 2012. The including criteria were: literature reviews, clinical studies and case reports in English that focused on the response of the soft tissue in contact with zirconia implant abutments. The studies that were not in English and did not match the tackled issue were excluded.

**Results:** A total of 32 articles were found. According to the search strategy, just 16 articles were selected for this review. Three studies affirmed that zirconia abutments have an excellent soft tissue response; one study showed increased gingival recession with zirconia abutments and nine studies do not stand out any difference on biological behavior between titanium and zirconia abutments. Three studies affirmed that zirconia abutments provide natural gingival appearance, anatomic contour and greater esthetics.

**Conclusion:** The use of zirconia abutments is recommended for anterior regions because of their greater optical properties and esthetic results and more studies should be performed and analyzed longitudinally regarding their biological response.

**Clinical significance:** The zirconia abutments have been established to be essential in order to achieve great esthetic results in cases of thin peri-implant soft tissues and in regions where the three-dimensional placement of implants is more superficial.

**Keywords:** Dental implants, Gingiva, Esthetics, Review.

**How to cite this article:** de Medeiros RA, Vechiato-Filho AJ, Pellizzer EP, Mazaro JVQ, dos Santos DM, Goiato MC. Analysis

of the Peri-implant Soft Tissues in Contact with Zirconia Abutments: An Evidence-based Literature Review. *J Contemp Dent Pract* 2013;14(3):567-572.

**Source of support:** Nil

**Conflict of interest:** None declared

### BACKGROUND

In the last years, the implantology created a new treatment modality in the field of oral rehabilitation with high success rates.<sup>1</sup> These good results are usually related to the cortical bone stability and the health of peri-implant soft tissues.<sup>2-4</sup>

Besides, the esthetic has gained a great valorization in the contemporary society, becoming an additional criterion to obtain success in the rehabilitation treatment with osseointegrated implants.<sup>1</sup> The restoration of a peri-implant profile that simulates the gingival outline of the adjacent tooth is one of the biggest challenges to be solved in implant dentistry.<sup>5</sup>

To this type of restoration, the titanium abutments are considered the 'gold standard' because of the longevity that implant-supported crowns exhibit when associated with these components.<sup>6</sup> However, the worse esthetic disadvantage of metallic abutments is the grayish color that is produced when in contact with thin soft tissues, which causes great esthetic lost, mainly in anterior areas.<sup>1,6-10</sup>

There are also other factors that can affect peri-implant soft tissue and cause gingival recession, exposing the abutments metallic ring and leading the treatment to failure. In this context, the abutments of zirconia stand out because there is an excellent linking between esthetics and mechanical properties, besides lower bacterial adherence in comparison with titanium alloys, for example.<sup>11,12</sup>

However, the literature is scarce about studies that analyze the behavior of peri-implant soft tissue in contact with zirconia abutments. So, the aim of this study is to

evaluate, through a literature review, the response of peri-implant soft tissue in contact with zirconia abutments, including comparisons among three case reports of implant-supported single crowns with titanium and zirconia abutments, as well as the factors that must be considered when selecting these components.

## MATERIALS AND METHODS

A search about the tackled subject of was performed on PubMed database from 2000 to September 2012. The following keywords were singly used: 'zirconia abutment and soft tissue reaction', 'zirconia abutment and biological complications', 'zirconia abutment and soft tissue complications', 'zirconia abutment and soft tissue inflammation', 'dental implant and ceramic abutment and biological complications', 'zirconia abutment and esthetic and all-ceramic crown'. The including criteria were: literature reviews, clinical studies and case reports that evaluated the response of the peri-implant soft tissue in contact with zirconia abutment. The studies that were not in English and did not match the proposed subject were excluded. Titles and abstracts, and full-texts when necessary, were read by two reviewers. The results obtained were analyzed, crossed and discussed for the reviewing.

## RESULTS

By using the keyword, a total of 32 articles were found. From this initial result, just 16 articles fit into the search strategy and were used to this current study. The studies were tabulated and classified according to the degree of scientific evidence (Table 1).

## DISCUSSION

In 2004, Glauser et al<sup>13</sup> reported in their study that the ceramic abutments were introduced in implant dentistry in 1993, with the purpose of enhancing esthetic results of implant-supported single crowns in anterior areas, since the titanium abutments may cause a grayish aspect in peri-implant soft tissue, affecting clinical appearance of the implant-supported restoration.

In the same year, Doring et al<sup>6</sup> affirmed that the interaction between the implant fixed reconstructions and the surrounding soft tissue is a crucial factor that should be considered to obtain clinical success. According to these authors, zirconia abutments promote less bacterial adherence in comparison with titanium abutments, preventing gingival inflammation.

However, Tan et al<sup>14</sup> observed the esthetic result produced by exchanging titanium and zirconia abutments

in an implant-supported single crown. In this study, the ceramic component showed a subtle difference in the final clinical appearance. Thus, according to Sailer et al,<sup>1</sup> among the relevant esthetic parameters on abutment selection, the smile line, gingival biotype, three-dimensional (3D) implant placement, color of the adjacent tooth, costs and patient expectations should be considered (Figs 1A to D).

Waktin et al in 2008,<sup>5</sup> affirmed that for patients with high smile line, the zirconia abutments have better esthetic result and may re-establish more naturally the silhouette, color and health aspect of the peri-implant soft tissues in comparison with titanium abutments (Figs 2A to C). This fact can be attributed to the minimum influence on color shade of the component when in contact with the gingiva. But, in the same year, Linkevicius et al<sup>3</sup> made a systematic review similar to the anterior study, concluding that there was no difference between zirconia and titanium abutments in the tissue anatomy, as can be observed on two illustrated cases of implant-supported single crowns (Figs 3A to D). For the authors, there are few works that focused on the clinical performance of tissue around zirconia abutments. Thus, more studies about this component are necessary, as it is considered an important factor for the long-term success of implant treatment.

Corroborating with this affirmatives, in 2009, Sailer et al<sup>8</sup> and Zembic et al<sup>10</sup> compared the tissues response around zirconia and titanium abutments, during 1 and 3 years, respectively. For these authors, both components showed the same results in all the analyzed aspects.

In 2010, Nothdurft et al<sup>2</sup> published in their study that the bacterial ingress, masticatory forces and prosthetic manipulation may affect the gingival integrity. The authors evaluated the peri-implant health around ceramic abutments with 1 year of follow-up. Most of the tissues did not show any trace of inflammation, presenting themselves with healthy appearance because less microorganisms adherence on abutments surface. However, van Brakel et al<sup>4</sup> made a microbiological analyses and found no difference in the primary colonization for both zirconia and titanium abutments. This fact can be explained by the similarity on the surface characteristics of these materials, suggesting a histological study in order to stand out subtle differences on the response of peri-implant soft tissue.

In 2011, Lewis et al<sup>15</sup> studied through a systematic literature review the importance of the abutment's material biocompatibility with the surrounding gingiva. These authors found evidences of better biological outcome when the peri-implant soft tissues are in contact with zirconia abutments, but they suggested that more longitudinal studies are necessary to affirm this conclusion. In order to

Table 1: Articles screened according to the search strategy

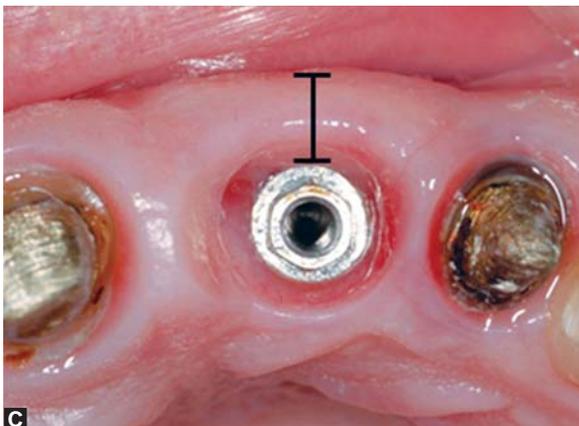
Authors	Type of study	Scientific evidence degree	Purpose of study	Outcomes
Glauser et al, 2004	Prospective study	6	To analyze the presence of peri-implant soft tissue inflammation in esthetic areas with zirconia (Zr) abutments	No significant differences for the parameters analyzed
Doring et al, 2004	Retrospective study	6	To evaluate the clinical outcome of Ankylos system, up to 8 years of follow-up with titanium (Ti) or Zr abutments	Both abutments presented good clinical performance with no biological alterations
Tan et al, 2004	Case report	7	To evaluate the esthetic outcome with Ti and Zr abutments	Satisfactory esthetic outcome for both
Sailer et al, 2007	Case report	7	To compare the esthetic outcome of Zr and Ti abutments	The authors recommend the use of Zr abutments for anterior zones
Waktin et al, 2008	Case report	7	To evaluate esthetic outcome of replacing Ti for Zr abutment	Improvement of gingival appearance
Linkevicius et al, 2008	Systematic review	1	To evaluate the soft tissue stability of ceramic abutments comparing with other metallic alloys	There is no evidence that proves the better response of Ti abutments compared with other materials
Sailer, 2009	Prospective study	6	To evaluate if Zr abutments have the same success rates than Ti abutments	There was no difference about the soft tissue response
Zembic, 2009	Prospective study	6	To evaluate if Zr abutments have the same biological response than Ti abutments.	No difference was found between the types of components
Sailer et al, 2009	Systematic review	1	To verify the survival and complications of Zr and Ti abutments	There are no evidences to provide differences on technical and biological aspects
Nothdurft et al, 2010	Clinical study	7	To analyze if Zr abutments may be indicated to posterior zones	Peri-implant soft tissues had health appearance and free from inflammatory reaction
Van Brakel et al, 2010	<i>In vivo</i> study	7	To compare the microorganisms ingress and soft tissue health on Zr and Ti abutments	No alterations on the peri-implant soft tissue
Lewis and Klineberg, 2011	Literature review	7	To review the literature about cases with single crowns, considering the abutment type and the surrounding tissues	Zr, Ti and gold abutments had excellent biological response
Ekfeldt et al, 2011	Retrospective study	6	To evaluate the clinical outcomes of personalized Zr abutments	The abutments show good biological and functional response
Salihoglu et al, 2011	<i>In vivo</i> study	7	To compare the bacterial adherence on Zr and Ti abutments	No difference was found between the types of components
Van Brakel et al, 2012	<i>In vivo</i> study	7	To compare through histological data the health of the peri-implant soft tissues between Zr and Ti abutments	There is no difference on the biological response
Hosseini et al, 2012	Prospective study	6	To identify the outcome variables of all-ceramic and metal-ceramic implant-supported single crown	Greater recession of all-ceramic restorations

complement this study, Ekfeldt et al<sup>11</sup> evaluated the plaque accumulation, probing pocket depths and bleeding on probing of zirconia abutments for 5 years, concluding that these abutments have an excellent response on the evaluated biological parameters.

For Salihoglu et al,<sup>9</sup> the plaque accumulation on these components is directly linked with the success of implant treatment. This group of authors executed a microbiological analysis of the peri-implant soft tissues of ceramic and

titanium abutments, finding that there was no difference in the microorganism colonization for both types of abutments.

In 2012, van Brakel et al<sup>16</sup> made a histological study previously mentioned, with the purpose of assessing the inflammatory reaction of the soft tissues around zirconia and titanium abutments. In this study, there was no significant difference on qualitative histological features between the two types of abutments tested and both showed health gingival appearance. Similarly, Housseini et al<sup>7</sup> did



**Figs 1A to D:** (A) and (B) show the reduced thickness of the gingival biotype; indicating the use of zirconia abutment. In order to avoid the gray aspect of the surrounding tissue, the use of titanium abutments in implant-supported single crowns is recommended just in areas with thicker gingival biotypes, as showed on (C) and (D)



**Figs 2A to C:** (A) and (B) the excellent esthetic outcome is observed. Along 3 years of follow-up (C), the peri-implant soft tissue presented no clinical alterations and the color, silhouette and natural aspect of the gingiva were preserved

not find any mismatch on the soft tissues response around zirconia and titanium abutments of implant-supported single crowns. But, they observed significantly more complications in all-ceramic restorations than metaloceramic crowns, concerning marginal adaptation of abutment-crowns interface, what can promote greater bacterial adherence and consequently more tissues inflammation reactions.

Sailer et al<sup>12</sup> published a systematic review presenting the same rates of biological complications for zirconia and titanium abutments, but the ceramic component showed twice the rate of gingival recession, being 8.9 and 3.8%,



**Figs 3A to D:** (A) and (B) final clinical esthetic outcome with prepared prefabricated zirconia abutments, (C) and (D) metallic abutments (personalized UCLA). Those images show that the patient with metallic abutment has a gingival biotype with more fiber content, decreasing the translucence and avoiding the grayish aspect caused by the metallic component

respectively. These results can be attributed to the frequent use of ceramic abutments in the esthetic zone as well as the higher risk of recession of this area when compared with thicker gingival biotypes of posterior regions.

## CONCLUSION

There is not a conscience in the literature about the response of peri-implant soft tissue in contact with zirconia abutments. However, in order to achieve greater esthetics outcomes, zirconia abutments are recommended for areas with thin soft tissues and in regions where the 3D placement of implants is more superficial.

## CLINICAL SIGNIFICANCE

Zirconia abutments indicate to have a great response in terms of peri-implant soft tissue response. Also, these abutments have been established to be essential in order to achieve great esthetic results in cases of thin peri-implant soft tissues and in regions where the 3D placement of implants is more superficial.

## REFERENCES

1. Sailer I, Zembic A, Jung RE, Hämmerle CHF, Mattioli A. Single-tooth implant reconstructions: esthetic factors influencing the decision between titanium and zirconia abutments in anterior regions. *Eur J Esthet Dent* 2007 Autumn;3(2):296-310.
2. Nothdurft F, Pospiech P. Prefabricated zirconium dioxide implant abutments for single-tooth replacement in the posterior region: evaluation of peri-implant tissues and superstructures after 12 months of function. *Clin Oral Implants Res* 2010 Aug;21(8):857-865.
3. Linkevicius T, Apse P. Influence of abutment material on stability of peri-implant tissues: a systematic review. *Int J Oral Maxillofac Implants* 2008 May-Jun;23(3):449-456.
4. van Brakel R, Cune MS, van Winkelhoff AJ, de Putter C, Verhoeven JW, van der Reijden W. Early bacterial colonization and soft tissue health around zirconia and titanium abutments: an in vivo study in man. *Clin Oral Implants Res* 2011 Jun;22(6):571-577.
5. Watkin A, Kerstein RB. Improving darkened anterior peri-implant tissue color with zirconia custom implant abutments. *Compend Contin Educ Dent* 2008 May;29(4):238-240, 242.
6. Döring K, Eisenmann E, Stiller M. Functional and esthetic considerations for single-tooth Ankylos implant-crowns: 8 years of clinical performance. *J Oral Implantol* 2004;30(3):198-209.
7. Hosseini M, Worsaae N, Schiødt M, Gotfredsen K. A 3-year prospective study of implant-supported, single-tooth restorations of all-ceramic and metal-ceramic materials in patients with tooth agenesis. *Clin Oral Implants Res* 2012 Jun 18. [Epub ahead of print].
8. Sailer I, Zembic A, Jung RE, Siegenthaler D, Holderegger C, Hämmerle CH. Randomized controlled clinical trial of customized zirconia and titanium implant abutments for canine and posterior single-tooth implant reconstructions: preliminary results at 1 year of function. *Clin Oral Implants Res* 2009 Mar;20(3):219-225.

9. Salihoglu U, Boynuegri D, Engin D, Duman AN, Gokalp P, Balos K. Bacterial adhesion and colonization differences between zirconium oxide and titanium alloys: an in vivo human study. *Int J Oral Maxillofac Implants* 2011 Jan-Feb;26(1):101-107.
10. Zembic A, Sailer I, Jung RE, Hämmerle CH. Randomized-controlled clinical trial of customized zirconia and titanium implant abutments for single-tooth implants in canine and posterior regions: 3-year results. *Clin Oral Implants Res* 2009 Aug;20(8):802-808.
11. Ekfeldt A, Fürst B, Carlsson GE. Zirconia abutments for single-tooth implant restorations: a retrospective and clinical follow-up study. *Clin Oral Implants Res* 2011 Nov;22(11):1308-1314.
12. Sailer I, Philipp A, Zembic A, Pjetursson BE, Hämmerle CH, Zwahlen M. A systematic review of the performance of ceramic and metal implant abutments supporting fixed implant reconstructions. *Clin Oral Implants Res* 2009 Sep;20 (Suppl 4):4-31.
13. Glauser R, Sailer I, Wohlwend A, Studer S, Schibli M, Schärer P. Experimental zirconia abutments for implant-supported single-tooth restorations in esthetically demanding regions: 4-year results of a prospective clinical study. *Int J Prosthodont* 2004 May-Jun;17(3):285-290.
14. Tan PL, Dunne JT Jr. An esthetic comparison of a metal ceramic crown and cast metal abutment with an all-ceramic crown and zirconia abutment: a clinical report. *J Prosthet Dent* 2004 Mar;91(3):215-218.
15. Lewis MB, Klineberg I. Prosthodontic considerations designed to optimize outcomes for single-tooth implants. A review of the literature. *Aust Dent J* 2011 Jun;56(2):181-192.
16. van Brakel R, Meijer GJ, Verhoeven JW, Jansen J, de Putter C, Cune MS. Soft tissue response to zirconia and titanium implant abutments: an in vivo within-subject comparison. *J Clin Periodontol* 2012 Oct;39(10):995-1001.

## ABOUT THE AUTHORS

### Rodrigo Antonio de Medeiros (Corresponding Author)

Department of Dental Materials and Prosthodontics, Univ Estadual Paulista (UNESP), Araçatuba Dental School, São Paulo, Brazil, Phone: 551836363247, e-mail: rodrigomedeiros88@hotmail.com

### Aljomar José Vechiato-Filho

Department of Dental Materials and Prosthodontics, Univ Estadual Paulista (UNESP), Araçatuba Dental School, São Paulo, Brazil

### Eduardo Piza Pellizzer

Department of Dental Materials and Prosthodontics, Univ Estadual Paulista (UNESP), Araçatuba Dental School, São Paulo, Brazil

### Jose Vitor Quinelli Mazaro

Department of Dental Materials and Prosthodontics, Univ Estadual Paulista (UNESP), Araçatuba Dental School, São Paulo, Brazil

### Daniela Micheline dos Santos

Department of Dental Materials and Prosthodontics, Univ Estadual Paulista (UNESP), Araçatuba Dental School, São Paulo, Brazil

### Marcelo Coelho Goiato

Department of Dental Materials and Prosthodontics, Univ Estadual Paulista (UNESP), Araçatuba Dental School, São Paulo, Brazil