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### RESEARCH ARTICLE

#### SHOULD WE STILL TALK ABOUT CROWN TO IMPLANT RATIO?

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#### *Abstract*

It has been recognized for a long time that the longer the implant, the better the success rate, and this idea is no longer valid since the advent of short implants, which currently represent reliable solutions that respond favourably to some situations like low bone height, thus offering a good alternative to more invasive bone augmentation surgeries and often not accepted by patients. The aim of our systematic review is to answer the following question: Why the principle of ratio crown / implant identical to that of the dental organ seems today somewhat out-dated? We meant to provide an electronic search on Pubmed using the Mesh Key words: Crown to implant ratio AND Marginal Bone Loss. We included only the Randomised controlled trials to have the best evidence level, we selected only publications in English and limited the date between 26/08/2007 and the 22/08/2017 (last 10 years) to assess the latest findings in this area. The screening and abstraction of the results were achieved by two independent reviewers. After a synthesis, we concluded that there is no cause/effect relationship between the crown / implant ratios and the increase in marginal bone loss, however caution is required in cases of available coronal height > 15mm or in the case of cantilevering.

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#### **Introduction:**

It has been recognized for a long time that the longer the implant, the better the success rate, and this idea is no longer valid since the advent of short implants, which currently represent reliable solutions that respond favourably to some situations like low bone height, thus offering a good alternative to more invasive bone augmentation surgeries and often not accepted by patients.

Why the principle of ratio crown / implant identical to that of the dental organ seems today somewhat outdated?

Is it necessary to use bone grafts that increase the duration of treatment, its cost and its morbidity, if the short implants get an equivalent result?

#### **What would be the influence of the unfavorable crown/ implant ratio on marginal bone resorption?**

Implant-supported prosthetic rehabilitation has been for a long time a challenge in posterior edentulous areas because of the anatomical conditions found, such as excessive volume of the maxillary sinus and bone atrophy. The use of short implants has become particularly advantageous nowadays as it eliminates the need for sinus floor elevation or bone grafting, thus reducing the cost, time and morbidity of often heavy surgeries.

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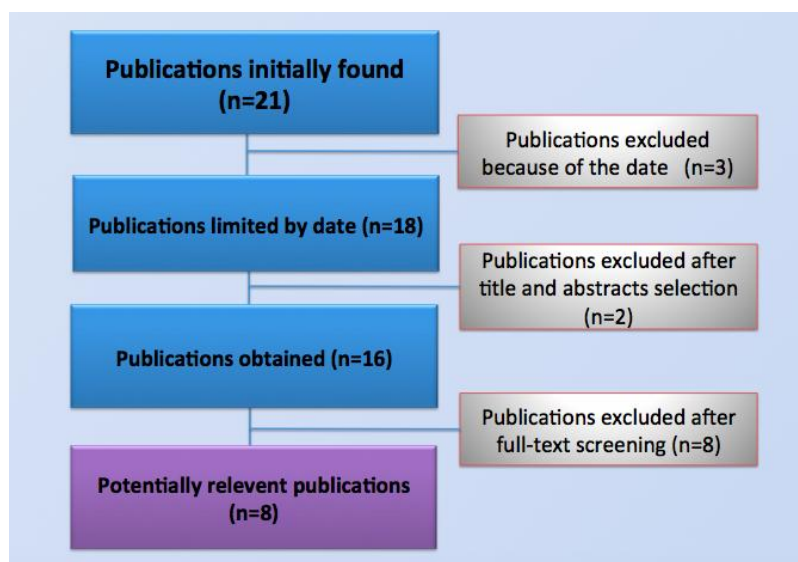
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Indeed the use of short implant generates an inverted crown implant ratio, empirically this ratio should be similar to that of the dental organ not to cause bending moments that can aggravate bone loss but this is now outdated because currently, the implants have micro-structured endosseous surfaces which gives them a better osseointegration and an increased contact surface between the bone and the implant, in addition to this optimized geometry, current implants have better properties in terms of primary stability. Moreover, biomechanical studies based on finite element analysis demonstrate that stress is concentrated only on the crestal part of the dental implant, at the first threads, while weak forces are transmitted to the apical part.

## Materials and Method:

### Systematic Search Strategy:

Before the beginning of the systematic literature search, the protocol was agreed by the authors. An electronic search was performed through MEDLINE database (PubMed) ([HTTPS://WWW.NCBI.NLM.NIH.GOV/PUBMED](https://www.ncbi.nlm.nih.gov/pubmed)). We meant to include only RCT published in English from 26/08/2007 to 22/08/2017. The following combination of MeSH terms was used in PubMed: “Crown to implant ratio AND Marginal Bone Loss”. Then a hand search was performed in ebsco database. Only the randomised controlled trials (RCT) were included. Two independent reviewers achieved the screening and the abstraction of the data. The literature search was conducted following the steps as seen in the flow chart below (*Figure 1*). The first step concerned entering the research equation followed by setting methodological filters. The second step was based on the hand searching. The third one was achieved by full-text selection.



**Figure:** Flow chart showing the process of article's selection

### Inclusion Criteria:

Articles were included if all of the following inclusion criteria were met:

1. Randomised controlled trials of parallel group design and of split-mouth design reporting on short implant and their outcomes and complications related to bone resorption.
2. In each group in the study, at least the following outcomes were detailed: marginal bone loss, implant failure or survival rate, aesthetic outcome, and prosthetic complications.
3. The type of edentulism, the site and the jaw must be detailed.
4. The time of implant placement must be cited (post extractive or in a healed site).

### Exclusion criteria:

Articles were excluded if they met one of the next exclusion criteria:

1. Not RCT study.
2. The patients enrolled in the study present a parafunctional habit.
3. Articles reporting on the outcomes of sinus lift.
4. Studies that concentrated on other complications rather than bone loss.

Two authors extracted the data, and if there was a disagreement, the study was checked and discussed until consensus was reached.

### Results:

The first search through PubMed provided 21 papers. Then, after setting methodological filters (date, year of publication) we obtained 18 papers, only 16 were kept after title and abstract selection, then after full-text selection only 8 met the inclusion criteria. Therefore we obtained 8 articles potentially right to be included (after critical screening). The most significant results were ranked in this table below:

Author	Year	Type of study	Population	Implants	Site of implantation	Correlation with marginal bone loss
Nunes m. [1]	2016	Retrospective Cohort (3 years)	59 patients	118 implants 4 width 7 mm length	Premolars et molars maxillary and mandibular	No correlation between an crown to implant ratio > 2 and increasing bone loss
Guljé f. l. [2]	2016	Prospective (1 year)	37 patients	47 implants 6 mm length	Posterior region maxillary and mandibular	High crown to implant ratios are not accompanied with high marginal bone loss or prosthetic complications during a follow up of 1 year. The mean bone loss was $0,13 \pm 0,36$ mm. no complication has occurred.
Mangano f. [3]	2016	Prospective (5 year)	51 patients	6.5 mm length 5mm width	Posterior region maxillary and mandibular	No statistically significant difference was showed between the two groups $c/i < 2$ and $c/i > 2$ .
Ghariani l. [4]	2016	Prospective (1 year)	12 patients	12 implants 6–8 mm	Mandibular molar	No statistically significant difference Concerning both bone level and survival rate of implants
Slotte c. [5]	2014	Prospective (5 year)	28 patients	86 implants 4-mm length	Mandibular molar	Like the standards implants the resorption was importante the first year then it becomes stable over the following years.
Anitua E. [6]	2014	Retrospective 1-4 year	34 patients	45 implants 5,5-6,5mm length	Mandibular molar	No correlation between high crown to implant ratio and increasing bone loss
Anitua E. [7]	2013	Retrospective	63 patients	128 implants $\leq 8,5$ mm	Posterior region maxillary and mandibular	Crown to implant ratio didn't show a significant influence on marginal bone loss. The only one variable that showed a significant

						negative effect was the use of the cantilever for the prosthetic rehabilitations
Mertens c. [8]	2012	Retrospective (10 years)	14 patients	52 implants 8-9 mm	Anterior and posterior region maxillary and mandibular	The results of the long term study suggest that the use of short implants lead to a marginal bone loss and a survival rate similar to those of standards implants.

**Table 1:** Results of all included studies

### Discussion:

The literature reviewed in our systematic review also confirmed that marginal bone loss was very limited and occurred mostly during the first year similarly to standard implants, [1] and the mean resorption was 0.13 to 0.4mm [Guljé and al., Mangano and al., Slotte and al., Ghariani and al., Mertens and al.]. [2] [3] [4] [5] [8]

On the other hand, for Anitua et al. 2015, the type of the antagonist arch significantly influences the marginal bone loss, thus according to this team this resorption was more important for the implants opposing a partial removable prosthesis  $1.28\text{mm} \pm 1.09$  and lower around the implants opposing both a natural toothing  $0.73 \pm 0.60$  and a total removable prosthesis  $0.89 \pm 0.60\text{mm}$ .

Furthermore, it should be kept in mind that other factors are more important to the success of these short implants, in fact the diameter is more determinant than the length the presence of cantilever in the prosthetic restoration, occlusal table architecture (the inclination of external cusps and the width of the occlusal table) and a coronal height > 15mm is a more aggravating factor regardless of crown / implant ratio.

Implants with an increased C / I ratio can achieve excellent long-term survival rates (Mertens et al., Slotte et al., 92.2%, Anitua et al., 97.9%) as long as occlusion and Parafunctional habits are controlled. [5][7][8].

Today, the use of short implants can be an interesting option to avoid the morbidity of advanced surgical techniques, and at the same time contribute to a simplification of patient care, a decrease in the duration and cost of treatment.

### Conclusion:

Today, the use of short implants can be an interesting option to avoid the morbidity of advanced surgical techniques, and at the same time contribute to a simplification of patient care, a decrease in the duration and cost of treatment. There is no correlation between the crown / implant ratios and the increase in peri-implant bone loss, however caution is required in cases of available coronal height > 15mm or in the case of cantilevering.

### Acknowledgment:

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