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# **PRESENTATION**

It is with great enthusiasm that we present this book that explores the vast territory of technology and innovation applied to dentistry. This book, organized by the Brazilian Journals publishing house, brings together significant contributions from authors in the field, consolidating it for professionals and academics committed to the advancement of modern dentistry.

This book seeks to provide scientific dissemination on topics and research that are at the forefront of the sector. With chapters written by researchers and professionals in the field, the book offers a comprehensive overview of the latest advances and emerging trends that are shaping the future of dentistry.

With the consolidation of the digital age, new artificial intelligence technologies, 3D printing, bioprinting, virtual and augmented reality, telehealth, among other modern and multidisciplinary innovations, we invite you to dive into these pages and explore the exciting narratives that outline the present and anticipate the future of dentistry. May this book be not only a source of knowledge, but also a source of inspiration for your own journey in modern dentistry.

Happy reading!

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# **CHAPTER 1**

TOMOGRAPHIC ANALYSIS OF BUCCAL AND LINGUAL BONE THICKNESS BASED ON THE INCLINATION OF DENTAL IMPLANTS

# Geovana Pires da Silva

Graduate Student in Dentistry

Institution: Universidade Federal de Uberlândia (UFU)

Address: Uberlândia, Minas Gerais, Brazil E-mail: geovanapires3878@gmail.com

# Jefferson de Sá Buso

Graduate in Dentistry

Institution: Universidade Federal de Uberlândia (UFU)

Address: Uberlândia, Minas Gerais, Brazil

E-mail: jeffdentista@gmail.com

# Daniel Hilário da Silva

Doctorate Student in Biomedical Engineering Institution: Instituto Federal Goiano (IFGOIANO)

Address: Cristalina, Goiás, Brazil E-mail: daniel.hilario@ifgoiano.edu.br

# Roberto Bernardino Júnior

**Doctor in Education** 

Institution: Universidade Federal de Uberlândia (UFU)

Address: Uberlândia, Minas Gerais, Brazil

E-mail: bernardino@ufu.br

ABSTRACT: Implantology has been shown to be a rapidly growing area, given that the aesthetic concern of individuals is increasing. In this scenario, it is extremely important that, prior to the installation of implants, the dental surgeon makes a good plan, considering issues such as the thickness of the buccal and lingual/palatal remaining bone, as well as considering the inclination of the natural teeth. Therefore, imaging exams, especially computed tomography, which provides a three-dimensional image of the patient's oral cavity, become very useful tools, favoring better planning and enabling greater implant longevity. The research was based on the documental analysis of 70 computed tomography scans, without distinction of gender or age of the patients. The thickness of the remaining bone between the buccal and lingual/palatal faces to the wall of dental implants was evaluated. The results were tabulated in Microsoft Excel and, through Mann-Whitney statistical tests with p less than 0.05, were evaluated quantitatively. Results: Eleven implants were found with remaining buccal and lingual/palatal bone below the recommended value; three implants with adequate buccal bone remnant and with lingual/palatal bone remnant below recommended; thirty-one implants without remaining buccal and lingual/palatal bone in the cervical region of the implant; and five implants with both bone remnants according to the

literature. Due to the large number of failures observed, it was inferred that the dentist is not using the most appropriate technique for analyzing millimetric structures.

**KEYWORDS:** dental implant, immediate loading, dental socket, imaging diagnosis.

**RESUMO:** A implantodontia tem-se mostrado uma área em franco crescimento, haja vista que a preocupação estética dos indivíduos é cada vez maior. Nesse cenário, é de suma importância que previamente à instalação de implantes, o cirurgião dentista faça um bom planejamento, levando em consideração quesitos como a espessura do remanescente ósseo vestibular e lingual/palatino, bem como considerar a inclinação dos dentes naturais. Para tanto, os exames de imagem, em especial a tomografia computadorizada que fornece uma imagem tridimensional da cavidade bucal do paciente, tornam-se ferramentas muito úteis, favorecendo um melhor planejamento e possibilitando uma maior longevidade dos implantes. A pesquisa foi calcada na análise documental de 70 tomografias computadorizadas, sem distinção de sexoou idade dos pacientes. Foi avaliada a espessura de remanescente ósseo entre as faces vestibular e lingual/palatina à parede de implantes odontológicos. Os resultados obtidos foram tabelados no Microsoft Excel e, por meio de testes estatísticos de Mann-Whitney com p < 0.05, foram avaliados quantitativamente. Resultados: Foram encontrados onze implantes com remanescente ósseo vestibular e lingual/palatino abaixo do valor preconizado; três implantes com remanescente ósseo vestibular adequado e com remanescente ósseo lingual/palatino abaixo do preconizado; trinta e um implantes sem remanescente ósseo vestibular e lingual/palatino na região cervical do implante; e cinco implantes com ambos os remanescentes ósseos de acordo com a literatura. Devido à grande quantidade de falhas observadas, inferiu-se que o cirurgião dentista não está empregando a técnica mais adequada para análise de estruturas milimétricas.

**PALAVRAS-CHAVE:** implante dentário, carga imediata, alvéolo dental, diagnóstico por imageamento.

# 1. INTRODUCTION

Some habits are indispensable for a healthy life, among them is a balanced diet and carried out in an adequate manner. In the search for the most correct way of feeding, the diversity of nutrients, the absence of products that in the short, medium or long term induce some damage to health, in any of their multiple aspects, deserve attention. But attention must also be paid to the way of feeding, which, if carried out correctly, will optimize the absorption of nutrients and allow the consumption of food in the necessary quantity, without exaggeration or excesses. For this to be achieved, correct chewing has a unique role, giving food the ideal crushing for absorption into the digestive tract and providing the time needed to realize the amount to be consumed.

In order to perform this important masticatory function, several organs and systems act in an integrated and interdependent way, making up the stomatognathic apparatus, which in turn is formed by bones, muscles, joints, teeth, vessels, nerves and glands<sup>1</sup>.

Chewing, one of the functions of the stomatognathic apparatus, is a complex process that mutually involves the action of various structures. Thus, from the integrated effort of the muscles that move the jaw, the teeth slide over each other cutting and grinding food into smaller particles. Based on this, the absence or inefficiency of some component of the stomatognathic apparatus can negatively influence chewing.

With the clear understanding that the active agents of the chewing process are the muscles, but that teeth are essential in this activity, one arrives the necessary observation that such dental elements must "fit perfectly" to optimize the desired function. In 1972, Andrews<sup>2</sup> identified six normal occlusion keys, describing morphologically essential dental features such as the relationship between molars, angle of crowns, inclination of crowns, tooth rotation, interproximal contacts, and occlusal arrangement curves such as Spee's.

As characteristics of the occlusion switches, it has been observed that, in general, all crowns present a positive angle for mesial (Figure 1). In addition, all upper incisors are inclined to vestibular, while canines, premolars, and upper molars are inclined to lingual. In the lower arcade, all teeth are inclined towards the lingual, and this inclination becomes more pronounced as one moves towards the posterior region<sup>3</sup>.

These inclinations/angulations aim to optimize the distribution of the masticatory forces considering the capacity for this of the spongy and compact bones adjacent to the dental position (Figure 2).

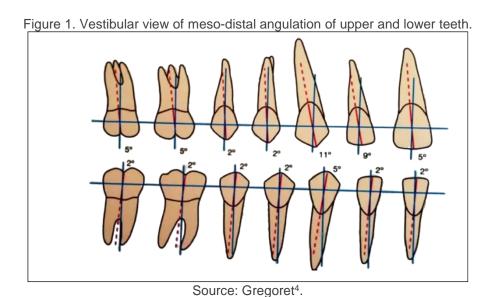
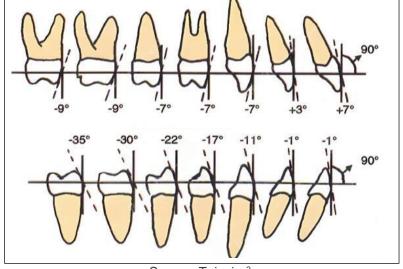


Figure 2. Proximal view of the lingual vestibule slope of the crowns of upper and lower teeth.



Source: Teixeira<sup>3</sup>.

Regarding actions to preserve oral health, we have to say that initially they were based only on healing principles.<sup>5</sup>. Thus, the first data about the oral conditions of the Brazilian population show a dental practice based on mass extractions<sup>6</sup>. Currently, although most individuals recognize the importance of preserving the integrity of dental elements, many still do not have access to dental services.

Nogueira *et al.*<sup>7</sup> points out that, because of their anatomical characteristics, permanent molars are the most commonly lost teeth. This is because their occlusal face has scarring, cesspools and narrow fissures that favor the accumulation of food and make hygienization difficult, constituting the perfect scenario for the development of caries.

Thus, such teeth are lost early, which negatively impacts the functioning of the stomatognathic apparatus.

According to Kublitski *et al.*<sup>8</sup>, tooth loss is still something recurrent in the daily life of a large part of Brazilians. Faced with this, oral rehabilitation shows itself to be an activity of paramount importance for the restoration of the function of the stomatognathic apparatus and of esthetics, which provide the individual with a better quality of life. To do so, Misch<sup>9</sup> states that there are numerous possibilities, such as rehabilitation with conventional or implant-supported dental prostheses, removable or fixed and partial or total.

In the context of rehabilitation with implant-supported fixed prostheses, in the past, as the place of installation and the inclination of the implant were established by the amount of residual bone in the region the failure rate used to be very high <sup>10.11</sup>. This is because implants installed in inadequate positions bring about the distribution of non-axial forces in the prostheses and the inadequate dissipation of the charges received. The result is an increase in the concentration of tension, with the consequent loss of the bone integration, which, according to Lindhe<sup>12</sup>, brings about clinical complications such as the loosening of screws, fracture of the prosthetic crown, bone resorption throughout the implant, besides a fracture and failure of the implant itself.

Subsequently, the desire to obtain a predictable and lasting prosthesis spurred several studies in the area of implantodontics. Among the scholars, the orthopedist Per-Ingvar Bränemark stood out, who, at the Toronto conference in 1982, presented to the world his studies about the protocol for implant-supported prostheses with a high rate of success. Thus, according to Bränemark, such a model is characterized by the installation of 4 to 6 implants in the jaw region, between the mental foramens, with distal cantilever on both sides to replace the posterior teeth, and the installation of 6 to 8 implants in the maxilla region<sup>13</sup>.

To do so, they use the so-called prosthetic components, which show small variations in accordance with the company that produces them and with the

particularities relating to the angle and inclination that each clinical case requires. Thus, Neves<sup>14</sup> proposes that the implant act as an analog of the root, that is, the artificial device that will be introduced into the bone in order to perform the functions that were previously exercised by the root. The pillar is the equivalent of the tooth's nucleus and is responsible for the union of the implant with the prosthetic crown. And finally, the prosthetic crown is the analog of the crown of the natural tooth.

Bearing this in mind, although the implant is the ideal substitute in the face of tooth loss, it does not have a periodontal ligament, whose primary function is to receive and transmit the charges along the root surface, giving protection against occlusal overloads<sup>15</sup>. In addition, in a natural tooth, such a structure is able to detect high restorations, absorb shocks, and actively participate in occlusal changes, allowing a greater adaptation to the forces of deformation and tension<sup>16</sup>. Thus, as the implant does not have the same protective mechanisms as a natural tooth, it is important that the Dentist respects the basic principles of occlusion to avoid overloads and consequently decrease the risk of treatment failure<sup>17</sup>.

To provide the correct installation location of dental implants, guides are constructed, facilitating placement in the correct locations, considering occlusal interrelation, adjacent teeth and antagonists, and also bone thickness between the implant and the mesial, distal, vestibular and lingual faces.

Note that the implant is supported by bone and it is this tissue that will dissipate the forces applied to it by the chewing process. In this sense, the objective is to analyze the respect to the bone margin of safety for implants installation both in the vestibular and in the lingual/palatine, considering the morphofunctional relevance of complying with the correct bone thickness for an optimal function of the implants as substitutes for the teeth, fundamental agents of the stomatognathic apparatus.

# 2. MATERIALS AND METHODS

The present study has a basic, deductive, quantitative and descriptive nature, approved by the Research Ethics Committee of the Federal University of Uberlândia (CAAE 95742918.7.0000.5152). It was carried out by means of the computerized tomography (CT's) analysis of the archive of the CEDDRO Ltda Clinic of Uberlândia, using the software of Sirona – SIDEX 4 for analysis and measurement of the images.

The CTs that make up the sample are the first 70 that were opened, beginning in January 2021, which had dental implants performed and whose images presented a quality that allowed for measurement in a clear and safe manner.

For the analysis of the correct bone thickness on the vestibular and lingual/palatine faces for the installation of dental implants, data from Scipioni *et al.*<sup>18</sup> and Dos Santos<sup>19</sup> were used as reference.

According to Lindhe<sup>12</sup>, when a dental element is removed, about 25% of the bone volume is lost after the first year. Usually, this deterioration evolves over time, culminating in the loss of 40 to 60% of the alveolar bone volume during the first 3 years after removal. Also according to the author, vestibular bone resorption is usually more pronounced than reabsorption in the lingual/palatine portion.

In line with this, Buser *et al.*<sup>20</sup> state that for the implant to remain stable in the long term it is necessary that the vestibular bone wall has an ideal thickness of 2 mm. However, Januário *et al.*<sup>21</sup> noticed that most people had vestibular bone remnants that were less than or equal to 1 mm thick. Thus, Scipioni *et al.*<sup>18</sup> suggest that when installing an implant it is important to have a minimum bone thickness of 1 to 1.5 mm in both the vestibular and lingual/palatine portion. Dos Santos<sup>19</sup> suggests a minimum vestibular bone thickness of 1 mm. On this basis, for the analysis of the images, the following reference was adopted:

- vestibular bone remnant 1 to 1.5 mm;
- lingual/palatine bone remnant 1 to 1.5 mm.

Sirona software – Sidex 4 – was used to analyze the computed tomographs, which was always done by the same researcher. Subsequently, the images were evaluated as to the thickness of the bone remnant between the vestibular face and the cervical portion of the implant wall and as to the thickness of the bone remnant between the lingual/palatine face and the cervical portion of the implant wall. Both verifications were made on the basis of the proposal by Scipioni *et al.*<sup>18</sup> and Dos Santos<sup>19</sup>.

When a tomographic image presented more than one implant performed, all of them were measured and their data collected. Sirona's software – Sidex 4 was also used to carry out the measurements. Finally, the collected data were evaluated by means of descriptive statistical analysis of percentage and submitted to the Mann Whitney test, using the BioEstat 5.0 program, with significance degree of p < 0.05. To this end, the following crossings were carried out:

- general vestibular bone thickness x General lingual/palatine bone thickness;
- anterior vestibular bone thickness x Anterior lingual/palatine bone thickness;
- posterior vestibular bone thickness x Lingual bone thickness/posterior palate;
- anterior vestibular bone thickness x Posterior vestibular bone thickness;
- lingual bone thickness/anterior palate x Lingual bone thickness/posterior palate.

# 3. RESULTS

The dimensions presented below comprise the values of cervical vestibular bone thickness and lingual bone thickness/cervical palate up to the implant wall, as well as the specification of the region where the implant was installed (anterior or posterior). In addition, all measurements were obtained from the analysis of computed tomographies and measured in millimeters (mm).

Table 1. Measurement in millimeters of vestibular and lingual/palatine bone thickness in anterior and posterior implants.

Image Code			Cervical bone thickness at	Cervical lingual/palatine bone thickness in mm	
	Prev	Rear	vestibular in mm		
1.	X		0.25 mm	0.73 mm	
2.	X		0 mm	0 mm	
3.		Χ	0 mm	2.47mm	
4.		Χ	0 mm	0 mm	
5		Χ	0 mm	0 mm	
6		Χ	0 mm	0 mm	
7		Χ	0 mm	0 mm	
8		Χ	0 mm	0.85 mm	
9	X		0.76 mm	0.82 mm	
10		Χ	0 mm	0mm	
11		Х	0.10 mm	1.36mm	
12		Χ	0.87mm	0.58 mm	
13	X		1.07 mm	0.58 mm	
14	X		0.49 mm	0.35 mm	
15	Χ		1.63 mm	0.50 mm	
16		Χ	0.49 mm	1.28 mm	
17		Х	1.75 mm	0.29 mm	
18		Χ	0 mm	0 mm	
19		Х	0 mm	0 mm	
20		Χ	0 mm	0 mm	

21		Χ		0.14 mm	1.41 mm
22	Х			0.40 mm	1.57 mm
23	Х			0.92 mm	3.68 mm
24	Χ			1.00 mm	2.95mm
25	X			0.87mm	1.88mm
26	Χ			0.45 mm	2.33mm
27	X			1.14 mm	1.37mm
28	X			0.50 mm	0.86 mm
29		Х		1.06 mm	1.50 mm
30	Χ			0.51 mm	0.51 mm
31	Х			0 mm	0.89 mm
32	X			0 mm	1 mm
33		Х		0 mm	1.36mm
34		Х		0 mm	0 mm
35		Х		0 mm	0 mm
36		Χ		0 mm	0 mm
37		Х		0 mm	1.31mm
38		Χ		0 mm	1.06 mm
39	Х			2.55 mm	1.01 mm
40		Х		0.28 mm	0.28 mm
41			Х	0 mm	0 mm
42			Χ	1.06 mm	1.10 mm
43	Х			0 mm	0 mm
44	X			0.45 mm	0.45 mm
45	X			0 mm	0 mm
46	X			0 mm	0 mm
47			Х	0 mm	0 mm
48			Χ	0 mm	0 mm
49	Х			0 mm	0 mm
50			Χ	0 mm	0 mm
51			Х	0 mm	0 mm
52			Χ	0.87mm	0 mm
53	X			0 mm	0 mm
54	X			0 mm	0 mm
55			Х	0.29 mm	3.78 mm
56			Х	0 mm	3.88mm
57			Х	0 mm	0 mm
58			Х	0 mm	0 mm
59			Х	0 mm	0 mm
60			Χ	0 mm	0 mm
61	Х			0 mm	0 mm
62			Χ	0.58 mm	2.33mm
63			Х	0 mm	0 mm

64		Х	0 mm	0 mm
65		Х	0 mm	0 mm
66	Χ		0.65 mm	1.98mm
67		Х	0 mm	1.48 mm
68		Χ	0 mm	1.20 mm
69		Χ	1.06 mm	0 mm
70	Χ		0.74 mm	1.61 mm

Source: The author.

Table 2 provides an important summary of the data presented in Table 1, where information regarding 70 images was collected, allowing an analysis of the collected data.

Table 2. Distribution of the images analyzed in the study.

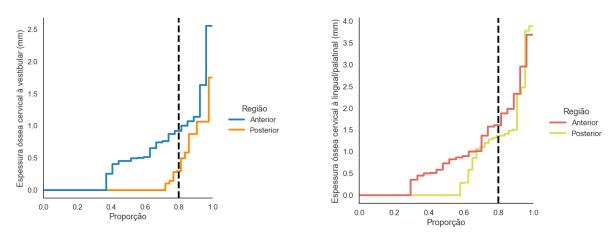
		Previous Region	Back Region	Total
Number of images Mean and standard deviation of cervical bone thickness (mm)	27		43	70
To the entrance exam		$0.5326 \pm 0.6036$	$0.1989 \pm 0.4087$	
Lingual/palatinal		$0.9285 \pm 0.9749$	$0.6400 \pm 0.9969$	

Source: The author.

The 70 images analyzed in this study are divided into two groups, i.e., the Anterior Region with 27 and the Posterior Region with 43 images. The mean  $\pm$  standard deviation of cervical bone thickness in mm at the vestibular for both regions was 0.5326  $\pm$  0.6036 for the Anterior and 0.1989  $\pm$  0.4087 for the Posterior, for the lingual/palatinal was 0.9285  $\pm$  0.9749 for the Anterior and 0.6400  $\pm$  0.9969 for the Posterior, showing a higher mean value for cervical bone thickness at the lingual palatinal in relation to the vestibular.

The *Empirical Cumulative Distribution Function* (ECDF) used in this work for the construction of Figure 3 is a useful tool in exploring data distribution, enabling a better visualization of the distribution of relevant characteristics<sup>22</sup>. Figure 3 provides a comparison for cervical bone thickness to the vestibular and lingual/palatinal regions, considering the anterior and posterior regions.

Figure 3. Empirical Cumulative Distribution function of cervical bone thickness in mm a) to vestibular and b) to lingual/palatinal.



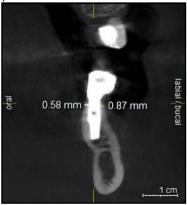
Source: The author.

It is noted by Figure 3 item a) that 80% of the images analyzed in this study have cervical bone thickness ranging from 0 to 1.00 mm for the Anterior region and 0 to 0.35 mm for the Posterior region and when considering Figure 3 item b) the lingual/palatinal thickness range has values ranging from 0 to 1.30 mm for the Anterior region and 0 to 1.60 mm for the Posterior region with the same proportion of images.

Still considering the data presented in Table 1, among the seventy implants evaluated, it is important to highlight that eleven implants were found with vestibular and lingual/palatine bone remnant below the recommended value (images n° 1, 8, 9, 12, 14, 28, 30, 31, 40, 44 and 52); three implants with appropriate vestibular bone remnant, but with lingual/palatine bone remnant below the recommended value (images n° 13, 15 and 17); and twenty implants with bone remnant suitable palatine, but with vestibular bone remnant below that recommended (images no. 3, 11, 16, 21, 22, 23, 25, 26, 32, 36, 37, 38, 55, 56, 62, 66, 67, 68, 69 and 70).

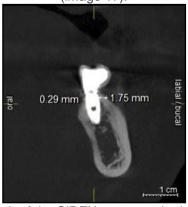
Finally, thirty-one implants with no vestibular and lingual/palatine bone remnant were found in the cervical region of the implant (images no. 2, 4, 5, 6, 7, 10, 18, 19, 20, 34, 35, 36, 41, 43, 45, 46, 47, 48, 49, 50, 51, 53, 54, 57, 58, 59, 60, 61, 63, 63, 64 and 64 5); and five implants with both vestibular bone remnant and lingual/palatine bone remnant suitable as recommended by the literature (images n° 24, 27, 29, 39 and 42).

Figure 4. Vestibular and lingual/palatine bone remnants below recommended value (image 12).



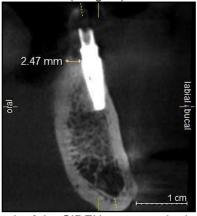
Source: Photograph of the SIDEX program obtained by the author.

Figure 5. Suitable vestibular bone remnant and lingual/palatine bone remnant below recommended (image 17).



Source: Photograph of the SIDEX program obtained by the author.

Figure 6. Adequate lingual/palatine bone remnant and vestibular bone remnant below recommended (image 3).



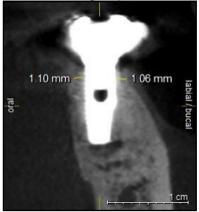
Source: Photograph of the SIDEX program obtained by the author.

Figure 7. Absence of vestibular and lingual/palatine bone remnants in the cervical region of the implant (image 64).



Source: Photograph of the SIDEX program obtained by the author.

Figure 8. Adequate vestibular and lingual/palatine bone remnants (image 42).



Source: Photograph of the SIDEX program obtained by the author.

After the data collected were submitted to the statistical test, the crossings that showed significant results were A (general vestibular bone thickness X general lingual bone thickness/general palate) with p = 0.0178 and Cp(posterior vestibular bone thickness X posterior lingual bone thickness/posterior palatine).

# 4. DISCUSSION

In a scenario in which tooth loss is still a widely occurring reality, implantodontics stands out as the best alternative for oral rehabilitation. Considering that the implants are supported by bone and that this is responsible for dissipating the masticatory forces, respect for the morphological and technical bases for carrying out the implants in dental practice permeates non-negotiable criteria for the success of what was

previously planned. However, the results found in the present study demonstrated weaknesses in this observation.

Currently, there are several designs of implants in the dental market, most of the systems being composed of an intraosseous portion (implant itself) and a transmucosal connection (intermediate). Based on this, three models stand out: external hexagon, internal hexagon and morse cone<sup>23</sup>.

Proposed by Bränemark, the external hexagon system has as its components the prosthetic screw and a connection in the form of a hexagon that acts as an anti-rotational mechanism and is located above the implant. Another system, the internal hexagon, has as its components the prosthetic screw and a connection also in the form of a hexagon and with anti-rotational action, though located in the internal portion of the implant. Conceived in 1985, the cone morse system presents as components the prosthetic screw and a cone-shaped connection that connects internally with the implant<sup>24</sup>.

In addition, bone remodeling in the periimplantar cervical region is a reality for all osseointegrated implants<sup>24</sup>. Thus, considering the hexagonal systems, a loss of approximately 1 mm in height is expected over the first year and about 0.1 mm in each subsequent year <sup>25,26</sup>. There are several assumptions about the reason for this resorption, highlighting the theory that the most expressive loss in the first year after installation comes from the attempt to form an alveolar bone crest similar to the natural tooth, while the least expressive loss in subsequent years is due to the masticatory load and the action of bacteria and their bacterial products<sup>27,28</sup>.

Considering the cone morse system, according to the study by Akça and Chreli<sup>29</sup>, it is expected for implants with internal conical type connection a loss in height lower than that proposed for hexagonal systems. This is because the authors of such a study proposed that the conical structure is less prone to bacterial infiltration and consequently has little relation to marginal bone loss.

Therefore, the recurrent physiological bone loss in the different types of implant is not sufficient to justify the results found in this study with vestibular and/or lingual/palatine bone remnant, measured in the cervical region of the implants in the transverse direction, below that recommended by the literature. This is because, even if one were to take into consideration the great time passed since the installation of the implants, so relevant bone loss, far exceeds the millimeters expected for this minoration.

Regarding the intrinsic factors to the patient, it is important to take into consideration the age of the patient and the region where the implant was installed (anterior or posterior). Then, according to Hwang *et al.*<sup>30</sup>, with the advancement of age the individual becomes more prone to being affected by local diseases, such as dry mouth and reabsorption of the edge, by systemic diseases, such as osteoporosis and diabetes, besides showing greater difficulty in adapting muscles. Thinking about the success of the implant, osteoporosis, a condition marked by the reduction in bone mass due to the prevalence of reabsorption over deposition, is one of the diseases related to aging that are of great concern to the dental surgeon. However, Johnson *et al.*<sup>31</sup> claim that the jaw and jaw function differently from the rest of the skeleton and therefore osteoporosis affects such bones differently. Furthermore, some studies show that, despite the alterations suffered, the osteoporotic bone preserves a healing capacity, at least minimally adequate<sup>30</sup>.

Also in this sense, Hwang *et al.*<sup>30</sup> point out that most clinical studies do not relate the patient's age to the failure of the implant, since the systemic and local factors mentioned above can be adjusted by the joint action of the dental surgeon with other health professionals and the installation of the implants can be done without great efforts through adequate surgical planning. With this science, the age of the patient, although relevant, also does not seem to be sufficient to justify the large amount of results found in this research below that recommended by the literature.

Regarding the implant installation region, Katranji, Misch and Wang<sup>32</sup> conducted a study to determine the average thickness of bone in the toothless jaw. They evaluated that immediately after the extraction, both the anterior and posterior region of the maxilla showed greater vestibular and lingual/palatine cortical bone thickness than the respective regions in the mandible. However, the same authors found that after a certain period after extraction, the thickness of vestibular and lingual/palatine cortical bone of the anterior and posterior region of the jaw was greater than or equal to the jaw.

With regard to region, the study cited above supports the inference that region is not a determining factor for the lack of vestibular and/or lingual/palatine bone observed in this study, considering that measurements were not made immediately after extraction, both the anterior and posterior region of maxilla and jaw presented implants with vestibular and lingual bone thickness below that recommended by the literature. Therefore, the

region of installation (before or after) also does not appear to have an influence on the so many measurements below that recommended by the literature.

Based on what was proposed by Ramalho-Ferreira *et al.*<sup>33</sup>, the results found in the present study may be related, among other factors, to the implant installation in an unfavorable position and angle, which is very common when the professional does not make a proper surgical-prosthetic planning, as well as when he does not use surgical guide or computerized tomographies as important auxiliaries.

The surgical-prosthetic planning takes into account a number of factors, among them the evaluation of the quantity of bone remaining after tooth extraction, since the bone undergoes resorption and makes the installation of the implant unfeasible; the evaluation of bone quality, which can interfere in the locking and in the primary stability of the implant; the evaluation of anatomical limitations, since they can limit the number and length of implants; and the evaluation of the shape of the edendulum edge in the direction V-L (language vestibule) and I-G (gingival incision), which interferes with the acquisition of an adequate esthetics. <sup>34</sup>.

According to Cehreli *et al.*<sup>35</sup>, the surgical guide aims to optimize the correct positioning for implant installation, because its channels guide the drills so that they do not divert the angulation during surgery.

It is also noted that, according to Iplikcioglu *et al.*<sup>36</sup>, computed tomography provides images of the cross section and these allow the assessment of the most suitable place for implant installation.

Therefore, considering the above, the inadequate prosthetic-surgical planning and the non-use of surgical guide and computed tomography as auxiliary, generate losses in the installation of the implants, as observed in this work, resulting in deficiencies for chewing, swallowing, hygiene, aesthetics and in the very longevity of the implant.

# 5. CONCLUSIONS

After analyzing the results found, it was concluded that:

1. there is a low consideration as to the amount of bone required for proper installation of the implants, noting that in 88.8% of the images analyzed referring to the anterior region, the non-compliance of the bone margin of safety recommended by the

- literature was found, either in the vestibular portion, in the lingual/palatine or in both and that in the posterior region this technical failure is 95.5%;
- 2. from the observed shortcomings, it is inferred that the most suitable image collection technique for carrying out the implants is not being used, that is to say, computerized tomography. Note that panoramic x-rays do not present images with adequate confidence for the millimeter structures to be considered;
- there is an urgent need for the dissemination of data that causes professionals to be concerned with the most accurate planning for carrying out dental implants;

Future research with longitudinal data on the longevity and functionality of implants deserves attention.

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# **CHAPTER 2**

# MICROBIOLOGICAL ANALYSIS OF ABSORBENT PAPER TIPS USED IN ENDODONTICS

# Yanka Alves Bourguignon

Bachelor of Dentistry

Institution: Centro Universitário Multivix Vitória

Address: Vitória, Espírito Santo, Brazil E-mail: yankaalves75@outlook.com

### Willian Ferreira Azevedo

Graduate in Dentistry

Institution: Centro Universitário Multivix Vitória

Address: Vitória, Espírito Santo, Brazil E-mail: Willianazevedo89@gmail.com

# Gabrielly Fernanda Gonçalves de Campos

Bachelor of Dentistry

Institution: Centro Universitário Multivix Vitória

Address: Vitória, Espírito Santo, Brazil E-mail: drafernandagcampos@outlook.com

# Letícia Krobel da Cunha Kiill

Graduate Student in Dentistry

Institution: Centro Universitário Multivix Vitória

Address: Vitória, Espírito Santo, Brazil E-mail: leeticiakrobel@gmail.com

# Daniela Fardim da Silva

Graduate Student in Dentistry

Institution: Centro Universitário Multivix Vitória

Address: Vitória, Espírito Santo, Brazil E-mail: fardim contato@hotmail.com

# **Daniela Pertel Milleri**

Master in Clinical Dentistry

Institution: Universidade Federal do Espírito Santo (UFES)

Address: Vitória, Espírito Santo, Brazil E-mail: pertel.daniela@gmail.com

# Kleber Borgo Kill

Doctor in Dentistry

Institution: Universidade Federal do Espírito Santo (UFES)

Address: Vitória, Espírito Santo, Brazil

E-mail: kleberkill68@gmail.com

ABSTRACT: In order to reduce the risk of contamination during the filling stage of endodontic treatment, it is of paramount importance that the absorbent paper tips used in drying the root canals are adequately sterile. In this context, dental surgeons need to be aware of which brands of nominally sterile absorbent paper tips by the manufacturer, really present such a condition. The present study objective to analyze the microbiological condition of absorbent paper tips from the Meta Biomed, Dentsply and Tanari brands. An experimental research was carried out by microbiological analysis with 108 absorbent paper tips, confining itself to the Meta Biomed, Dentsply and Tanari brands, of caliber 0.45 to 0.80, all in Cell Pack type packaging denominated sterile by their manufacturers and within the expiration date. The samples, inserted into test tubes containing BIH broth, were stored in a bacteriological oven at 37°C and analyzed after 72h by verification of the cloudiness of the culture medium. In total, nine sealedboxes of absorbent paper tips were analyzed. Of the three brands evaluated in this experiment the Tanari brand presented cloudiness of the culture medium. In all. contamination was found in 11 of his samples. From a microbiological point of view, only the Dentsply and Meta Biomedbrands have proved to be suitable for use during treatment of the root channels.

**KEYWORDS:** absorbent paper tips, contamination, endodontics, sterilization, microorganisms.

RESUMO: Para que se possa diminuir os riscos de contaminação na etapa da obturação do tratamento endodôntico, é de suma importância que as pontas de papel absorvente utilizadas na secagem dos canais radiculares estejam devidamente estéreis. Neste contexto, os cirurgiões-dentistas precisam ter conhecimento de quais marcas de pontas de papel absorvente nominalmente estéreis pelo fabricante, apresentam realmente tal condição. O presente estudo teve como objetivo analisar a condição microbiológica de pontas de papel absorvente das marcas Meta Biomed, Dentsply e Tanari. Foi realizada uma pesquisa experimental por meio de análise microbiológica com 108 pontas de papel absorventes, delimitando-se às marcas Meta Biomed, Dentsply e Tanari, de calibre 0,45 a 0,80, todas em embalagens tipo Cell Pack denominadas estéreis por seus fabricantes e dentro do prazo de validade. As amostras, inseridas em tubos de ensaio contendo caldo BIH, foram armazenadas em estufa bacteriológica a 37°C e analisadas após 72h por verificação do turvamento do meio de cultura. No total, foram analisadas nove caixas lacradas de pontas de papel absorvente. Das três marcas avaliadas neste experimento, a marca Tanari apresentou turvamento do meio de cultura. No total, foi constatada contaminação em 11 de suas amostras. Do ponto de vista microbiológico, apenas as marcas Dentsply e Meta Biomed se mostraram adequadas ao uso durante o tratamento dos canais radiculares.

**PALAVRAS-CHAVE:** pontas de papel absorvente, contaminação, endodontia, esterilização, microrganismos.

# 1. INTRODUCTION

During endodontic treatment, breaking the aseptic chain by lack of a strict aseptic protocol can lead to access of microorganisms within the root channels, which can lead to perirradicular pathologies. After chemical-mechanical preparation, the disinfected environment is maintained by filling (Aguiar *et al.*, 2020; Santos *et al.*, 2020).

At this stage, it is extremely important that the channels are free of humidity for a better sealing to occur, creating a barrier against the entry of microorganisms. In this sense, absorbent paper tips are a great option for drying root canals (Marion *et al.*, 2014).

According to Leonardo *et al.* (1997), contaminated instruments can introduce micro-organisms into root canals, which can contribute to the installation and persistence of endodontic diseases. For this reason, gutta-percha cones and absorbent paper tips should also be free from microbial load at the time they are used (Almeida, 2010, p. 81, apud Leonardo *et al.*, p. 31-2, 1997)

The tips of absorbent paper can be sold in plastic boxes that contain about 120 units of standard size and separated by a plastic partition, a form of packaging that does not allow for the maintenance of the sterility of the product. For this type of packaging, the best solution would be to sterilize the tips of paper before their use. However, when submitted to sterilization methods, the tips of paper cannot be compromised as to their capacity for absorption. As far as this issue is concerned, the literature shows that it is not advisable to submit these materials to sterilization procedures at high temperatures, such as autoclave, as it can cause changes in their absorption capacity (Lopes; Siqueira Júnior, 2020).

According to Prado *et al.* (2012) and Abu-Melha, *et al.* (2018) due to the contamination of the absorbent paper tips stored in single and non-sterile boxes, Cell Pack-type packaging, nominally sterile by manufacturers, has started to be marketed. Such tips of paper are stored individually in cells, in small quantities. The main purpose of this type of packaging is to prevent the contamination of the paper tips of the remaining "cells", making them suitable for use in a future endodontic treatment.

In a study by Almeida *et al.* (2010), 114 absorbent paper tips of the Dentsply, Roeko and Endopoints brands were analyzed and it was observed that the paper tips of the Dentsply and Roeko brands did not show contamination. The tips of the Endopoints brand showed contamination in all the samples evaluated. Silva (2016), analyzing 160 tips of

paper absorbing random marks, used by students in the Dentistry course at the Federal University of Rio Grande do Sul, found that 48 tips were contaminated.

Xavier *et al.* (2014) carried out a microbiological study with absorbent paper tips, from the brands Dentsply (conventional packaging), Endo Points (conventional packaging) and Endo Points (cell pack packaging). It was observed that of the 180 samples, 73 were contaminated, which is equivalent to 41% of the tips used in the research.

In clinical practice, the dental surgeon is not able to demonstrate the presence of microbial load on the tips of absorbent paper, and is therefore dependent on the information provided by the manufacturer. Unfortunately, studies show that the information provided by the manufacturer of some brands tested, is not true (Almeida *et al.*, 2010).

In this context, the present study aims to analyze the microbiological condition of absorbent paper tips of the brands Meta Biomed, Dentsply and Tanari denominated as sterile by the manufacturer.

# 2. RESEARCH METHODOLOGY AND METHOD

An analysis of the microbiological condition of 108 tips of absorbent paper called sterile by their manufacturers was carried out. For this, three different trademarks were selected, from 0.45 to 0.80 caliber. In total, nine sealed boxes of absorbent paper tips were tested, making three boxes for each brand, all in "Cell Pack" packaging and within the expiration date. The boxes of the same brand belonged to different manufacturing batches.

The brands chosen for the experiment were Tanari (Tanariman Industrial Ltda, Manacapuru – AM, Brazil), Dentsply (DENTSPLY Indústria e Comércio Ltda, Pirassununga – SP, Brazil) and Meta Biomed (Meta Biomed Co, Brazil). LTD, Cheongju — Korea). For better identification, the tips of paper were divided into groups where each corresponds to its trademark, and into subgroups according to its manufacturing batches (Table 1).

Table 1 – Sample division into groups and subgroups.

	Group 1	Group 2	Group 3
	Tanari	Dentsply	Meta Biomed
Sub-group 1	Lot 0122108P	Lot 362212L	Lot PE19111241
Sub-group 2	Lot 0221101P	Lot 361433L	Batch PE2103U181
Sub-group 3	Lot 0322110P	Lot 377472N	Batch PE2203U296

Source: Produced by the authors, 2023.

# 2.1 BHI BROTH - BRAIN HEART INFUSION BROTH

300mL of the BHI broth was prepared, in the proportion of 11 grams of powder, weighed in precision scales, dissolved in 300mL of distilled water, following the recommended proportion of 37 grams for each 1000mL of distilled water. The prepared broth was distributed in 60 test tubes with the aid of a graduated pipette, 5 mL of the broth were inserted into each tube. Afterwards, all the tubes were closed and submitted to the sterilization process in an autoclave for 15 minutes at a temperature of 121°C. All tubes were kept in a refrigerator until the time of their use.

BHI is a very nutrient-rich broth of the heart and brain. It is clear and yellowish in color. BHI induces the growth of microorganisms when they are present and can be seen by clouding of the culture medium. It is indicated for the cultivation of bacteria, yeasts and fungi (Salvatierra, 2014).

# 2.2 MICROBIOLOGICAL COLLECTION

The experiment was run on three different days. Twenty tubes containing the BHI broth were used each day and were prepared and autoclaved. On the first day, 40 Tanari tips were used, among them 2 tips for positive control and 2 tips for negative control. After decontamination with sterile alcohol gauze 70% of the cell-pack packaging, with the help of a sterile clinical clamp for each cell, the paper tips were carefully removed and manipulated around the Bunsen burner. Two tips of each caliber of the selected marks were immersed in the test tubes, numbered according to their groups and subgroups, containing the BHI culture medium. Soon after, the tubes containing the tips were stored in a bacteriological greenhouse at 37°C for 72 hours and subsequently analyzed. The experiment with the Dentsply and Meta Biomed brands followed suit.

In addition to the experimental groups, positive control was performed on each of the 3 days of the experiment, where two paper absorbent tips of each brand, purposefully contaminated, were immersed in a test tube containing the BHI culture medium. Negative control was also performed, where 2 tips were sterile in autoclave to confirm their sterility. In total, 120 absorbent paper tips were used, among these, 6 were used for positive control and 6 for negative control.

After the period of 72 hours, the reading was done, observing which tubes showed cloudiness of the BHI culture medium, representing bacterial growth, that is, the presence of microorganisms in the samples.

# 3. RESULTS AND DISCUSSION

Among the three brands of absorbent paper tips analyzed, the Tanari brand presented cloudiness in 5 samples of lot 0122108P, as well as in all samples of lot 0221101P, totaling contamination in 11 samples, which makes up 61% of all samples of the Tanari brand. Samples from batch 0322110P were not cloudy. No signs of contamination were observed in the samples of any batch of the Dentsply and Meta Biomed brands (Table 2).

Table 2 – Distribution of samples with respect to their microbiological condition

	Tanari	Dentsply	Meta Biomed	Total
Contaminated samples	11	0	0	11
Samples free from contamination	7	18	18	43

Source: Produced by the authors, 2023.

Sample classification is a categorical nominal dichotomous variable (turbidity/no change) and when tested with polychomic variables (Tanari, Dentsply and Meta Biomed), the indicated test was Chi-square. The statistical tests were performed in Microsoft Excel®. There was a statistically significant difference (p = 6.8x10<sup>-5</sup>). The level of significance established for the tests was 5%, which established a 95% confidence interval.

The literature shows studies that investigated the presence of contamination in tips of absorbent paper of different brands and in Cell Pack type packaging, having found flaws in sterility in some brands, although the materials are marketed as sterile

inside their respective packaging. Silva *et al.* (2018) noted that both the ends packaged in Cell Pack and conventional packaging showed some degree of contamination. Confirming that there is indeed the possibility of absorbent paper tips marketed as sterile, presenting microbial contamination. In the study by Xavier *et al.* (2014) contamination was found in 73 of the 180 samples evaluated, which is equivalent to 41% of the tips used in the research. Therefore, the aforementioned research corroborates with the present analysis, which attested to the existence of sterility flaws of the Tanari samples.

Studies that carried out tests on tips of absorbent paper of the Tanari brand found the presence of microbial charge. Leonardo *et al.* (1997) observed in their research 66.6% contamination in the Tanari brand samples taken from individual packages and 70.8% taken from assorted packages (Almeida *et al.*, 2010, p. 82, apud Leonardo *et al.*, p. 2-31, 1997). The percentages cited resemble the result of 61% contamination of the Tanari brand obtained in this work.

Lins et al. (2014) analyzed the microbiological condition of the Cell Pack absorbent paper tips of the Roeko, Dentsply, Tanari and Meta brands, it was possible to find contamination of the Tanari and Roeko brands, and absence of contamination of the Dentsply and Meta brands. These results are in agreement with the data obtained in the report, in which contamination was evidenced in samples of the Tanari brand, and absence of microbial load of the brands Dentsply and Meta Biomed.

# 4. FINAL CONSIDERATIONS

Of the three paper tip marks evaluated in this experiment, the Tanari brand was the only one to show cloudiness of the culture medium in its samples, evidencing contamination in two of its three batches evaluated. The paper tips of the Dentsply and Meta Biomed brands showed no signs of microbial contamination, demonstrating that they are, from the microbiological point of view, suitable for use during the treatment of the root channels.

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# **CHAPTER 3**

CONSERVATIVE TREATMENT OF DENTIGEROUS CYST ASSOCIATED WITH ADENOMATOID ODONTOGENIC TUMOR IN MAXILLARY SINUS: CASE REPORT

#### Júlia Sobral Sousa

Graduate in Dentistry

Institution: Universidade Potiguar (UnP) Address: Natal, Rio Grande do Norte, Brazil

E-mail: juliasobral6@hotmail.com

# Janayna Soares Luciano

Graduate in Dentistry

Institution: Universidade Potiguar (UnP) Address: Natal, Rio Grande do Norte, Brazil

E-mail: lucianojanayna@gmail.com

# Leonardo Magalhães Carlan

Doctorate Student in Dental Sciences from the Universidade Federal do Rio Grande

do Norte (UFRN)

Institution: Universidade Potiguar (UnP) Address: Natal, Rio Grande do Norte, Brazil E-mail: Imcarlan.estomatopato@gmail.com

# Gentil Homem de Araújo Neto

Master in Dentistry from the Universidade Federal de Uberlândia (UFU)

Institution: Universidade Potiguar (UnP)
Address: Natal, Rio Grande do Norte, Brazil

E-mail: gentilhaneto@hotmail.com

# Francisco de Assis de Souza Junior

Doctor in Dental Clinics from the Universidade Federal do Rio Grande do Norte (UFRN)

Institution: Universidade Potiguar (UnP) Address: Natal, Rio Grande do Norte, Brazil

E-mail: souzajuniorfa@hotmail.com

ABSTRACT: The dentigerous cyst is the most common type of developmental odontogenic cyst and the second most frequent among all that occur in the jaws, which develops from the accumulation of fluid between the reduced epithelium of the enamel organ and the crown of a tooth not erupted. They are frequently associated with lower third molars and upper canines and less frequently with upper third molars and lower second premolars, with a greater predilection for the mandibular bone. In view of the management, enucleation and marsupialization are the classic techniques for treatment, as we are in an era that opts for more conservative procedures, the choice was marsupialization, with the aim of decompressing it for a reduction of the bone defect and subsequent removal of it in outpatient setting under conscious drug

sedation. The aim of this study is report a conservative treatment of a rare case of a large dentigerous cyst associated with a third molar inside the left maxillary sinus in a young patient.

**KEYWORDS:** dentigerous cyst, marsupialization, conservative treatment, maxillary sinus.

**RESUMO:** O cisto dentígero é o tipo mais comum dos cistos odontogênicos de desenvolvimento e o segundo mais frequente entre todos que ocorrem nos maxilares, o qual se desenvolve a partir do acúmulo de fluido entre o epitélio reduzido do orgão do esmalte e a coroa de um dente não irrompido. Frequentemente, estão associados aos terceiros molares inferiores e caninos superiores e com menos frequência aos terceiros molares superiores e segundo pré-molares inferiores, com uma maior predileção pelo osso mandibular. Diante ao manejo, a enucleção e marsupialização são as técnicas clássicas para tratamento, ao estarmos em uma era que se optapor procedimentos mais conservadores, a escolha foi a marsupialização, com intuito descomprimi-lo para uma redução do defeito ósseo e posterior remoção deste em ambiente ambulatorial sob sedação medicamentosa consciente. O presente trabalho tem como objetivo relatar um tratamento conservador de um raro caso de um cisto dentígero de grande proporção associado a um terceiro molar no interior do seio maxilaresquerdo em um paciente jovem.

**PALAVRAS-CHAVE:** cisto dentígero, marsupialização, tratamento conservador, seio maxilar.

#### 1. INTRODUCTION

An epithelial-coated cyst with a liquid or semi-solid content inside is a unique characteristic of gnatic bones. Odontogenic cysts are found quite frequently in dental practice, and are therefore studied extensively. (Neville *et al.*, 2009).

According to their origin, they are subclassified into inflammatory cysts, if they result from inflammation, or development cysts, which are generally credited to an alteration in the growth of cells, such as epithelial remains of malassez and others being of unknown origin (Neville *et al.*, 2009).

In the group of inflammatory cysts, we find: root cyst; residual cyst; vestibular bifurcation cyst. Among these, the root cyst is the most clinically significant for dentists, as it is the most common cystic lesion found in the jaw bones, representing more than 50% of all odontogenic cysts (Neville *et al.* 2009; Nigel *et al.*, 2012).

Already, in the group of development cysts, we find: tooth cyst; eruption cyst; keratocyst; orthokeratinizing odontogenic cyst; adult gingival cyst; newborn gingival cyst; lateral periodontal cyst; calcifying odontogenic cyst; glandular odontogenic cyst. Of these, the tooth cyst is the most common, accounting for about 20% of all epithelial-coated cysts (Neville *et al.* 2009; Nigel *et al.*, 2012).

The tooth cyst develops from the accumulation of fluid between the reduced enamel epithelium and the crown of the unbroken tooth, being most common in the lower third molars, accounting for 65% of all cases. With a lower frequency are found associated with the upper canines, upper third molars and lower premolar seconds (Neville *et al.*, 2009., Siqueira *et al.*, 2016). In addition, they are occasionally associated with supernumerary teeth or odontomas (Neville *et al.*, 2009., Yong Lee *et al.*, 2019., Giustina. *et al.*, 2012).

The vast majority of them, being asymptomatic, are discovered in routine radiographic examinations, but in some cases they can grow too much, thus generating pain and facial asymmetry. For a correct diagnosis, a good clinical examination is necessary, associated with complementary, radiographic and histopathological examinations (Neville *et al.*, 2009., Siqueira *et al.*, 2016).

Radiographically, it is presented as a unilocular radiolucent area with welldefined margins associated with tooth crown at the cementenamel junction; moreover, in cases where the cyst takes large proportions, it may result in root resorption of adjacent teeth (Neville et al., 2009).

Histologically, the characteristics of the tooth cyst are variable. If it is not inflamed, it has a capsule of loose, slender connective tissue, lined with non-ceratinized epithelial cells, composed of two or three layers of flat or cuboidal cells. When there is an infection, secondary present, the connective tissue is denser, with variable infiltration of chronic inflammatory cells. Coating epithelium may have varying levels of hyperplasia, with development of epithelial ridges with more marked squamous features (Neville *et al.*, 2009).

Before treating a cystic lesion, it is of paramount importance to perform a biopsy, with the intention of discarding odontogenic tumors and vascular lesions, since it is known that keratocystic odontogenic tumor and unicystic ameloblastoma, can present similar clinical-radiographic characteristics, which are part of the differential diagnoses of this lesion. It is worth noting that in intraosseous lesions an intralesional puncture is required.

Treatment management may consist of enucleation and marsupialization of the cyst with removal of the associated tooth. Which are classic techniques enshrined in literature and numerous case reports. As criteria of choice we must take into consideration the size of the cystic cavity, the age of the patient, the teeth involved and the proximity to the anatomical structures.

Enucleation is the therapy of choice for smaller cysts and when there is no continuity with important anatomical structures. Extensive lesions can be treated by marsupialization, which aims to communicate the lesion with the oral cavity, which results in a decrease in cystic internal pressure, therefore results in a reduction in the size of the bone defect and thus minimizes the risk of damage to important anatomical structures, besides leaving a more favorable environment for later enucleation (Caliento *et al.*, 2013; Rajae *et al.*, 2021).

Regardless of the treatment chosen, the prognosis of this lesion is favorable and has a low rate of recurrence, when a suitable treatment plan is employed (Caliento *et al.*, 2013; Bertolo *et al.*, 2017). However, dentistry increasingly advocates minimally invasive and conservative treatments.

It is worth mentioning, that rarely this cyst undergoes neoplastic transformation, but when it occurs, they are associated with ameloblastoma, squamous cell carcinomas and intra-osseous muscoepidemoid carcinoma. Bilodeau *et al.*, 2017; Panneerselvam *et al.*, 2017).

#### 2. METHODOLOGY

The present study proposes to present a conservative treatment of a rare and complex case of a tooth cyst within the maxillary sinus under conscious drug sedation in an outpatient environment through clinical case reporting. Thus, in accordance with the knowledge of clinical practice and based on the scientific literature on the subject addressed, and considering the different possibilities of conduction of the presented case, it was proposed to perform, first, marsupialization with the objective of decompressing it for a reduction of the bone defect and subsequent removal of it by surgical procedure. The patient in question signed the Consent Form, allowing participation in the study prior to the start of treatment, as well as the procedures followed were in accordance with ethical standards in human research according to the Declaration of Helsinki of 1975, as revised in 1983.

#### 3. CASE REPORTING

Male patient M.L.M., 16 years old, sought dental care at the Academic League of Stomatology and Oral Pathology of Rio Grande do Norte at the Solon Galvão Clinic (*Universidade Potiguar – UnP*, Natal-RN, Brazil) with complaint of increased volume in the left maxilla region. In history, it was asymptomatic, without paresthesias, hypoesthesias or other complaints. He reported being a carrier of type 2 diabetes mellitus and allergic to dyes. At the extraoral clinical examination, an increase in volume was observed in the infraorbital region. On intraoral physical examination, a purplish nodule of 5 cm with sessile base and floating consistency was noted in the posterior region of the left maxilla.

After clinical evaluation, supplementary examinations were requested, the panoramic radiography demonstrated an extensive radiolucent lesion, circumscribed and well delimited by radiopaque halo, involving a dental element in its major part of the maxillary sinus, suggestive of cystic injury.

To complement the necessary documentation, the patient was submitted to the tomography, which visualized a hypodense osteolytic extensive unilocular lesion involving the crown of the third molar included in the inside of the left maxillary sinus, causing veiling of the latter, as well as root resorption of elements 26 and 27 (Figure 1).

As initial diagnostic hypotheses, the possibilities of keratocystic odontogenic tumor, unicystic ameloblastoma, adenomatoid odontogenic tumor and tooth cyst were raised.





Source: Authors (2022).

#### 4. BIOPSY PERFORMANCE

In this case, to confirm the cystic nature of the lesion, the FAP (Fine Needle Aspirative Puncture) was performed in an outpatient environment, which was found to have a citrus yellow colored liquid. Subsequently, due to the proportion of the lesion and complex location, marsupialization was performed, which sutures the cyst coating to the oral mucosa, usually recommended in the literature in cases of extensive lesions, because it promotes decompression, stimulating bone neoformation and making an environment more conducive to enucleation (Figure 2). In the post-operative care, the patient was instructed to maintain strict oral hygiene and 0.9% saline irrigation, with the aid of a syringe, inside the lesion, at a frequency of 4 times a day.

The patient remained in a clinical/radiographic follow-up for one year, in which the progressive reduction of the lesion was noted, allowing, at this moment, the exodontia of the included element and the enucleation of the lesion.

Figure 2. Fine needle aspiration (A) and histopathologic lamina with diagnosis of tooth cyst.

A

B

Source: Authors (2022).

## **5. SURGICAL PHASE**

Full enucleation surgery of the lesion was performed in an outpatient environment under conscious drug sedation, with blood pressure, heart rate, peripheral oxyhemoglobin saturation and respiratory rate monitored throughout the procedure (Figure 3). Initially, two tablets were administered orally of midazolam maleate 15mg 1 hour prior to the procedure, and supplementation was required with 1 ml intravenous containing 5 mg plus 0.5 ml in each nostril of the same substance (Figure 3).



Source: Authors (2022).

Soon after, the surgery itself began, patient in dorsal decubitus, starting with anesthesia of the posterior superior alveolar nerve and infiltration in the background of the groove on the left side with mepivacaine 2% associated with epinephrine 1:100,000. The planned flap was the Caldwell-Luc technique, where a deep incision was made in the canine region until second molar exposing the anterior wall of the maxillary sinus, through a mucoperiosteal displacement (Figure 4).

Figure 4. Incision in the canine to second molar region (A) and mucoperisteal detachment (B).

Source: Authors (2022).

Subsequently, osteotomy of the vestibular wall of the maxillary sinus with diamonds (Figure 5) was performed.

Figure 5. Osteotomy of the vestibular wall of the maxillary sinus (A) and the third molar included in the left maxillary sinus (B).



Source: Authors (2022).

After proper access, the lesion was removed along with the tooth involved, thus, the cavity was cleaned with saline (Figure 6).



Source: Authors (2022).

Finally, the suture was performed with catgut 4-0 thread and 4-0 silk. The collected material was packaged in 10% formaldehyde solution and sent for histopathological examination again (Figure 7).



Source: Authors (2022).

At the end of the procedure, Clavulin 875 mg 12/12 hours post-operative medications were prescribed for a period of 7 days and celestone 1mg 12/12 hours for 3 days, in addition to recommendations of cold liquid and pasty diet for 24 hours, as well as ice compresses at the site to mitigate postoperative edema. The patient returned to the dental clinic 10 days after surgery to remove the suture and was within normal standards (Figure 8).

Figure 8. Patient after 10 days of postoperative.

Source: Authors (2022).

# 6. DISCUSSION

According to the literature, the tooth cyst has a greater predilection for the mandible (65%), in general related to included third molars, in this way we can see the rarity of the lesion inside the maxillary sinus. In their plurality, they present themselves asymptomatic, being only discovered in an early manner in unpretentious routine x-rays. However, in some cases there may be excessive cyst development, generating painful symptoms and facial asymmetry. They are more incidents in young patients, occurring between the first and third decade of life (Neville *et al.*, 2009., Siqueira *et al.*, 2016).

Therefore, the tooth cyst extending into the maxillary sinus, associated with the included third upper molar, is extremely uncommon (Bento *et al.*, 1996). In the case described, we can evaluate its extent from the images (CT) requested from the first consultation, which showed great involvement of the maxillary sinus and generating sinusitis to the patient.

In view of this, the decision of treatment should take into consideration some relevant aspects such as: age of the patient, size of the lesion, location, proximity to the anatomical structures and importance of the tooth involved (Neville *et al.*, 2009., Siqueira *et al.*, 2016). Surgical techniques include enucleation, marsupialization, decompression, or even resection, the latter being more invasive and currently considered the last treatment option, thus it is up to the professional to analyze the case and make the best choice of the therapeutic technique. In advance of any decision, it is essential to perform aspiration puncture, with the purpose of confirming cystic lesion, and biopsy so that histopathological examination confirms the diagnosis and discard lesions with similar clinical-radiographic characteristics, in addition to annual postoperative radiographic follow-up. (Caliento *et al.*, 2013).

Given the treatment of choice, marsupialization is considered a conservative treatment and is generally indicated for lesions that affect a large proportion, aims to reduce the internal pressure of the lesion with the removal of the fluid, thus resulting in bone neoformation and reduction of the lesion. While decompression differs from marsupialization by the need to use a device, thus facilitating hygienization. On the other hand, it is indispensable that the patient be routinely accompanied for a greater evaluation of the device, due to the COVID-19 virus pandemic it would not be possible to support the patient in the way that the technique needs, thus not being the procedure of choice. (Caliento *et al.* 2013; Rajae *et al.* 2021).

Enucleation, on the other hand, is considered a definitive treatment, because it is performed the exodontics of the dental element together with the cystic lesion, being the treatment of choice for small and distant lesions of anatomical structures, and may or may not be associated with marsupialization or decompression when we refer to larger lesions (Caliento *et al.*, 2013).

At the same time as the choice of treatment, it is of utmost importance to report the relevance of conscious drug sedation made with midazolam, which is a safe medicinal product with a wide therapeutic window and short half-life, thus leaving no pharmacological remains after use. In addition, he was able to control his anxiety, making him more cooperative, as well as reducing salivary flow and the gag reflex and skeletal muscle relaxation. In addition, treatment of injuries such as this is usually done in a surgical setting. With the help of this technique we can operate it in an outpatient

environment in a safe manner, bringing benefits in the cost of surgery and in a better post-operative recovery (Silva et al., 2021).

It is worth highlighting, the importance of having a reverser, flumazenil, during surgery, since in some patients the benzopiazepines can show paradoxical (contrary) effects, that is, excitation, agitation and irritability.

Prognosis of the dentigerus cyst is favorable when appropriate therapy is employed. In the case in question, the marsupialization maneuver prior to enucleation was necessary due to the intimate contact of the lesion with a large part of the maxillary sinus. Thus, after one year of marsupialization, the size of the lesion drastically reduced, and the bone malformation occurred, thus it was possible to remove the lesion completely by enucleation.

Antibiotic therapy appropriate for this treatment should prioritize broad-spectrum drugs that comprise effectiveness against aerobic and anaerobic microorganisms, for which Clavulin 875 mg was prescribed in 12/12 hours for a period of 7 days. Furthermore, as it was a surgery that had great tissue manipulation, Celestone 1mg was prescribed for 12/12 hours for 3 days, which is a corticoid with great anti-inflammatory action.

In the reported case, which was performed marsupialization followed by enucleation after one year, there was no evidence of postoperative complications referring to the technique.

#### 7. CONCLUSION

It is concluded that the decision of the chosen surgical technique is of utmost importance for the comfort and satisfactory predictability of the treatment. The choice of marsuialization gave us the assurance that there would be a reduction of the lesion favoring and reducing the risks of affecting the noble structures of the maxillary sinus. Therefore, we must take into consideration a good planning and execution of the techniques by means of the Dentist Surgeon, having fundamental importance in the success of the treatment.

Finally, it is also suggested that the previously described associated surgery techniques present advantages, showing us the efficiency and effectiveness in their favorable clinical performance and prognosis.

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# **CHAPTER 4**

## HOMEOPATHY APPLIED TO DENTISTRY

# Pedro Guimarães Sampaio Trajano dos Santos

Graduate Student in Dentistry

Institution: Faculdade de Odontologia do Recife (FOR)

Address: Recife, Pernambuco, Brazil

E-mail: pedroguimaraessampaio@gmail.com

# **Sophie Oliveira Laluce**

Graduate Student in Dentistry

Institution: Faculdade de Odontologia do Recife (FOR)

Address: Recife, Pernambuco, Brazil E-mail: sophielaluce@gmail.com

#### Lucas Cavalcanti de Lima Félix

Graduate Student in Dentistry

Institution: Faculdade de Odontologia do Recife (FOR)

Address: Recife, Pernambuco, Brazil E-mail: lucascavalcanti209@gmail.com

#### **Rut Almeida Barbosa**

Graduate Student in Dentistry

Institution: Faculdade de Odontologia do Recife (FOR)

Address: Recife, Pernambuco, Brazil E-mail: Rut\_almeida@hotmail.com

#### **Lara Martins Correia**

Graduate Student in Dentistry

Institution: Faculdade de Odontologia do Recife (FOR)

Address: Recife, Pernambuco, Brazil E-mail: laramartinscorrei@gmail.com

# **Marvin Gonçalves Duarte**

Graduate Student in Dentistry

Institution: Faculdade de Odontologia do Recife (FOR)

Address: Recife, Pernambuco, Brazil E-mail: marvingduartee@gmail.com

#### **Luciano Barreto Silva**

Doctor of Endodontics

Institution: Faculdade de Odontologia do Recife (FOR)

Address: Recife, Pernambuco, Brazil E-mail: lucianobareto63@gmail.com

ABSTRACT: Objective: To research, through literature review, the use of homeopathy as an alternative treatment for many pathologies involved in dentistry field. Methodology: online searches using databases available at PUBMED Central and VHL/BIREME. Other platforms such as Web of Science, Science Direct and Google Academy. Results: Our search resulted in 25 articles. Conclusion: Despite the mysticism that surrounds it, the use of homeopathic medicines in dental treatments is, in fact, a scientifically proven alternative treatment, which helps in various pre and post surgical procedures, which has a low financial cost and great effectiveness, enabling a contribution to dental care. Scientific study in this area requires more research and clinical evidence, so that this practice is more widespread and used by dental surgeons, in addition to the application of homeopathy as a discipline in dentistry.

**KEYWORDS:** homeopathy, homeopathic clinic, homeopathic pharmacotechnique.

RESUMO: Objetivo: Pesquisar através de revisão de literatura o uso da homeopatia como um alternativo para tratamentos para várias patologias envolvidas na área da odontologia. Metodologia: buscas online utilizando bases de dados disponíveis na PUBMED Central e BVS/BIREME. Outras plataformas como Web of Science, Science Direct e Google Academy. Resultados: Nossa busca resultou em 25 artigos. Conclusão: Apesar do misticismo que a acerca, o uso de medicamentos homeopáticos em tratamentos odontológicos é, na verdade, um tratamento alternativo comprovado cientificamente, que auxilia em diversos procedimentos pré e pós cirúrgicos, do qual possui um baixo custo financeiro e grande eficácia, possibilitando uma contribuição nos atendimentos da odontologia. O estudo científico nesta área necessita de mais pesquisas e evidências clínicas, para que essa prática seja mais disseminada e utilizada pelos cirurgiões dentistas, além da aplicação da homeopatia como disciplina na odontologia.

PALAVRAS-CHAVE: homeopatia, clínica homeopática, farmacotécnica homeopática.

#### 1. INTRODUCTION

The way of treating diseases has come along with humanity throughout its existence. At some point during its development, the first hominids discovered that some plants had therapeutic effects to alleviate symptoms of diseases or injuries caused by the daily struggle for survival, a fact that can still be contemplated nowadays, observing indigenous and others recused communities (Loaces *et al.*, 2002).

In this sense, the strength and corporate interests of pharmaceutical industries in the scientific world have, in the vast majority of cases, subjugated the use of "alternative" medicines for specific treatments or prevention of different pathologies, regardless of how they arise, often implying lack of scientific evidence for the large-scale use of such this medicine approach.

However, the scientific use of plants and other natural substances, in appropriate dilutions for each case, constitutes to the basis of the homeopathic therapy, which includes phytotherapeutic multidimensionality as one of its facets in the search for homeostasis for patients treated with its medicines (Futuro, 2010). The use of the homeopathic therapy is not recent, and the first reports seem to have appeared centuries before Christ. Therefore, the aim of this work was to carry out a narrative literature review, to address the different applications and indications of homeopathic therapy in dentistry, in comparison with traditional allopathy.

#### 2. METHODOLOGY

For the construction of this article, readings and contextualization were accomplished with the work of Mattos (2015), serving as a guideline to clarify the main differences between different literature reviews, associated with online research using the databases available at PUBMED Central and VHL/BIREME. Other platforms such as Science Direct, CAPES Portal Journal, Web of Science were used, as well as the Google Scholar, the latter being the last platform used to collect the articles. Books and periodicals were also necessary for methodological overall comprehension. Articles duplicated were reduced to one, and the data obtained by them were divided in topics organized from the state of the art as the following: history, indications, conflicts and differences with allopathy; as well as the philosophy and principles that differ from one another.

#### 3. RESULTS

#### 3.1 HISTORY

The origin of the word "Homeopathy" is derived from ancient Greek (Diniz, 2006). In its semantic field, and using Greek radicals, "homeo" refers to *similar*, while "pathos" is linked to the idea of *suffering* (Casali, 2006). It is considered a branch of Hippocratic medicine, due to the fact that the principles are similar as for what they consider *health* and *illness*: both situations being considered as *balance* and *imbalance*, respectively (Shang *et al.*, 2005).

The therapy itself may be described by their practitioners as an alternative, or even complementary, treatment approach. The very first reports date back to 460 BC, which states that its pharmacological principle is based on the fact that a single substance capable of leveraging symptoms in a healthy individual may also be used to treat similar symptoms in a sick person. This concept is called *Similia Similibus Curentur* or *Law of Similars*. Its precepts claim that substances present and available in nature have the potential to treat the same symptoms that they are capable of producing. Therefore, "similar people may be healed by similar people" (Spezzia, 2021). From this point of view, homeopathic medication takes into account particular characteristics of the sick organism that are revealed in the diagnosed condition (Hahnemann, 2007).

#### 3.2 INDICATIONS

In homeopathy there is a holistic analysis of the human being, considering the individual as a whole being not only formed by flesh and bones. Through this point of view, there is a general concern not only with the disease itself, but also with the being in its entirety and plenitude (Teixeira, 2010). In this sense human beings develop pathological processes not only due to physical reasons, but also because of the way they interact with the environment, including the way they feel emotionally, and how they deal with such feelings. This issue permeates homeopathy in a more integralist approach of treatment than allopathy is.

In 1810, doctor Samuel Hahnemann depicted the contents and explained the basis of the homeopathic theory. In it, he stated that "the disappearance of every morbid phenomenon, which means, of every considerable alteration that departs from the healthy vital process through healing, certainly also implies and presupposes, necessarily, the reestablishment of the integrity of the vital principle and, consequently, the return of health to the entire organism" <sup>13</sup>. In short, as a result of this integral ideation of the process of human illness, in which the organic-vital imbalance is deciphered in the grouping of signs and manifest symptoms, homeopathic semiology values the multiple aspects of the patient, that is, homeopathic therapy encompasses the treatment of the different spheres, which may an integration of physical, psychic, and mental, totaling a healthy mind in a healthy body (Vannier, 1998; Dudgeon, 1994; Peres *et al.*, 2022).

#### 3.3 CONFLICTS WITH ALLOPATHY

Controversially, there is a traditional treatment method, practiced by those who follow the conventional principles of industrialized medical science and technology. It is understood that the treatment of diseases through different means may be defined as Allopathy. This traditional approach still has conflicts with homeopathic therapy because there is a hypothesis that the clinical effects of homeopathy are interpreted by some researchers as placebo effects. In conventional or allopathic medicine, there is a thesis that the positive response of homeopathy occurs due to the patient's psychological expectation that the treatment will undoubtedly help him/her, even if the treatment itself does not have direct pharmacological effects. Furthermore, there are even conflicts concerning the financial sphere of both therapeutic approaches. Due to its low market value and consequently lower profit, homeopathy is not fully accepted in conventional medicine, therefore, large pharmaceutical companies prefer to invest in traditional medicines with a more attractive margin profit, the majority of which are allopathic medicines (Vannier, 1998).

#### 3.4 DIFFERENCES BETWEEN HOMEOPATHY AND ALLOPATHY

As has been described in the previous paragraphs, there are fundamental, and philosophical differences between the two main therapies used in the world<sup>13</sup>. In this context, homeopathy and allopathy are regarded as two systems of medicine that differ from each other by their approaches and fundamental principles. An example of this is Allopathy, which is a system of conventional medicine used by many doctors and health professionals in different countries around the world, whose foundations are based on the use of medicines that trigger effects that are opposite or different from the symptoms caused by a disease (Batello, 2016).

Allopathic medicines are normally manufactured using chemical and/or synthetic substances, with the dosage prescribed according to the symptoms caused and their degree of action, in addition to being associated with the conditions in which the patient is, also taking into account that treatments are normally indicated and used to alleviate the symptoms of the disease, aiming to treat its underlying causes. In homeopathy, the aim of the treatment is deeper and more complex. When treating the individual in their physical, psychic and mental fields, and although it does not provide a cure in them all, it has an interesting function in therapeutic application (Teixeira, 1998).

As homeopathy is based on the principle of "similar cures similars", its medicines are highly diluted and made through the use of substances of mineral, vegetable and animal origins. The prescription of homeopathic medicines takes action on an individual basis, as it takes into account not only the physical symptoms, but also the emotional and mental aspects of the patient, caused by the fact that homeopathy emphasizes the promotion of the natural healing capacity that the body endows; as well as the organism's search for homeostasis as a whole (Teixeira, 1998).

# 3.5 PRODUCTION OF HOMEOPATHIC AND ALLOPATHIC MEDICINES AND THEIR DIFFERENCES

The understanding of homeopathy as a medical specialty that faces the patient as a whole individual will inevitably come into conflict with traditional allopathic treatments. Allopathic medicine is mostly produced by large transnational pharmaceutical industries, and is subjected to rigid standardized technical

specifications and industrialized quality control methods. In turn, the medicine derived from homeopathy is produced in homeopathic compounding pharmacies, and may or may not have generalized standardization of final preparation.

The processing of homeopathic medicine is almost exclusively carried out by the many homonymous pharmacies available in the market, with its main characteristic being a different approach to the traditional medicine industry, in which the patient is the one that gets adapted to the medicine, when from its homeopathic point of view, it should be the medicine the one that should be adapted to the patient, favoring the lack of standardization of its medicine, even though new resolutions have been created by the National Health Surveillance Agency, seeking to establish standards and inspection guidance for such establishments (Agência Nacional de Vigilância Sanitária, 1999). The specifications for the starting substances, which are ones used in the production of the pharmaceutical ingredients and which constitute the structure of the medicine, are often of vegetable, animal or mineral origin, as well as mother tinctures, which are the ethanolic extracts obtained through plants, together with inert substances that do not react chemically and are used as vehicles or diluents.

The final product purchased is often exposed to many dilution processes and may only benefit from specifications and quality control methods that are considered to be based on exclusions. Thus, we have as an example, an alcoholic solution of Chamomilla 30CH, which may have its alcohol content, its color and transparency measured, its flavor and odor passed by an evaluation, and in addition to these factors, it must be colorless and translucent. However, none of these parameters guarantee that these are 30 dilutions made at a ratio of 1:100, from a mother tincture from the correctly indicated part of the plant, which had already been cultivated and collected appropriately. This specific factor makes trust in the homeopathic pharmacist an aspect of great importance and responsibility, a factor that breaks the mass industrialization of medicines.

The inevitable conclusion is reached that the main characteristics that differentiate allopathy from homeopathy is that the former uses medicines that act directly on the symptoms caused by the disease, the second uses very diluted substances, based on the fact that it is believed to generate a stimulus in the human body's immune system. In short, each system has its respective philosophy, approach and evidence of effectiveness. The choice between them is often relative, depending

on preferences and familiarity with medications and mainly on the clinical experience of each professional, applied directly to the individual needs and objectives of each patient (Agência Nacional de Vigilância Sanitária, 1999).

#### 3.6 PRINCIPLE OF SIMILARS AND CONTRARIES

The understanding of a large part of homeopathic practice is based on four basic principles: the law of similars, experimentation on healthy patients, minimum doses and the single medicine.

# 3.6.1 The Law of Similars and experimentation on healthy patients

There are several statements that attempt to define the law created by Hippocrates, observed by Paracelsus, Crollius and developed and applied by Hahnemann. Through this law "substances that, in considerable doses, whether toxic or physiological, have the capacity to cause a specific set of symptoms in an apparently healthy but sensitive individual, may also, in other ill and sensitive individuals, cause similar symptoms to disappear, if they are prescribed in hypophysiological doses" (Abrahão, 2019; Coulter, 1982)

#### 3.6.2 Minimum doses

Hahnemann's experiences in his clinical life are based on the Law of Similars, which began with the use of high doses of common medications used in his time. Patients had very drastic and difficult symptoms, caused by an aggravation before the body began to react, causing many patients to give up treatment. Aiming to reduce these problems and effects, Hahnemann began to use a dilution technique in water and alcohol, on a progressive centesimal scale, taking care to homogenize each dilution through succussion, a procedure he named. The creator of Homeopathy was surprised by the results obtained, as the medicines prepared using this technique, in addition to reducing the aggravation of symptoms caused by the use of high doses, had a greater healing potential. This pharmacotechnical process, called dynamization, causes a greater possibility of a quick and gentle cure (Messias, 2017).

# 3.6.3 Single medicine

Hahnemann, when creating his methodology for experimentation on healthy men, established that each medicine would have to be studied in isolation in order to obtain the respective pathogenesis of the medicine. Therefore, he administered the medications in isolation, one at a time, as it was a theoretically more rational way, as well as to avoid interactions between different medications. The homeopath, from this perspective, aims to individualize the patient's symptomatic condition to acquire the simillimum (Abrahão, 2019; Corrêa, 2006).

# 3.6.4 Clinical indications for the use of homeopathy in dentistry

In dentistry, homeopathic remedies have been proposed to be used in oral ulcers, sialorrhea, neuralgia, temporomandibular joint disorders, xerostomia, lichen planus, bruxism (Steinchler, 2015; Fischer, 2005), as an adjunct to conventional treatment in treatments that include minor acute illnesses to chronic pathologies. complex, atypical facial pain, burning mouth syndrome, postoperative osteitis and anxiety about dental treatment. Furthermore, it has been shown to be effective for recurrent infections and chronic conditions, in which the literature says that traditional treatment has failed or is contraindicated (Amaral, 2021).

The main medicines can be found in different vehicles, such as tablets, pills, drops, liquids, granules and creams (Darby, 2011). Some are even administered by dissolving on or under the tongue where it would be quickly absorbed. Thus, the instruction is that such medicine is placed directly in the mouth, sucked or chewed (Darby, 2011). In this way, homeopathic medicines have the potential to offer a range of benefits in several areas of dentistry, mainly in orthodontics, stomatology, endodontics, pediatric dentistry, periodontics and surgery, due to their low cost and wide range of applications, therefore, they have a relative range of efficacy, safety and ease of use (Eleutério, 2011; Mendonça, 2022; Almeida *et al.*, 2023).

#### 4. DISCUSSION

Allopathic traditional industries have throughout mankind development played a millinery role for the treatment of the many traditional and transitional diseases. More specifically, in the recent COVID-19 pandemic, billions of dollars were used in order to halt the transmission speed worldwide. It's only natural that in moments in which lives are at risk, scientists recur to allopathic drugs that have been studied for longer time periods through centuries.

On the other hand, homeopathy offers a different approach. If more research should be carried out, under rigid scientific overview, it might be used more frequently in order to stimulate the immune system to develop stronger and more efficiently, transforming weak patients into functional ones. Expectable as it may seem, the industrial pharmaceutical power does make such homeopathic progress much more difficult, due to marketing strategies, including bonus for pharmaceutical representatives, prizes for reached aims, as well as laboratorial gratifications. The lack of homeopathic disciplines in medical and dental graduation in universities constitute a huge gap, over which students must surpass if they want to study this alternative approach.

The lack or belief and the expectable resistance of professors and institutions, although comprehensible, may jeopardize the accomplishment of valuable research studies, impeding the access of students to the homeopathic world, whose importance begin to appear as progressively more and more dentists and doctors seem to be interested by the subject. Another interesting point of view is the less reports of side effects and allergies reported with the use of homeopathy. No matter what clinical or research way is to be chosen, homeopathy will gradually increase its importance as an interesting tool for the arsenal developed to combat pathologies, in almost all medical and dental fields.

# 5. CONCLUSION

Homeopathic medicines seem to have the potential to be used as main therapy for various pathologies involved in the field of dentistry. However, for them to be used more commonly, more research and clinical evidence will be needed, published in elite journals, so that educational institutions accept homeopathy as a way of treating their patients through the adoption of the discipline in dentistry schools.

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# **CHAPTER 5**

ALGINATE VERSUS ADDITION SILICONE: WHAT IS THE BEST MATERIAL FOR REMOVABLE PARTIAL DENTURES?

# Pedro Guimarães Sampaio Trajano dos Santos

Graduate Student in Dentistry

Institution: Faculdade de Odontologia do Recife (FOR)

Address: Recife, Pernambuco, Brazil

E-mail: pedroguimaraessampaio@gmail.com

# Maria Clara Domingues da Silva

Graduate Student in Dentistry

Institution: Faculdade de Odontologia do Recife (FOR)

Address: Recife, Pernambuco, Brazil

E-mail: mariaclaradomingues1307@gmail.com

#### Lucas Cavalcanti de Lima Félix

Graduate Student in Dentistry

Institution: Faculdade de Odontologia do Recife (FOR)

Address: Recife, Pernambuco, Brazil E-mail: lucascavalcanti209@gmail.com

## Maria Eduarda Maldonado Coimbra do Nascimento

Graduate Student in Dentistry

Institution: Faculdade de Odontologia do Recife (FOR)

Address: Recife, Pernambuco, Brazil

E-mail: mariaeduardamcnascimento@gmail.com

#### Irene Alcantara Eiras Silva

Graduate Student in Dentistry

Institution: Faculdade de Odontologia do Recife (FOR)

Address: Recife, Pernambuco, Brazil

E-mail: Irenealc9@gmail.com

# **Eudoro de Queiroz Marques Filho**

Specialist in Implant Dentistry

Institution: Faculdade de Odontologia do Recife (FOR)

Address: Recife, Pernambuco, Brazil E-mail: eudoromarques@hotmail.com

#### Ailton Coelho de Ataíde Filho

Specialist in Legal Dentistry, Prosthodontics, Dentistry, Implantology

Institution: Faculdade de Odontologia do Recife (FOR)

Address: Recife, Pernambuco, Brazil E-mail: ailtonataide@hotmail.com

**ABSTRACT:** Objective: The objective of this study was to create a narrative literature review article, covering two different types of materials: silicone and alginate, with the aim of seeing which is the best material to compose a removable partial denture. Methodology: The searches were carried out in PUBMED Central, Web of Science, VHL/BIREME, Brazilian CAPES, Scielo and using the Google Academy portal. A total of 24 articles were acquired that address the benefits and harms of using silicone and alginate in removable partial dentures, in addition to their differences. We consult periodicals and books, aiming to obtain more reliable information on the topic. In order to carry out a literature review, the vision of Mattos (2015) was used to structure the article. Results: During the study, it was seen that addition silicone is widely considered the best material due to its high precision, excellent ability to reproduce details and superior dimensional stability, however alginate is more economical and easier to use, it is more suitable for preliminary impressions and situations where extreme precision is not essential.

**KEYWORDS:** removable partial denture, silicones, alginates.

RESUMO: Objetivo: O objetivo deste estudo foi fazer um artigo de revisão de literatura narrativa, abordando dois tipos de materiais diferentes: silicone e alginato, com objetivo de ver qual é o melhor material para compor uma prótese parcial removível. Metodologia: As buscas foram realizadas na PUBMED Central, Web of Science, BVS/BIREME, CAPES brasileira, Scielo e utilizando o portal Google Academy. Foram adquiridos um total de 24 artigos que abordam sobre os benefícios e malefícios do uso de silicone e alginato nas próteses parciais removíveis, além de suas diferenças. Realizamos consultas de periódicos e livros, visando obter mais informações confiáveis sobre o tema. Tendo em vista realizar uma revisão de literatura, a visão de Mattos (2015) foi utilizada para estruturar o artigo. Resultados: Ao decorrer do estudo, foi visto que o silicone de adição é amplamente considerado o melhor material devido à sua alta precisão, excelente capacidade de reprodução de detalhes e superior estabilidade dimensional, entretanto o alginato é mais econômico e fácil de usar, é mais adequado para impressões preliminares e situações onde a precisão extrema não é essencial.

**PALAVRAS-CHAVE:** prótese parcial removível, silicones, alginatos.

#### 1. INTRODUCTION

During the learning phase of dentistry students, students are often faced with the crucial question of taking an impression to create removable partial dentures (RPDs). This issue also often exists among the same teachers in prosthetics clinics, namely: some argue that alginate is the best option as it can adequately copy the dental arches that will receive a PPR, while others argue that, despite it being able to be carried out with alginate, addition silicone is undoubtedly the best material because of its structural stability.

In dental practice, the choice of material for mouth impressions is crucial to guarantee the quality and precision of removable partial dentures. Among the available materials, alginate and addition silicone stand out for their distinct characteristics and clinical application. Alginate is widely used due to its low cost, ease of handling and comfort for the patient. However, it presents limitations in terms of precision and dimensional stability, requiring the impressions to be cast immediately to avoid distortions. On the other hand, addition silicone, or polyvinylsiloxane, is recognized for its high precision, excellent dimensional stability and durability, characteristics that make it ideal for high-fidelity moldings, although at a higher cost and more complex manipulation.

The aim of this study was to carry out a literature review article, covering two different types of materials: silicone and alginate, with the aim of seeing which is the best material to compose a removable partial denture.

# 2. METHODOLOGY

During the construction of this narrative literature article, readings and contextualizations were carried out using the work of Mattos (2015), which explains how to construct a literature review, serving as a basis to clarify the differences between the different types of reviews, together with the article by Rother (2007), who structured the methodology used and the type of literature review assigned in this work. Associated with online research using data available in VHL/BIREME and PUBMED Central. The searches were carried out on other platforms, such as: Portal CAPES Journal, Science

Direct, Web of Science, and also on Google Scholar, the last platform used to collect the articles. Physical books and periodicals were also used in the search.

#### 3. RESULTS

# 3.1 ALGINATE IN DENTAL IMPRESSIONS

Alginate has been a material used in dentistry for decades. Before the appearance of addition silicone, this irreversible hydrocolloid was considered the most used impression material in prostheses due to its ease of handling, cost and good clinical results. As for the chemical composition, sodium (or potassium) alginate is the main component that forms an irreversible hydrocolloid gel that can only be used once, as it will be destroyed after removing the plaster, which it will be applied to.

This copying material can be defined as a polymer derived from seaweed (brown algae) which, when mixed with water and a crosslinking agent, allows the formation of an elastic gel. Calcium sulfate (or other calcium salts) acts as protagonists in this chemical reaction. Crosslinking agents can be defined as substances that have a low molar mass and reactive functional groups capable of allowing the formation of inter- or intra-polymer chain bonds (Carr; Brown, 2011).

These react with sodium alginate to form alginate gel. Sodium silicate (or other gelling retardants) controls the setting time, called gelling, increasing working time, at the same time allowing the dentist to manipulate and apply the material before it starts to gel. Trisodium phosphate (or other pH regulators) regulates the pH of this mixture, ensuring that the gelation reaction occurs in a controlled manner, allowing the clinical operator to notice the change in its consistency during the actual handling of the material.

Another component is zinc oxide, which improves the consistency and resistance of this material, providing the necessary mass for mixing, while also helping to define details of the area to be molded, which in the vast majority of cases are the dental arches. Another active ingredient is the filling agent called diatomine (or diatomaceous earth), which improves the consistency and compressive strength of the alginate in impressions. In addition to what was mentioned above, added pigments and dyes provide the material's characteristic color, facilitating its visualization and

identification of the material's structural and visual changes during its application (Khasanov; Mansurov, 2022; Garcia *et al.*, 2023).

In order to facilitate clinical applicability in the acceptance of the material during patient impressions, flavorings and flavors further improve acceptability, providing a more pleasant taste and aroma during the procedure itself, together with humectant agents, which improve mixing as well as its handling, helping to disperse the powdered components homogeneously in the water, thus ensuring a uniform and smooth dough.

When alginate powder is mixed with water, a chemical reaction occurs between sodium alginate and calcium sulfate, resulting in the formation of an alginate gel. This gel captures the impression of the patient's mouth, allowing the creation of a detailed mold for making prosthetics. Nevertheless, Errors during manipulation have been pointed as the main fact for flaws and defects since the forties (Sknner; Pomes, 1946). Some additional considerations must be carried out, as can be seen below:

- setting time: setting time may vary depending on the specific alginate formula, which can be adjusted by adding or modifying the amount of retarders or accelerators;
- 2. dimensional stability: although alginate is easy to use, its dimensional stability is a limitation, requiring molds to be poured quickly to avoid distortion.

These components and their functions have allowed alginate to be a popular and practical choice for preliminary impressions and study models in dental practice. Like any material, it has advantages and disadvantages as we will see below:

# 3.1.2 Advantages of alginate

- Craig and Powers (2002) highlight that alginate is widely used due to its low cost and ease of handling, making it accessible and convenient for use in dental offices;
- 2. Anusavice (2003) emphasizes the rapid mixing and short working time of alginate, which provides comfort to the patient and efficiency to the dentist;
- Johnson and Craig (2011) note that alginate is generally well tolerated by patients as it is gentle and does not cause significant discomfort during impression taking;

- 4. Powers and Sakaguchi (2012) note that alginate has a good ability to reproduce details when handled correctly, being effective for preliminary impressions;
- 5. Rosenstiel, Land, and Fujimoto (2015) highlight the ease of use of alginate, which does not require expensive or complex equipment for its application.

# 3.1.3 Disadvantages of alginate

- 1. Phillips (2003) points out that the main limitation of alginate is its inadequate dimensional stability, leading to distortions if the impressions are not cast immediately;
- 2. Craig and Powers (2002) mention the lower precision of alginate compared to more advanced materials, such as addition silicones;
- 3. Anusavice (2003) notes that alginate is susceptible to variations in humidity and temperature, which can affect the quality of the impression;
- Johnson and Craig (2011) highlight that alginate is not suitable for impressions that require prolonged storage, due to its tendency to undergo syneresis and imbibition;
- 5. Powers and Sakaguchi (2012) report that alginate can present difficulties in obtaining fine details in complex areas of the dental arch;
- 6. Therefore, the advantages and disadvantages imply indications and contraindications for the material, as follows:

# 3.1.4 Indications for alginate

- 1. Craig and Powers (2002) suggest the use of alginate for preliminary impressions and for making study models, where extreme precision is not crucial;
- 2. Anusavice (2003) recommends alginate for orthodontic impressions, where fast and efficient impressions are required;
- 3. Johnson and Craig (2011) recommend alginate for making temporary dentures and for preliminary impressions of removable dentures;
- 4. Powers and Sakaguchi (2012) highlight that alginate is appropriate for pediatric patients due to its quick application and comfort.

# 3.1.5 Alginate contraindications

- Phillips (2003) contraindicates the use of alginate in definitive impressions for fixed prostheses and implants, where precision and dimensional stability are essential;
- 2. Craig and Powers (2002) advise against alginate in situations where the impression cannot be cast immediately, due to the risk of distortion;
- 3. Anusavice (2003) warns against the use of alginate in environments with high humidity and temperature variations, which can compromise the quality of the impression;
- 4. Johnson and Craig (2011) contraindicate alginate for patients with intolerance to the material or allergies to any of its components.

#### 3.2 ADDITION SILICONE TO DENTAL IMPRESSIONS

Addition silicone, also called addition silicone (polyvinylsiloxane), is an elastic impression material, used in the manufacture of molds and dental prostheses (Eckert; Lammie,1996). What sets it apart is its ability to not undergo significant deformation over time, ensuring more precise and reliable impressions, a fact that makes it a material with a much higher reproduction capacity than alginate. However, it cannot be handled with latex gloves, but can be handled with nitrile gloves. Its molding technique, however, is more complex than that of alginate. It is carried out using the double impression technique, or relining technique, in which two materials of different viscosities are used. The procedure consists of carrying out a preliminary molding with the heavy material that is manipulated with the hands and applied to the surface to be molded. Then, a material with a more fluid consistency is used and applied to the internal face of the first stage. This more fluid material, after setting, offers excellent and stable copying capacity (Hyde et al., 2011).

#### 3.2.1 Advantages of addition silicone

- 1. Craig and Powers (2002) highlight that addition silicone offers excellent precision and dimensional stability, making it ideal for impressions that require high fidelity;
- 2. Anusavice (2003) highlights that the material presents an excellent reproduction of details, capturing even the smallest anatomical contours;
- 3. Powers and Sakaguchi (2012) note the superior dimensional stability of filler silicone, allowing impressions to be stored for extended periods without distortion:
- 4. Rosenstiel, Land, and Fujimoto (2015) highlight tear resistance, which minimizes loss of detail during removal of the impression from the patient's mouth;
- 5. Johnson *et al.* (2011) observe that addition silicone has low polymerization shrinkage, which contributes to the precision of moldings;
- 6. Walker and Petrie (2005) point out the ease of disinfection of silicone and addition, which maintains its properties even after the application of disinfectant agents;
- 7. Craig, Powers and Wataha (2000) mention the compatibility of addition silicone with a wide variety of plasters and resins for models.

# 3.2.2 Disadvantages of addition silicone

- 1. Craig and Powers (2002) mention that addition silicone is more expensive compared to other impression materials such as alginate;
- 2. Anusavice (2003) notes that the handling of addition silicone can be more complex, requiring specific equipment for mixing and application;
- 3. Powers and Sakaguchi (2012) point out that the polymerization time can be longer, which can increase the patient's chair time;
- Rosenstiel, Land, and Fujimoto (2015) report that some addition silicones can release hydrogen gases after molding, requiring a waiting time before pouring the model;
- Walker and Petrie (2005) highlight that addition to the mold holder may be insufficient, requiring the use of specific adhesives to guarantee stability during molding.

#### 3.2.3 Addition silicone indications

- 1. Craig and Powers (2002) recommend addition silicone for definitive impressions of fixed prostheses, such as crowns and bridges, where precision is critical;
- 2. Anusavice (2003) suggests the use of addition silicone in implant impressions due to its dimensional stability and detailed reproduction;
- 3. Powers and Sakaguchi (2012) recommend addition silicone for impressions of partial and complete removable dentures, ensuring a precise fit;
- 4. Rosenstiel, Land, and Fujimoto (2015) recommend addition silicone for cases of high anatomical complexity, where fine details are essential;
- 5. Johnson *et al.* (2011) highlight the use of addition silicone in orthodontics for precise and long-lasting impressions.

#### 3.3.4 Contraindications of addition silicone

- Craig and Powers (2002) contraindicate the use of addition silicone in situations where cost is a limiting factor, such as in low-budget practices;
- Anusavice (2003) advises against the use of addition silicone in preliminary impressions, where high precision is not necessary;
- Powers and Sakaguchi (2012) warn against the use of added silicone in patients with allergies to the material's components;
- Rosenstiel, Land, and Fujimoto (2015) recommend caution when using addition silicone in environments where polymerization may be affected by high temperatures;
- Walker and Petrie (2005) contraindicate the use of addition silicone in molds that need to be poured immediately, due to the possible release of hydrogen gases.

## 4. DISCUSSION

The choice of a dental material for impressions of removable partial dentures is, undoubtedly, a fundamental issue for the success of a prosthesis that adapts well to the patient's arch, avoiding costly repetitions for the professional and facilitating customer satisfaction.

Alginate is often used in preliminary dental impressions due to its ease of use and affordable cost, although its dimensional stability is limited. On the other hand, addition silicone is preferred for definitive impressions due to its high precision, excellent reproduction of details and dimensional stability that is unquestionably superior to that of alginate. The choice between these materials depends on the specific needs of each clinical case, balancing cost, practicality and precision required to manufacture these types of removable prostheses, as well as other fixed ones. The work of Chiarello, Tiossi, Lapria Faria, Silveira Rodrigues and Ribeiro (2006), already mentioned that the main disadvantage of irreversible hydrocolloids are low tear strength, low capacity for reproducing tiny little details when compared to elastomeric materials.

Regardless of the material to be chosen, some peculiar situations may appear in prosthetic clinics, or integrated or Extension clinics, during the learning curve of students at Higher Education Institutions (HEIs). The big issue revolves around the costs of materials and the speed they can present during the manufacture of a prosthesis, focused on the need for temporary adaptation to the number of clinics available per semester. Without a shadow of a doubt, alginate is the material that loses out in terms of its ability to copy the hard and soft structures of the dental arches during reproduction in plaster. However, in some specific situations, it can be used, in simpler cases, as long as the casting of the plaster inside the negative presented by the impression is done immediately.

The work of Craig and Powers (2002) as well as Powers and Sakaguchi (2012) is very clear regarding the indications for addition silicone. Their considerations refer to the recommendation of addition silicone for definitive impressions of prostheses where precision is critical. However, they suggest the use of alginate for preliminary impressions and for making study models, where extreme precision is not crucial. The issue, according to their conclusions, is the ability to reproduce in the final stage of molding. The authors also reiterate the unquestionable issue regarding the lower precision of alginate compared to addition silicone. Their ideas are corroborated by Powers and Sakaguchi (2012), by whinkler (2002) as well as Nogueira, Antoniazzi and Bortoluzzi, (2019), who state that, despite the good ability to reproduce details when handled appropriately, alginate is in fact effective, but for preliminary impressions. For this purpose, they also add that it may show deficiencies in obtaining fine details, in difficult-to-access areas of the dental arch.

The low polymerization shrinkage led Johnson *et al.* (2011) and Puri and Dixit (2015) state that addition silicone is more precise in impressions, while Walker and Petrie (2005) add that the ease of disinfection remains present in the properties of this material, even after the application of disinfectant agents. Rosenstiel, Land, and Fujimoto (2015) emphasize resistance to tearing, one of the factors that may cause fragmentation of the plaster when removed from the tray; a fact that minimizes the loss of detail when removing the impression from the patient's mouth Preiskel (2011) in his book also agrees with the precision of impression concerning the low polymerization shrinkage of addition silicone. Similar conclusions have been reached by McCabe and Walls (2008), Phoenix, Cagna, DeFreest, and Stewart (2012); Rosenstiel, Land, and Fujimoto (2006).

The difficulties in using addition silicone are due to its excellent reproducibility and post-set structural stability. The work of Anusavice (2003) states that manipulation in two stages is richer in details and requires greater dexterity and experience from the professional or student, completing the report by stating that as a result of this, the patient's time in the chair may take longer, a fact that may be more or less relevant, depending on the needs of each patient.

Thus, as final considerations, this review comes to the understanding that reproduction capacity is the critical issue that separates both materials when deciding what type of prosthesis will be made.

# 5. CONCLUSION

Alginate is widely used in dental impressions due to its ease of use and costeffectiveness. Its main components include sodium alginate and calcium sulfate, which
acts as a cross-linking agent. Although alginate is effective for preliminary impressions
and study casts, its limited dimensional stability requires immediate casting to prevent
distortion, making it less ideal for impressions that require high precision and fine detail.
For this purpose, addition silicone seems to be the material of first choice because of
its ability to reproduce the hard and soft structures of the oral cavity. The literature
review suggests that, for the fabrication of removable partial dentures (RPDs), addition
silicone is widely considered the best material due to its high precision, excellent ability
to reproduce details and superior dimensional stability. Although alginate is more

economical and easier to use, it is best suited for preliminary impressions and situations where extreme precision is not essential.

From this, it is seen that more studies should be carried out on both types of materials, providing more information on the subject, with a view to carrying out case reports that address the great difference of each material in daily clinical life, its benefits and harms. Seeking to obtain data on which is the best type to be used in each specific case and objective during daily care.

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# **CHAPTER 6**

# REGENERATION OF GRADE II FURCATION LESIONS USING AUTOLOGOUS PLATELET CONCENTRATES: A NARRATIVE REVIEW

# **Glayson Pereira Vitor**

Doctoral Student in Periodontics Institution: Faculdade Anhanquera

Address: Belo Horizonte, Minas Gerais, Brazil

E-mail: gvitorr@hotmail.com

# Jorge Antônio Mansur de Miranda

Master in Periodontics

Institution: Faculdade de Sete Lagoas (FACSETE)

Address: Sete Lagoas, Minas Gerais, Brazil E-mail:jamansurmiranda@yahoo.com.br

#### Leonardo Silveira Damasceno

Doctor in Cell Biology

Institution: Faculdade Anhanguera

Address: Belo Horizonte, Minas Gerais, Brazil E-mail: leonardo.damasceno@pitagoras.com.br

ABSTRACT: The furcation defects is related to the presence of bone resorption and loss of attachment in the interradicular region as a consequence of periodontal disease. They are difficult places of immunity and with several treatment options. Objective: to verify, through a narrative review, the applicability of platelet-rich fibrin in the treatment of grade II furcation defects. Methodology: studies in English were selected, from 2012 to 2022, indexed in PubMed / Medline and Lilacs and Cochrane databases that used PRF to treat grade II furcation defects alone or combined with other materials. First, a screening was performed by title followed by reading the abstracts. After verifying a relationship with the theme, the articles were viewed in full by a single researcher. Discussion: studies report that the use of PRF adjuvant to other biomaterials in class II furcation defects seems to be significantly (p<0.01) beneficial for reducing probing depth and gain in clinical hospitalization compared to bone grafts and too much materials when they are used alone. Conclusion: PRF has been identified as a promising biomaterial in the process of tissue immunity in grade II furcation defects.

**KEYWORDS:** furcation defects, platelet rich fibrin, LPRF, periodontitis.

**RESUMO:** Lesão de furca está relacionada a presença de reabsorções ósseas e perda de inserção na região interradicular resultante da doença periodontal. São locais difíceis de regeneração e com diversas opções de tratamento. Objetivo: verificar através de uma revisão narrativa a aplicabilidade das fibrinas ricas em plaquetas no tratamento das lesões de furca grau II. Metodologia: foi selecionado estudos na

língua inglesa, período de 2012 a 2022, indexados nas bases de dados PubMed / Medline, Lilacs e Cochrane que utilizaram PRF para tratar as lesões de furca grau II isolado ou combinado com outros materiais. Primeiro foi realizado uma triagem pelo título seguida de leitura dos resumos. Após constatar relação com o tema, os artigos foram vistos na íntegra por um único pesquisador. Discussão: estudos relatam que o uso adjuvante de PRF a outros biomateriais em defeitos de furca classe II parece ser significativamente (p<0,01) benéfico para redução de profundidade de sondagem e ganho de nível de inserção clínica em comparação com enxerto ósseos e demais materiais quando são usados sozinhos. Conclusão: PRF tem sido apontada como promissor biomaterial no processo de regeneração tecidual de lesão de furca grau II.

**PALAVRAS-CHAVE:** defeitos da furca, fibrina rica em plaquetas, L-PRF, periodontite.

# 1. INTRODUCTION

Periodontitis is an immunoinflammatory disease that affects the tissues of protection and support of the teeth and can lead to loss of the dental element. Its pathogenesis is related to a model of polymicrobial synergy and dysbiosis, inducing a nonresolutive, destructive host response, with activation of different cytokines and proinflammatory mediators (Tonetti 2018). It is multifactorial in nature, and the course of the disease is modulated by different biological, genetic, environmental and behavioral factors (Bouchard, 2017; Tonetti, 2018).

Furca lesions are characterized by bone resorptions and insertion loss in the interradicular region resulting from periodontal disease associated with bacterial plaque (Serroni, 2022; Panda 2019). The furca region presents an unfavorable anatomy, with the presence of grooves, convexities and concavities, which hinders access for self-cleaning (Tarallo, 2020) and for adequate professional debridement, thus limiting the prognosis of the affected teeth and representing an obstacle to the proper control of bacterial plaque and its maintenance (Sanz, 2015).

Factors that may aggravate this injury include biofilm accumulation, size, and divergence of roots and root horn. For diagnosis and evaluation of the furca lesion, it is important to carry out the clinical examination, together with the evaluation of radiographs of the region (Rodrigues, 2020; Vargas, 2020; Jepsen, 2020).

Treatment of furcum injury depends on disease progression and periodontal involvement. It can be carried out through conservative methods such as scraping and root straightening, with or without flap, odontoplasty and osteoplasty, resective methods of tunneling, root amputation and root resection, and regenerative methods such as guided tissue regeneration, bone graft and platelet concentrates across the platelet-rich Fibrin (PRF) membrane (Miron, 2021, Vargas, 2020; Jepsen, 2020; Bajaj, 2013). Among these forms of treatment and with the development of optimized and simplified protocols, autologous platelet concentrates have had greater visibility, with a potential application in the regeneration of these lesions (Pepelassi, 2022; Serroni, 2022).

PRF is an autologous product obtained by venopution of peripheral blood and selective blood sedimentation (Choukroun, 2006). It contains cells such as platelets and leukocytes, as well as a variety of growth factors and cytokines, including transformer growth factor-beta 1, platelet-derived growth factor, vascular endothelial

growth factor, and interleukins-1ß, 4 and 6. These factors act directly on the proliferation and differentiation of osteoblasts, endothelial cells, chondrocytes and various types of fibroblasts (Serroni, 2022, Tarallo, 2020). The fibrinogen clot has the possibility to retain a higher number of cytokines and growth factors, and can gradually release all of these factors for at least 10 days (Serroni, 2022, Tarallo, 2020, Jepsen, 2020). Due to these factors, it has been used in the treatment of furca lesions (Bajaj, 2013) and becoming a promising biomaterial in tissue regeneration (Miron, 2021).

In this context, the objective of the present study was to verify through a narrative review the applicability of the PRF in the treatment of grade II furcation lesions, either in isolation or associated with other biomaterials or forms of treatment, and thus to lead to better treatment decisions and scientific basis for professionals as well as to provide a better quality of life for individuals.

# 2. METHODOLOGY

The study characterized itself as a revisional, of a narrative nature, where the author chooses in an arbitrary manner the articles from which the information comes (Bernardo, 2004). In this study, from the literature search, cross-sectional, longitudinal studies, human clinical trials and systematic reviews in the English language were selected, from 2012 to 2022, indexed in the PubMed/Medline, Lilacs and Cochrane databases that used PRF to treat grade II furca lesions alone or combined with other materials. The descriptors "furca", "furca defects", "furca involvement", "fibrin-rich platelets", "PRF" and platelet-rich fibrin" were used in conjunction with *the boolean connectors "AND*" and "*OR*". Clinical cases, case reports and opinion papers were excluded. First a screening was performed by the title followed by reading the abstracts. Afterwards, stating the relationship with the theme, the selected articles were seen in their entirety by a single researcher.

# 3. LITERATURE REVIEW

Periodontitis is an inflammatory process of bacterial origin characterized by the loss of protective tissues and tooth support. It is associated with the presence of

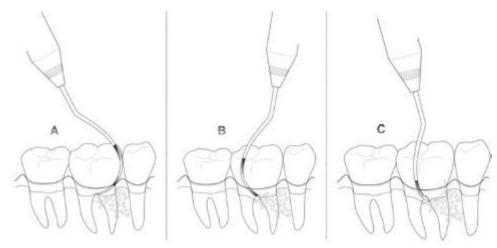
periodonto pathogens in the subgingival environment and an immunoinflammatory response of the host (Tonetti, 2018).

One of the main problems of the progression of the periodontal disease is the loss of the tissues of insertion of the teeth, represented by the root cementum, periodontal ligament and alveolar bone (Miron, 2021) and, when uncontrolled, can bring about mobility and tooth loss and thus negatively affect the quality of life of the individual (Serroni, 2022).

Furca involvement is defined as bone resorption and insertion loss in the interradicular space that results from plaque-associated periodontal disease (Panda, 2019). In regions where there is the presence of multi-root teeth with furca involvement, a higher rate of insertion loss is observed and these dental elements have a less favorable response to periodontal therapy (Pepelassi, 2022; Serroni, 2022; Miron, 2021).

The Nabers tube can be used to diagnose the hole defects by clinical examination, and it is possible to classify the extent of the lesion according to the depth of the probe. Several classifications have been proposed over the years based on the severity of the horizontal sounding depth in the hole defect or the vertical amount of alveolar bone loss within the defect (Panda, 2019). Hamp and colleagues (1975) published the classification, which is the most popular and the most widely used today, in which it divides the hole injury into three degrees: Class I is when there is a loss of approximately 3 mm from the horizontal support tissue; class II when the loss is greater than or equal to 3 mm; class III when there is complete exposure of the hole (Figure 1).

Figure 1. Classification of furcation defects according to Hamp *et al.* (1975). A: Grade I; B: Grade II; C: Grade III (Source: Hamp *et al.* (11)).



Source: Loureiro, 2018

Besides classifying the lesion clinically, an imaging test such as periapical x-ray may be important to evaluate the periodontal involvement, the verification of which structures were affected is fundamental to establish a correct diagnosis, prognosis and a treatment plan (Rodrigues, 2020). Computerized tapered beam tomography is also an important tool for diagnosis and treatment plan of the furca lesions, since the examination helps in the identification of the hole defects and has greater precision than intraoral radiography (Swami, 2022).

The treatment of furca defects represents a complex task that can compromise the success of periodontal therapy, the unfavorable anatomical characteristic of the furca restricts the appropriate instrumentation for proper debridement, makes the biofilm practically inaccessible for oral hygiene measures and thus limits the prognosis of the teeth involved (Tarallo, 2020; Panda, 2019).

In this context, multi-root teeth with furca involvement, where there is a root surface prone to bacterial toxin accumulation and dental calculi, tend to have a less favorable response to periodontal therapy, compared to unirradicular or non-furca teeth (Pepelassi, 2022; Serroni, 2022). Plate accumulation supports progressive insertion loss, negatively influencing not only the prognosis of the affected tooth, but also those adjacent (Avila-Ortiz, 2015; Ajaj, 2013).

It is therefore suggested to make basic periodontal therapy as the first option to eliminate periodontal pockets, tissue inflammation and stabilize the disease (Jepsen, 2020). Thus, the treatment plan to be instituted could go through the non-surgical or

surgical treatment, the latter is further divided into a conservative, resective or regenerative approach and its selection should be guided by some parameters (Loureiro, 2018), such as:

- a) degree of furca involvement;
- b) dental position;
- c) crown/root ratio;
- d) anatomy and root morphology;
- e) root divergence;
- f) strategic importance of the tooth involved;
- g) dental mobility;
- h) endodontic conditions;
- i) prosthetic demands.

However, the degree of furca involvement can be used as a clinical indicator to qualify the severity of the periodontal pathology and the prognosis of the tooth involved in the long-term, as well as serving as a guideline for which therapeutic strategy is most indicated for each category (Miron, 2021; Sanz, 2015) (Table 1).

Table 1: Recommended treatments according to the degree of furca involvement.

Grade I	Grade II	Grade III
<ul> <li>RAR and root debridement (without or with flap opening);</li> <li>Furcation plasty.</li> </ul>	<ul><li>Furcation plasty;</li><li>Regeneration;</li><li>Tunneling;</li><li>Root amputation;</li><li>Extraction.</li></ul>	<ul><li>Tunnelization;</li><li>Root amputation;</li><li>Extraction.</li></ul>

Source: Loureiro, 2018.

Nonsurgical strategies, such as scraping and root straightening, furca-plasty, are employed to treat the furcas with initial Grade I involvement that restores gingival health. On the other hand, surgical procedures, including regenerative and resective approaches, are carried out for the treatment of more advanced lesions, allowing access to the areas of the internal complex of furcas grade III and IV, and favoring the maintenance of the furca area (Panda, 2019).

Regenerative approaches aim at the closure of the hole by the formation of new bone, cementum and periodontal ligament in the interradicular space involved, proposed as a way to restore health to the periodontal, mainly in areas with periodontal insertion loss (Pepelassi, 2022; Panda 2019). However, true and complete periodontal

regeneration is difficult, since it consists of a complex interaction of epithelium, gingival connective tissue, periodontal ligament and alveolar bone (Miron, 2021).

Over the years, several techniques aimed at regenerating periodontal insertion tissues have been proposed, among them the use of bone grafts (Matarasso, 2015), guided tissue regeneration (Jepsen, 2020) and use of bisphosphonates (Wanikar, 2019; Carvalho Dutra, 2017). One strategy that has been proposed for the regeneration of intraosseous defects was the use of autologous or concentrated platelet growth factors (MIRON, 2021) that form a dense fibrin clot with platelets and glued host leukocytes, thus favoring a more prolonged release of growth factors over time.

PRF is characterized as a concentrate rich in fibrin, platelets (95% of peripheral blood), leukocytes (50% of peripheral blood), and undifferentiated cells with unlimited self-renewal and division. The dense fibrin network also acts as a deposit of cytokines and structural glycoproteins and allows the continuous and prolonged release of growth factors in a period of approximately 7 to 14 days, that is, during the whole cycle of growth of migratory cells (Panda, 2019; Vargas, 2020), thus leading to differentiation and proliferation of stem and progenitor cells in a local environment, so that all elements of the PRF will act synergistically, both in the modulation of the healing process, with intensification of the remodeling of the injured scar matrix and reconstruction of the site site In addition, as in regeneration, while ensuring the optimization of immune and inflammatory regulation (Pepelassi, 2022; Panda, 2019; Miron, 2021).

PRF when used as a membrane is also called L-PRF, an autologous biomaterial with a strong scar fibrin matrix, the main component of the platelet concentrate matrix being fibrin. L-PRF membranes, besides anchoring cell events, exert an effect identical to guided tissue repair, functioning as an effective barrier to epithelial cell migration (Miron, 2021). In this way, its mechanical properties provide a strong support matrix and guarantee a good stability of the tissues, referring to a possible function as filler material (Serroni, 2022).

Thus, PRF fills three important factors in tissue repair and regeneration (Del, 2012): it provides a three-dimensional fibrin matrix, has autologous cells (platelets, leukocytes, macrophages, granulocytes, neutrophils) and a reservoir of growth factors and cytokines, besides having the advantages of being a low-cost manipulation, release growth factors and contain defense cells that help in immune defense of the

host and helps in healing, also improving the patients' postoperative. Another important advantage of PRF is the improvement in blood supply, which directly assists in healing (Pepelassi, 2022; Vargas, 2020; Choukroun, 2006).

Recent research (Nasirzade, 2020; Zhang, 2020) has shown that PRF has the ability to favor macrophage polarization and decrease tissue inflammation. It also has some antibacterial/antimicrobial activity, thus favoring a potential wound healing of periodontal bags (Castro, 2019). Together, each of these factors is expected to contribute, or at least in part, to periodontal regeneration when PRF is used in combination with some other biomaterial (Miron, 2021).

Therefore, several studies (Serroni, 2022; Miron, 2021; Pepelassi, 2022; Wanikar, 2019; Castro, 2019) point out that autologous growth factors provide evidence of bone filling and gain of insertion in the treatment of grade II furca lesions and are used as an economic adjuvant (Panda, 2019) for surgical regenerative therapy. In this sense, Vargas and collaborators (2020) point out that the combination of flap scraping associated with the PRF showed promising results, such as statistically satisfactory healing levels (p < 0.01), to act in the treatment of patients with a hole injury.

Thus, the autologous preparation process is simplified, allowing rapid production of large amounts of bioactive membranes, rapid healing and reduction of postoperative complications, making the use of PRF with good cost/benefit and patient satisfaction.

# 4. DISCUSSION

The studies selected for this narrative review confirm the possible beneficial effect, and advantages, of PRF on periodontal regeneration. However, although little described in the literature, there are also disadvantages associated with PRF. One of them is the possible degradation time of the membranes after 1-2 weeks, and it has not yet been significantly demonstrated whether this period is sufficient to promote an adequate effect of space maintenance and tissue regeneration (Kawase, 2015).

The only randomized clinical trial comparing the use of PRF and Platelet-Rich Plasma (PRP) in the regeneration process was by Bajaj *et al.* (2013). According to this study, both techniques, combined with flap scraping, achieved significant clinical improvements (e.g., vertical insertion gain (mm) control group  $1.37 \pm 0.58$  vs  $2.71 \pm 0.58$ 

1.04 experimental group), and for all parameters evaluated (bone fill depth sounding) contrasting with the results of the control group, in which only flap scraping was performed. Therefore, the use of platelet concentrates was found to be superior to conservative therapy. However, there is a preference in using PRF due to the speed and simplification in its preparation.

Result that is also corroborated with the studies of a systematic review and meta-analysis of Panda and collaborators (2019), which showed that autologous platelet concentrates in the treatment of furca defects present beneficial effects. PRP and PRF can be advantageously used as an adjunct for open-label debridement and in additional grafting procedures (p < 0.001, mean difference 0.74, 95% CI 0.54, 0.94). However, there is no evidence of effect of platelet concentrate when used in combination with guided tissue regeneration (GTR). In the Pepelasse (2022) studies, adjuvant use of L-PRF to GTR was significantly beneficial for the improvement in insertion level gain (mean difference: 1.06 95% ci: 0.04 to 2.08) in endoseous defects.

Agarwal *et al.* (2019), in a randomized controlled clinical trial, explored the efficacy of PRF alone and with demineralized lyophilized bone allograft and demonstrated bone graft and PRF were significantly advantageous for the treatment of grade II mandibular furcation defects, significantly greater benefits than the use of PRF alone. Results also evidenced in the review studies of Troiano *et al.* (2016) where the gain in vertical clinical insertion level averaged 1.54 mm (p = 0.03, 95% CI: 1.23-1.85).

The same results were found in the studies of Tarallo and collaborators (2020), a systematic review and meta-analysis, where the adjunct of PRF to bone graft showed significant difference for increased vertical pouch depth and vertical clinical insertion level (1.73 mm and 1.42 mm, respectively, p < 0.05), suggesting a positive effect of the addition of PRF to bone graft procedures. On the other hand, the use of PRF appears to have no significant effect on gingival recession levels (0.14 mm, p = 0.40).

Miron (2021), in a systematic review and meta-analysis, observed that the use of PRF significantly improved (p < 0,001) the clinical results in intraosseous defects in the groups where it was used (PRF groups and retail debridement versus retail debridement and PRF and bone graft versus bone graft). Similar levels were observed between flap debridement plus bone graft versus flap debridement with bone graft and use of PRF, results showed significant improvements in the level of clinical insertion, mean gain of 1.39 mm, and in radiographic bone fill.

Pepelassi (2022), in a systematic review of randomized clinical trials, whose objective was to evaluate the adjuvant use of leukocyte-and-platelet-rich fibrin (L-PRF) in endosseous and furca periodontal defects, compared to without L-PRF, observed that in two- and/or three-wall endosseous defects the adjuvant use of L-PRF for flap debridement or bone graft was significantly beneficial for the reduction of probe depth and gain of clinical insertion level (true mean gain between 0.83 and 1.21 mm, difference in values is due to the high heterogeneity of the studies included in the systematic review ( $I^2 = 55\%$ ). The present results on the additive efficacy of L-PRF in the clinical insertion level gain are in line with the findings of Tarallo (2020) and Panda (2019).

The study also points to a reduction in radiographic defect depth (estimated mean reduction of 1.82 mm) compared to procedures without L-PRF. Interestingly, in relation to endosseous defects, when the adjuvant L-PRF was analyzed with another biomaterial, Emdogain, compared with Emdogain alone, showed a small non-statistically significant disadvantage in adding L-PRF to Emdogain (mean difference: -0.02 mm, 95% CI: -0.62 to 0.58) (Pepelassi, 2022).

Serroni (2022), in a clinical trial, evaluated the additional benefit of L-PRF to autogenous bone grafts (ABG) and retail debridement (OFD) in the treatment of inferior molar grade II furca involvement, probe depth, clinical insertion level, gingival recession and radiography (vertical bone level) were evaluated at baseline and 6 months after treatment. The addition of L-PRF to autogenous bone grafts (OFD+ABG+L-PRF) produces a significantly higher horizontal clinical insertion level gain (2.29  $\pm$  0.18 mm) compared to OFD+ABG treatment (1.61  $\pm$  0.18 mm) and OFD alone (0.86  $\pm$  0.18 mm). Both OFD+ABG+L-PRF and OFD+ABG therapies produced significantly greater clinical and radiographic improvement than OFD. Statistically significant improvements in all parameters evaluated were observed except for gingival recession that no significant difference within each group was reported, a result that ratifies the findings in the Tarallo (2020) studies.

Wanikar (2019) evaluated, clinically and radiographically, through a clinical trial, the efficacy of 1% Alendronate gel (ALN) in combination with PRF (PRF + ALN) and PRF alone in the treatment of grade II furca defects. The mean reduction in bag depth, clinical insertion level and horizontal sounding depth was  $1.85 \pm 0.59$  mm,  $1.9 \pm 0.64$  mm and  $1.7 \pm 0.73$  mm respectively for the PRF group and  $2.85 \pm 0.88$  mm,  $3.05 \pm 0.98$  mm and  $2.3 \pm 0.73$  mm respectively for the PRF+ALN group (p < 0.05). Mean

reduction in bone defect volume for the PRF group was  $8.65 \pm 3.84$  mm<sup>3</sup> and PRF+ALN was  $11.98 \pm 4.13$  mm<sup>3</sup>. Therefore, according to the study, defects treated with PRF + ALN exhibited better clinical and radiographic results suggestive of improved periodontal regeneration when compared to sites treated with PRF alone.

Swami (2022), evaluated and compared the effects of 1% of metformin (MF) plus PRF on PRF alone in the treatment of grade II furca defects, clinically and radiographically using computed conical beam tomography. In these studies the PRF is used as a three-dimensional matrix acting as a *drug delivery* system (PEPLASSI, 2022). Two groups were evaluated, group I treated with PRF only, while group II was treated with 1% MF and PRF gel. Both study groups produced improvements in the parameters evaluated; however, a significantly greater mean reduction in sounding depth gain, horizontal sounding depth, clinical insertion level was observed in Group II ( $3.90 \pm 0.78$  mm,  $2.94 \pm 0.80$  mm and  $3.42 \pm 0.93$  mm) compared to Group I ( $3.23 \pm 0.90$  mm,  $1.96 \pm 0.80$  mm and  $2.67 \pm 0.88$  mm) at 12 months, respectively. A significant reduction in bone defect was shown radiographically in Group II ( $12.61 \pm 4.01$  mm 3) compared to Group I ( $12.61 \pm 4.01$  mm 3) at the end of 12 months. Results that are shared in studies by Peplassi and collaborators (2022), where the addition of L-PRF to metformin significantly improved the results obtained in relation to those with metformin used alone, but in endosseous defects.

# 5. CONCLUSION

A significant improvement in the process of tissue regeneration and healing when PRF is used, along with other techniques for covering the furcation lesions, has been demonstrated in several studies. Therefore, the application of PRF seems promising, however, it is critical to recognize that there are still significant gaps in knowledge that need to be addressed for a more comprehensive and successful clinical application of PRF.

In this context, it is essential that future studies seek to standardize the methodologies used in the application of the PRF and in the evaluation of the results. This will allow for a more consistent comparison between the studies and will facilitate longitudinal analysis. In addition, future studies may explore the cost-benefit ratio of PRF use compared to other available therapies, considering not only clinical outcomes but also economic aspects.

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# **CHAPTER 7**

# GINGIVAL PLASTIC SURGERY: THE IMPORTANCE OF BIOLOGICAL SPACE

# Gisele Almeida de Caldas

Graduate Student in Dentistry

Institution: Universidade Professor Edson Antônio Velano (UNIFENAS)

# Luciana Moura Valadão

Graduate Student in Dentistry

Institution: Universidade Professor Edson Antônio Velano (UNIFENAS)

#### Manuella de Paula Amaral

Graduate Student in Dentistry

Institution: Universidade Professor Edson Antônio Velano (UNIFENAS)

# **Stephanie Quadros Tonelli**

Graduate Student in Dentistry

Institution: Universidade Professor Edson Antônio Velano (UNIFENAS)

# Virgínia da Silva Barros

Graduate Student in Dentistry

Institution: Universidade Professor Edson Antônio Velano (UNIFENAS)

# **Deise Alves Kastelic**

Graduate Student in Dentistry

Institution: Universidade Professor Edson Antônio Velano (UNIFENAS)

**ABSTRACT:** Gingivoplasty is a highly sought-after surgical procedure due to the search for a harmonious smile and increasingly pleasing aesthetics. It therefore generates great expectations in patients. This procedure corrects small discrepancies and minimizes the gingival smile, achieving the appropriate physiological contour and facilitating satisfactory oral hygiene. Gingival surgery may or may not be related to osteotomy, which aims to re-establish biological space by removing part of the bone surrounding the clinical crown. The combination of the two techniques occurs when, upon probing, the height necessary to perform gingivoplasty alone is not identified. In order to carry out bone wear, it is necessary to detach the bone using relaxing incisions. Drills are then used to re-establish a distance of at least 3 mm from where the incision for the crown augmentation will be made. It is a procedure that aims for aesthetics and ensures that the patient maintains healthy gingival tissues. Therefore, this study emphasizes how beneficial it is to perform gingival plastic surgery when desired and highlights the indication of osteotomy during this procedure.

**KEYWORDS:** gingival excess, periodontal surgery, dental aesthetics, biological space.

**RESUMO:** A gengivoplastia é um procedimento cirúrgico muito almejado devido à busca por um sorriso harmonioso e a uma estética cada vez mais agradável. Por isso, gera grandes expectativas no paciente. Tal procedimento corrige pequenas discrepâncias e minimiza o sorriso gengival, realizando o contorno fisiológico adequado, facilitando a realização de uma higiene bucal satisfatória. A cirurgia gengival pode ou não estar relacionada à osteotomia, que tem finalidade de restabelecer o espaço biológico ao remover parte do osso que envolve a coroa clínica. A associação das duas técnicas ocorre quando, ao realizar a sondagem, não é identificada a altura necessária para efetivar somente a gengivoplastia. Para a realização do desgaste ósseo, é necessário fazer o descolamento por meio de incisões relaxantes. Após isso, utilizam-se brocas com a finalidade de restabelecer a distância de, pelo menos, 3 mm de onde será feita a incisão para o aumento de coroa. É um procedimento que visa estética e garante que o paciente mantenha seus tecidos gengivais saudáveis. Portanto, este trabalho ressalta o quanto é benéfico realizar a cirurgia plástica gengival quando desejada e evidencia a indicação da osteotomia durante tal procedimento.

**PALAVRAS-CHAVE:** excesso gengival, cirurgia periodontal, estética dentária, espaço biológico.

# 1. CONTEXT

Aesthetics are becoming more and more desired by individuals. This leads many patients to seek dental practices to perform procedures aimed at improving and harmonizing smiles, thus increasing self-esteem and improving coexistence in society [1-3]. To achieve an esthetic smile, periodontal health is essential for the patient to be able to perform a gingivoplasty. This procedure aims to mitigate excessive gum exposure, bypass irregular tissue and correct any discrepancies present [4].

Gingival plastic surgery is performed according to the patient's facial features in order to remodel and bypass the gingival tissue in a way appropriate to their anatomy [5-6]. If the excess gum exposure is related to insufficient size of the clinical crown, a gingivoplasty is indicated, which may or may not be associated with an osteotomy. This technique corrects the asymmetries of the teeth and smile [7]. The bone wear procedure aims to re-establish the biological space when it is compromised during the performance of a gingival surgery [8-10].

Osteotomy is performed at the apical level to obtain a physiological outline and biological distance consistent with normality. It is recommended that the distance be at least 3 mm to avoid gum retraction and ensure satisfactory results in the short and long term [2].

The invasion of biological space, in the majority of cases, has no influence on the immediate result. For this reason, many professionals do not prioritize this procedure, since it does not alter the esthetics at the moment of care. However, the preservation of this space keeps the patient's gingival health up to date and prevents inflammatory reactions [1-4]. Some dental surgeons do not recognize the importance of combining the two techniques and are not fit to perform osteotomy.

Therefore, it is fundamental that professionals are trained to carry out these procedures and to identify about the need of each one, in each case. It should not be standardized that the dentist prizes only for aesthetics, neglecting periodontal health. With this, the gingival surgery that needs bone wear, should be carried out only when the professional is able to preserve and guarantee the well-being of his patient.

# 2. THEORETICAL GROUNDS

# 2.1 BIOLOGICAL SPACE

The biological space acts as a physical barrier adjacent to the root of the tooth, protecting the supporting tissues of the dental element against bacteria and their toxins. When this space is invaded, the body reacts by reabsorbing the supporting bone tissue to compensate for the loss of space. The periodontal tissues that make up the biological space are located within gingival tissue, around the tooth, where their integrity is maintained by a biological dimension essential to the health of the dental elements. The periodontal is composed of distinct structures: the root cementum, the periodontal ligament and the alveolar bone, playing a crucial role in the support and permanence of the dental element in the socket [1,2].

The biological space is the result of the measurement of the union epithelium and the insertion of the connective tissue, and the groove is not part of the composition of the biological space [4-6]. The crevicular fluid is intended to prevent bacteria from occurring within the biological space by acting on the maintenance of junctional epithelial structure and on the antimicrobial defense of the periodontal. Consequently, breaking this harmony may activate inflammatory response affecting gingival tissues when untreated [9]. The proportions of the biological space can be influenced according to the characteristics of the individual, age, position of the tooth in the arcade and gingival biotype [1,10].

# 2.2 THE SEARCH FOR AESTHETICS IN DENTISTRY

A smile is like someone's signature, revealing their intention to communicate. Smile harmonization happens when there is balance between teeth, lips and gums [11-13].

Currently, dentistry goes beyond prevention and promotion of oral health. Patients of all ages and genders seek to enhance their dental appearance. Studies indicate a high number of people with excessive gum problems, especially among women [14]. In this context, it is crucial to align the treatment plan with the individual aesthetic expectations of each patient [15,16]. Each person has their own perception

of an ideal smile, and this consideration is fundamental when developing a personalized dental plan (Pires; Souza; Menezes, 2010).

#### 2.3 GINGIVAL PLASTIC SURGERY AND OSTEOMY

The gingival smile is identified when, when smiling, the gum is exposed more than 3 mm from its margin to the line of the upper lip [17]. This additional exposure of the gum can affect both the aesthetics of the smile and periodontal health. Treatment may involve periodontal, surgical, and orthodontic therapy [18-20].

Lindhe (2018) reports on two types of gingival. The thin, which has translucent appearance and more fragile periodontal; and the thick, which is denser and resistant to surgical procedures, given that it presents less bone resorption and there is a tendency for formation of periodontal bags [1,10].

Aesthetic procedures in the area of periodontics often require surgical interventions. Gingivoplasty is performed to remodel the gum, restoring its anatomic shape and natural contour. On the other hand, gingivectomy is intended for the removal of periodontal bags and is a more specific surgical technique in its execution [20-24]. Against this background, it is crucial that health care professionals are up to date on the different forms of treatment to correct the gingival smile. This allows them to offer appropriate and personalized options to meet the aesthetic and oral health needs of each patient [25].

In some clinical cases, when the biological space is invaded during gingival surgery and looking towards periodontal health, some studies indicate the carrying out of osteotomy, used, in this context, to restore the biological space. This restoration is carried out by means of bone wear, using carbide-like drills or with chisels. The main objective of this procedure is to guarantee the desired result of surgery, preventing gingival retraction [23,26].

Several areas in dentistry aim at oral health care and all of them require attention and knowledge from professionals. In this context, periodontal health is related to the tissue that surrounds and provides tooth support. It therefore consists of the health of gingival tissues, which play an essential role in oral health as a whole [1].

The periodontal consists of the gum, periodontal ligament, root cementum and alveolar bone [2]. Its main function is to integrate the tooth with the bone tissues of the

jaw and maxilla, preserving the integrity of the masticatory mucosa in the oral cavity. The two main parts of the periodontal structure, both in the aspect of protection and support, are composed of several smaller parts, each with its specific functions, which contribute to the integral functioning of the mouth and its processes [3].

The biological space is the distance between the alveolar bone crest and the free gingival margin, and its integrity is of paramount importance to gingival health. This distance, between the bone crest and the gingival margin, is measured up to 3 mm, and can be evaluated with the insertion of the WHO probe into the gingival groove [4]. When the biological space is invaded, that is, when the recommended measures are not respected, a condition of gingival inflammation may occur, and may even result in tooth loss [5, 6]. In some cases, when the biological space is invaded, osteotomy is necessary to restore the correct distances through bone wear [7].

It is essential that the professional has adequate knowledge to, when he deems it necessary, carry out or forward the procedures correctly, minimizing possible traumas to the periodontal. Many professionals, however, do not have this knowledge and carry out procedures that do not respect the necessary measures, aggravating the oral health of patients [8, 9].

Good oral health requires greater attention from practitioners in all areas, increasing patients' self-esteem, especially when gingival plastic surgery is required. Knowledge about the preservation of the biological space is essential to avoid negative consequences. This study highlights the relevance of professionals having the basic knowledge to perform gingival plastic surgeries and, when necessary, osteotomy.

# 3. DISCUSSION

The periodontal tissue is the structure that surrounds the teeth and can be divided into two components, protection periodontal and support periodontal. The periodontal protection is composed of the gum and alveolar mucosa, while the periodontal support is represented by the periodontal ligament, cementum, and alveolar bone. The main function of the support periodontal is to insert the tooth into the maxillary and mandibular bone tissues, as well as helping to maintain the integrity of the surface of the masticatory mucosa and the oral cavity [10].

The protective periodontal is intended to cover both the internal and external environment of the oral cavity. In this way, it acts as a gateway to separate and protect the internal area (tissue) of the oral cavity, preventing infections caused by the invasion of microorganisms. Thus, the gum and mucosa form a functional unit. However, these structures may not only undergo certain changes over time due to biological and functional development, but may also undergo morphological changes associated with functional changes in the oral environment [10].

The fundamental parts that make up the periodontal include the marginal or free gums, located on the periphery of the gingival tissues and about 1 mm thick. This part of the gum is smoother compared to the inserted gum, which has a texture similar to orange peel. The inserted gum is attached to the marginal gum and, in turn, is firm, resistant, and is attached to the periosteum of the underlying alveolar bone. Its vestibular portion extends to the mobile alveolar mucosa, being bounded by the mucogingival junction. Inserted gum thickness is a clinically relevant measure, defined as the distance between the mucogingival junction and the projection of the outer surface of the gingival groove or periodontal pouch bottom.

The interdental gum, also called the interdental papilla, occupies the spaces between the teeth, known as interdental spaces, contributing to the integrity of the periodontal. The periodontal ligament, which binds the tooth to the surrounding alveolar bone, is composed of loose connective tissue and several cells, such as fibroblasts, fibrocytes, macrophages, plasma cells, and mast cells. The cementum covers the root of the tooth, ensuring its stability and union with tooth enamel, forming the amelocementary junction. The alveolar bone is an integral part of the jaw and jaw, providing support for the roots of the teeth [3].

In 1962, the concept of "biological space" was introduced to describe the distance between the base of the gingival groove and the top of the alveolar bone crest, excluding the gingival groove itself from these measures [11]. The biological space is composed of three main elements, the sulcus epithelium, the junctional epithelium, and the conjunctive insert. The sulcus epithelium is a keratinized area not adhering to the tooth, also known as the free gum or gingival groove, with an average depth of 0.7 to 1 mm. The junctional epithelium follows, a non-keratinized, permeable layer formed by two cellular layers (internal and external basal lamina). The outer lamina is relatively weakly attached to the enamel due to hemidesmosomes and is

responsible for the production of the crevicular fluid. Finally, the conjunctive insert, which accompanies the cementum-enamel junction, consists in the union of conjunctive fibers to the root cementum, with an average depth of 1.0 to 1.5 mm, also known as conjunctive sealing [11].

The term "biological space" refers to the sum of the measure of the conjunctival insertion and the junctional epithelium, excluding the measure of the gingival groove [12]. Preserving the biological space is fundamental, because its violation can result in chronic progressive inflammation, alveolar bone resorption to accommodate new connecting tissues, formation of periodontal sacs, loss of insertion and even tooth loss [12,13]. Therefore, to ensure accurate results and avoid pathological complications, it is essential to respect principles such as biological space during restorative and aesthetic procedures [14].

Gingivoplasty is a procedure that involves the removal of gingival tissue in order to minimize tissue exposure, ensuring adequate height and width for an optimal aesthetic [15]. According to [16], when performing surgical techniques, it is possible to make an incision with a traditional scalpel or to use electro. Although traditional scalpel is more common, both methods achieve similar aesthetic and satisfactory results. Thus, the choice between the techniques must be defined during the planning of the treatment, in agreement with the patient, taking into consideration the specificities of each situation. After the procedure, it is possible to observe immediately changes in the smile, with more appropriate and harmonious proportions according to the individual characteristics of the patient [17].

According to [18], to meet patient expectations and preserve periodontal health, it is necessary that gingival exposure is up to 3 mm. Otherwise, it is essential to consider not only intraoral health, but also facial features, respecting the individuality of the patient, in order to avoid any dissatisfaction with the final result [19].

The esthetic impairment of the smile, which occurs through excess gingival, is multifactorial. It can be by use of medicines that cause hyperplasia, pathological conditions in the gingival tissue, systemic conditions, hormonal changes during the gestation period and use of orthodontic appliances [20,21,22].

The gingival plastic surgery associated with bone wear, aims at a harmonious smile and also a more pleasant appearance, in addition to providing an instant improvement in self-esteem and ensuring periodontal health. Such techniques involve

the preservation of the biological space and aesthetic improvements, by transforming the gingival shape, asymmetries and excesses of the tissue [23,24,25].

When a gingival smile is identified, surgical techniques are available to increase the crown of the teeth. These include gingivectomy and gingivoplasty, both of which focus on eliminating gingival tissue. In gingivectomy, partial gum removal occurs to reduce or eliminate soft tissue in areas affected by periodontal pockets, while gingivoplasty is a surgical procedure that reshapes the gum to provide a more natural contour [26]. Another widely used surgical technique is resective bone surgery, which aims to restore the dimensions of the biological space, improve the control of bacterial plaque, aesthetics, occlusion and masticatory function [27]. Osteoplasty and osteotomy are terms employed when bone tissue is removed. Osteoplasty aims to create a physiological form of the alveolar bone without removing the supporting bone. In contrast, osteotomy involves the removal of the supporting bone, which is the bone directly associated with tooth insertion [27].

It is indispensable that the professional carefully observe the individual characteristics of each patient to establish an ideal planning and to meet the expectations in relation to the outcome of the procedure. Among these characteristics, we highlight the type of face, vertical height, symmetry, smile line, thickness and dimensions of lips, density of alveolar bone, gingival biotype and dental anatomy [28,29,30].

Thus, to achieve satisfactory esthetic results, in some situations, it is necessary to integrate various disciplines and to draw up a multidisciplinary treatment plan. The incorporation of innovations, aiming at a more efficient integration, has led to more comprehensive diagnoses and dental plans. It is fundamental to stress that the Dentist should always consider the aesthetic concerns and the wishes of transformation of the patient. Therefore, in-depth knowledge of periodontal surgical techniques, their indications and their results, is crucial for the design of a successful multidisciplinary treatment [31].

A study was conducted with the aim of highlighting the essential methods for a proper diagnosis, planning and treatment of the gingival smile, under a periodontal approach [32]. A literature review was conducted addressing different approaches to address the gingival smile, in addition to presenting two clinical cases. The results indicated that the surgery to correct the gingival hyperplasia produces predictable and

high quality results, without causing discomfort to the patient. Therefore, it is imperative that the Dentist has a solid understanding of the periodontal and aesthetic patterns involved in the treatment.

# 4. FINAL CONSIDERATIONS

Gingival plastic surgery is done to correct small discrepancies in gingival tissue. In this way, it establishes a harmonious and esthetic smile, as well as providing quality of life to the patient. An aesthetic smile is directly linked to self-esteem and social coexistence. To do so, it is necessary that the patient's complaints are respected and taken into consideration, provided that he maintains the health of the periodontal, to guarantee satisfaction with the procedure carried out. Correction of the gingival smile requires a solid knowledge of the dentist about facial, gingival and bone anatomy, as well as the correct surgical technique. It is essential to preserve the biological space, and for this to occur, the professional must have knowledge of when to carry out the bone wear, thus guaranteeing periodontal health.

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# **CHAPTER 8**

# ANALYSIS OF THE INTRINSIC POTENTIAL FOR COMPLEMENTARY PAIN CONTROL IN DENTAL PATIENTS

# **Polyana Fontes Rodrigues**

Graduate Student in Dentistry

Institution: Universidade Federal de Uberlândia (UFU)

Address: Uberlândia, Minas Gerais, Brazil E-mail: polyanafontesodonto90@gmail.com

# Roberto Bernardino Júnior

Doutor em Educação

Instituição: Universidade Federal de Uberlândia (UFU)

Address: Uberlândia, Minas Gerais, Brazil

E-mail: bernardino@ufu.br

**ABSTRACT:** Dentistry is one of the fields that, by common sense, is directly related to the perception of pain due to the high demand for curative rather than preventive care. In this context, various factors can contribute to pain reduction, including physical, chemical, and psychosomatic factors. Therefore, it is crucial for the dentist to have knowledge about unlocking intrinsic potentials to use them as adjuncts in possible treatments. In this regard, this study aimed to evaluate the placebo effect in pain control in dental patients undergoing outpatient procedures that required local anesthesia. For the research, information on the subjective perception of pain was collected using the visual analog scale (VAS). Subsequently, a topical anesthetic (ointment) was used prior to the anesthetic puncture. After 1 to 3 minutes, the subjective perception of pain was collected again before the actual anesthesia was administered. Finally, this same information was collected after the anesthesia was administered. With the VAS values obtained, a reduction in perceived pain by 44.53% and an increase in pain by 1.61% among the 30 volunteers were observed. The collected data were cross-referenced considering the three collection moments and subjected to the Mann-Whitney test with p<0.05, finding statistically non-significant results in only three cross-references. It is concluded that it was possible to reduce perceived pain only with the topical application of anesthetic prior to the procedure, in both sexes, confirming the existence of an intrinsic potential for pain control.

**KEYWORDS:** placebo effec, pain perception, local anestesia, intrinsic factor.

**RESUMO:** A odontologia é uma das áreas que por senso comum, possui relação direta com a percepção de dor, devido à alta procura por atendimentos curativos e não preventivos. Com esta realidade vários fatores que podem contribuir para a diminuição da dor, sendo eles de natureza física, química e psicossomática. Portanto, é crucial que o cirurgião dentista tenha conhecimento sobre o destravamento de potencialidades intrínsecas, para que os utilize como adjuvantes nos tratamentos possíveis. Nesse sentido este trabalho teve como objetivo avaliar o efeito placebo no

controle da dor em pacientes odontológicos submetidos à procedimentos ambulatoriais que necessitasse de anestesia local. Para realização da pesquisa foi coletada a informação sobre a percepção subjetiva da dor por meio da escala visual analógica (EVA). Em seguida foi utilizado anestésico tópico (pomada) previamente à punção anestésica. Após 1 a 3 minutos foi novamente coletada a percepção subjetiva da dor previamente a realização efetiva da anestesia. Por fim, coletou-se esta mesma informação após a execução da anestesia. Com os valores obtidos da EVA verificou-se a redução da dor percebida em 44,53% e aumento da dor em 1,61% dos 30 voluntários. Os dados coletados foram cruzados entre si considerando os três momentos de coleta e submetidos ao teste de Mann-Whitney com p<0,05, encontrando resultados estatisticamente não significativos em apenas três cruzamentos. Conclui-se que foi possível minorar a dor percebida apenas com a aplicação tópica de anestésico previamente a realização do procedimento, em ambos os sexos, confirmando a existência de um potencial intrínseco de controle da dor.

PALAVRAS-CHAVE: efeito placebo, percepção de dor, anestesia local, fator intrínseco.

#### 1. INTRODUCTION

Pain is an individual, particular, unique perception, based on physical and psychic factors that form one of man's greatest concerns. Although not desired, it is an important symptom as a warning that something aggressive or causing disharmony is occurring.

One of the areas of health that most require care, as a result of public conformity of pain perception, is dentistry. Various factors can contribute to the reduction of pain, within Dentistry, being: physical, chemical and psychosomatic.

Pain can be assimilated as a category of private, i.e. subjective, experience that cannot be shared with another person (Golden, 2004). Thus, individuals only learn the effects that arise from their experience and expression (Unikowsk, 2003). Pain is understood as a sign of attention, a precautionary action of the organism to harmful stimuli. It is described as an unpleasant sensory and emotional experience associated with actual or potential tissue injury, related to the individual's previous experiences (lasp, 2020).

The word pain originates from the Latin dolore, designating physical pain, moral pain, suffering, sadness, grief and disgust (Machado, 1990). When treating a disease mechanically, pain is an alarm that results from a somatic disease or structural injury of the organism, which to suppress it is necessary to understand what is causing it. However, for the biopsychosocial model, it is not possible to interpret mind and body as separate units when it comes to nociception. The patient should be analyzed from the medical-physical, psychosocial, behavioral and functional point of view (Camparis; Cardoso Júnior, 2002).

To explain the idea of pain, it is not enough to define it as the result of an internal physical condition, because it is a multifactorial symptom and, in view of this, it is important to address the psychodynamic aspects involved, particularly when it is characterized as psychogenic. It is a perception that involves the reaction of the individual to the noxious agents, the suffering and the ways of dealing with the anguish that is imposed. As a result, it is possible to see that the emotional state of the individual can significantly affect their perception of pain. The effect of emotional tensions on pain, suffering and behavior should be considered when evaluating the painful experience (Teixeira, 1997), (Perissinotti, 2003).

For the treatment of pain, chemical resources are commonly used, among them analgesics and anesthetics. However, other mechanisms of an alternative nature are also applied, such as acupuncture, emotional factors and placebo effect (Pereira, 2018). The application of acupuncture as a pain control technique for personal well-being with quality of life. (Santos, 2022). As well as, low-power laser therapy has analgesic and anti-inflammatory action (Cunha; Vilela; Faria, 2023).

In addition, there are examples of situations in which the drugs generally used cannot be considered as "proven therapeutic procedures", because of numerous positive results obtained with certain drugs, but which would correspond to a possible placebo effect presented by them (Golden *et al.*, 2004). Thus, the effects of placebo, together with the natural history and regression of the disease, can justify the high rates of good results, which are attributed to the specific effects of the treatment.

There is still no delimitation for the responses obtained from treatments of pains with placebos, since these effects are mediated by possible brain alterations that can lead to improvements in the bodily condition (Golden *et al.*, 2004). However, understanding placebo response mechanisms can help scientists unveil the human body's "intrinsic pharmacy." There is a consensus on the importance of the need for understanding pain and its mechanisms for any professional dealing with health, since the need of patients to obtain pain relief is one of the main causes that motivates the search for medical and dental care.

#### 1.1 OVERALL PLACEBO EFFECT

Scientists define a placebo as a drug-free substance that can be given as a control in clinical drug treatments, or given to the patient for *beneficial effects*. In research, the mechanisms responsible for its effects are highlighted, and indicate that this response may have a fundamental function in the healing process of the organism (Cindy, 2000). The placebo response can be understood as the improvement of the body's symptoms in response to non-specific factors, such as verbal suggestion, which is attributed to the symbolism that the treatment exerts (Teixeira, 2009). Placebo analgesia means the analgesic effect that a non-analgesic substance can stimulate in an individual (Yashima *et al.*, 2009).

The modulating mechanisms of the placebo response can be divided into three situations: classical conditioning or unconscious operative, when the placebo response occurs after the exposure of the individual to certain situations that require neural sensory suggestions, such as the environment of the office or even the color of the tablet that can be associated with effective interventions of the treatment; conscious expectation, when the perspective of clinical improvement of the patient is associated with verbal suggestion; and conscious expectation more the operative conditioning, when associating the two above mentioned, which normally occurs in placebo analgesia (Teixeira, 2009).

The placebo effect acts physiologically on the individual, both psychologically and somatically. From a psychological point of view, expectation, conditioning, learning, memorization, motivation, somatic focus, and anxiety reduction are mechanisms that are directly related to the placebo effect. With expectation and conditioning being the best known (Santos, 2007).

As regards the somatic response of the placebo, we note them by means of placebo analgesia, which has as its main mediators the endogenous opioid peptides in the brain, called endorphins, which act in the same place as the receptors of exogenous opioid analgesics, which are distributed in specific cerebral regions, that is, the brain stem, the thalamus and the spinal cord. This finding was confirmed by experiments with opioid receptor antagonist naloxone, where blocking of the placebo analgesic response due to its administration was evidenced (Teixeira, 2009).

There are indications that placebo given after analgesics administration may act similarly to active drugs, as *indicated* (Colloca *et al.*, 2013) in the section on psychological aspects of an article devoted to neurobiological and psychological mechanisms of placebo analgesia.

The search for dental care, socially still seen in a much more curative than preventive way, is characterized commonly and predominantly by the search for professional dental surgeons when pain is already present. It is noted that preventive actions, besides offering more oral health and consequently systemic, prevent unwanted pains or symptoms from appearing in front of lesions in the installation phase or even already present.

With this bias, the visit to the dental offices was constructed as a moment in which the pain would certainly be experienced, not being aware that, if prevention were practiced, the experience would be different.

Generally speaking, in dentistry, three groups of drugs are commonly used to control pain: local anesthetics, anti-inflammatory drugs (NSAIDs and corticosteroids), and central and/or peripheral-acting analgesics (Rocha *et al.*, 2003). Non-opioid central-acting analgesics act by two mechanisms: by binding with low affinity to u-opioid receptors or by inhibiting the feedback of noradrenaline and serotonin. (White, 2002, Rocha *et al.*, 2003). While, opioid analgesics, in turn, are little used in the dental clinic, for their low effectiveness in the control of orofacial pains (Mehlisch, 2002). Whereas peripheral-acting analgesics are inhibitors of prostaglandin synthesis, by acting on cyclooxygenases (COX-1 and COX-2), which results in the attenuation of inflammatory pain and explains the adverse effects of this group of drugs (Khan *et al.*, 2002, Rocha *et al.*, 2003).

In this sense, the very situation of being in a dental office already favors the emergence of psychic perceptions that amplify painful symptoms.

On the other hand, it is noted that, once these preconceived concepts about the relationship between pain and the dental environment have been overcome, a relationship of trust has been built between the professional and the patient, and the concept has been revised that "every dental procedure hurts", interventions of every order, even those that are cruel, show less demonstration of pain on the part of the patients, better healing in the case of surgical interventions and even more tranquility of both at the moment of care.

With this look, it is observed that, in certain situations in which confidence, tranquility, safety and the harmonious environment, favor that the organism itself uses its mechanisms of analgesia and resolution of painful processes. Here we see the unlocking of intrinsic potentialities, already present, but which, for lack of self-confidence needed external factors to be used, in this case, the environment, safety, built confidence and tranquility.

In other situations, such factors may be replaced or supplemented by a song, ointment, or even a vehicle-only tablet, with no drug present. With action only on the mucosa, and therefore superficial, in the dental routine prior to anesthetic puncture, a

topical anesthetic ointment is commonly used to minimize the discomfort of the needle perforation used in the desensitization procedure.

To record the subjective analysis of pain, the instrument is the Visual Analog Scale (VAS). VAS is usually a straight horizontal line, which describes the painful intensity that goes from no pain to the worst possible pain at each end of the line (Pohl *et al*, 2011).

In this sense, this work aimed to verify the possible placebo effect in clinical dental practice, by evaluating such potentiality as a possible complementary therapeutic agent for analgesics. Through the evaluation using VAS, the aim was to investigate the possible reduction of pain in men and women only with the cutaneous/mucosal application of the anesthetic ointment in patients with dental, gingival, muscle or joint pains, whose anesthetic puncture would necessarily be used later for the intervention proposed in the resolution of the algia. For the purpose of comparison by means of VAS, in both sexes, the subjective perception of pain was collected at the beginning of the care, after the application of the topical anesthetic and after the anesthesia actually performed, before the beginning of the intervention.

#### 2. METHODOLOGY

The research proposed in this project had basic, deductive, quanti-qualitative, descriptive and observational character, was approved by the Ethics Committee in Research with Human Beings of the Federal University of Uberlândia, identified by the number 69685323.9.0000.5152.

It was developed in the clinics of the Odontological Hospital (HO) and was able to count upon the participation of 30 volunteers who voluntarily sought out the (HO) for odontological interventions. The group surveyed was divided into male and female with equal number of participants, or 15 in each.

In order to participate in the research, the volunteer was approached by the researchers in the consulting office, before the examination and/or procedures were initiated and invited to participate. Received detailed explanation of what will be carried out and only after agreement and signature of the TCLE began the procedures of care, with which was observed desensitization researched.

In dental procedures where anesthesia is required, topical anesthetic is used at the puncture site to minimize the sensitivity of perforation with the anesthetic needle.

With this fact, and considering the potential intrinsic analysis effect of the individual, prior to initiating the procedures, volunteers were asked to fill the visual analog scale (VAS) for subjective pain analysis.

After applying the topical anesthetic and waiting 1 to 3 minutes, a new EVA was requested, before the actual anesthesia was performed. After the anesthesia was performed, the same scale was again requested to be filled in for pain analysis.

Looking at the various anesthetic techniques and regions used in clinical dental practice, it is noted that, for anatomical reasons, the technique of inferior alveolar nerve (NAI) blocking presents difficulties and that in which, being in the jaw, bone with more compact cortical, is not successful with infiltrative applications.

Therefore, in order to discard the possible effect of the topical anesthetic infiltrating the tissue, only volunteers whose foreseen procedure requires anesthesia of the NAI may participate.

Thus, both the use of the topical anesthetic and the voluntary potential only participated in the research if the procedure to be carried out required such interventions.

For analysis, the data were transcribed as a percentage and submitted to the Mann-Whitney test with p<0.05 (bilateral) with the following crossings:

- a) percentage of pain reduction analyzed using the EVA scale in men comparing data obtained before the topical anesthetic x topical anesthetic;
- b) percentage of pain reduction analyzed using the EVA scale in men comparing data obtained from topical anesthetic vs local anesthetic;
- c) percentage of pain reduction analyzed using the EVA scale in men comparing data obtained before the topical anesthetic vs. local anesthetic;
- d) percentage of pain reduction analyzed using the EVA scale in women comparing data obtained before topical anesthetic vs topical anesthetic;
- e) percentage of pain reduction analyzed using the EVA scale in women comparing data obtained from topical anesthetic vs local anesthetic;
- f) percentage of pain reduction analyzed using the EVA scale in women comparing data obtained before topical anesthetic vs local anesthetic;

- g) percentage of pain reduction analyzed using the EVA scale in men x women before the application of the topical anesthetic;
- h) percentage of pain reduction analyzed using the EVA scale in men x in women with topical anesthetic application only;
- i) percentage of pain reduction analyzed using the EVA scale in men x women after effective application of local anesthetic.

#### 3. RESULTS

In applying the proposed methodology, 15 male volunteers were analyzed. Of these, 86.66% noted reduced pain after administration of topical anesthetic. However, 13.33% had increased pain after administration of inferior alveolar nerve anesthesia.

Thus, after administration of the topical anesthetic, regarding subjective pain analysis measured by the EVA scale, it was recorded that 2 volunteers reported a reduction between 0-10%; another 2 reported a reduction between 10-20%; 1 reported a reduction between 20-30%; 2 volunteers reported a reduction between 30-40%; 2 reported a reduction between 40-50%; 2 reported a reduction between 50-60%; no volunteers with a reduction between 60-70%; 2 volunteers with a reduction between 70-8% 0%; 0 volunteers with reduction between 80%-90% and 2 marked reduction between 90%-100%, as can be observed in Table 1.

Table 1 – Data from 15 male volunteers, measured using the Visual Analog Scale (EVA), before administration of the topical anesthetic, after use of the topical anesthetic and then administration of Lower Alveolar Nerve anesthesia, with the respective percentages of change in subjective perception of pain

Volunteers (M)	Before topical anesthetic	After topical anesthetic	After NAI anesthesia	% reduction of pain with topic	of pain	% reduction of topic pain after anesthesia	Pain increase % of topic after anesthesia
	EVA 1	EVA 2	EVA 3				
	(0-10)	(0-10)	(0-10)				
01	5	2.	0	60%	0%	100%	0%
02	7	5	0	28.58%	0%	100%	0%
03	10	5	0	50%	0%	100%	0%
04	9	2.	0	77.78%	0%	100%	0%
05	3.	3.	4.	0%	0%	0%	33.33%
06	5	5	10	0%	0%	0%	100%
07	5	0	0	100%	0%	0%	0%
80	10	8	1.	20%	0%	87.5%	0%

09	10	8	3.	20%	0%	62.5%	0%
10	7	4.	1.	42.86%	0%	75%	0%
11	8	5	2.	37.5%	0%	60%	0%
12	10	4.	0	60%	0%	100%	0%
13	10	2.	0	80%	0%	100%	0%
14	5	3.	0	40%	0%	100%	0%
15	7	0	3.	100%	0%	0%	300%
Medium	7.4	125 3.73 75	1.6 31	49.59%	0%	57.10%	28.88%

Sources: authors.

When analyzing the data obtained from the 15 female volunteers, a reduction in pain was noted after the administration of the topical anesthetic in 80% of the cases. However, 13.33% had an increase in perceived pain after administration of the said anesthetic. In 6.66% of the volunteers there was no reduction or increase in pain after the administration of the topical anesthetic. However, in 6.66% of the volunteers it was stated that there had been an increase in pain, after the administration of anesthesia of the inferior alveolar nerve.

Thus, according to the Visual Analog Scale (VAS) after administration of the topical anesthetic, we found: 3 volunteers with a reduction between 0-10%, 4 volunteers with a reduction between 10-20%, 0 volunteers with a reduction between 20-30%, 3 volunteers with a reduction between 30-40%, 0 volunteers with a reduction between 40-50%, 2 volunteers with a reduction between 50-60%, 0 volunteers with a reduction between 60-70%, 0 volunteers with a reduction between 70-8% 0%, 0 volunteers with 80-90% reduction and 3 volunteers with 90-100% reduction according to Table 2.

Table 2 – Data from 15 female volunteers, measured using the Visual Analog Scale (EVA), before administration of the topical anesthetic, after use of the topical anesthetic and then administration of Lower Alveolar Nerve anesthesia, with the respective percentages of change in

subjective perception of pain

Voluntary (F)	Before topical anesthetic	After topical anesthetic	After NAI anesthesia	% reduction of pain with topic	% increase of pain with topic	% pain reduction topic after anesthesia	% increase pain topic after anesthesia
	EVA 1 (0-10)	EVA 2 (0-10)	EVA 3 (0-10)				
01	7	9	0	0%	28.57%	100%	0%
02	8	7	0	12.5%	0%	100%	0%
03	7	7	3.	0%	0%	57.15%	0%
04	9	6	3.	33.34%	0%	50%	0%
05	5	2.	0	60%	0%	100%	0%
06	8	0	0	100%	0%	0%	0%
07	10	0	0	100%	0%	0%	0%
08	10	8	7	20%	0%	12.5%	0%
09	10	8	4.	20%	0%	50%	0%
10	8	5	3.	37.5%	0%	40%	0%
11	10	0	2.	100%	0%	0%	200%
12	10	4.	0	60%	0%	100%	0%
13	10	8	7	20%	0%	12.5%	0%
14	8	5	2.	37.5%	0%	60%	0%
15	5	6	0	0%	20%	100%	0%
Medium	8.33	5.0	2.06	39.98%	3.23%	58.80%	13.33%

Source: authors.

According to the data recorded in Tables 1 and 2, when analyzing the total sample of 30 volunteers of the male and female sexes, a reduction in pain after administration of the topical anesthetic was noted in 83.33% of the volunteers. While 10% of volunteers experienced increased pain after administration of lower alveolar nerve anesthesia. In addition, 10% of the sample showed no increase or reduction of pain after administration of the topical anesthetic. Finally, only 6.66% of the volunteers had the opposite effect, from an increase in pain to the topical anesthetic.

In this sense, after administration of the topical anesthetic, it is verified: 5 volunteers with pain reduction between 0-10%, 6 volunteers with pain reduction between 10-20%, 1 volunteer with pain reduction between 20-30%, 5 volunteers with pain reduction between

3040%, 2 volunteers with pain reduction between 40-50%, 4 volunteers with pain reduction between 50-60%, 2 volunteers with pain reduction between 70-80% and 5 volunteers with pain reduction between 90-100%, according to Table 3.

Table 3 – Data from 30 male and female volunteers, measured using the Visual Analog Scale (VAS), before the administration of topical anesthetic, after the use of topical anesthetic and later administration of Lower Alveolar Nerve anesthesia, with the respective percentages of change in the

subjective perception of pain

Volunteers	Before topical anesthetic	After anesthesia the topic	After anesthesia NAI	% reduction pain with topic	% increase in topical pain	% pain reduction topic after anesthesia	% increase pain topic after anesthesia
	(0-10)	(0-10)	(0-10)				
01	7	9	0	0%	28.57%	100%	0%
02	8	7	0	12.5%	0%	100%	0%
03	7	7	3.	0%	0%	57.15%	0%
04	9	6	3.	33.34%	0%	50%	0%
05	5	2.	0	60%	0%	100%	0%
06	8	0	0	100%	0%	0%	0%
07	10	0	0	100%	0%	0%	0%
08	10	8	7	20%	0%	12.5%	0%
09	10	8	4.	20%	0%	50%	0%
10	8	5	3.	37.5%	0%	40%	0%
11	10	0	2.	100%	0%	0%	200%
12	10	4.	0	60%	0%	100%	0%
13	10	8	7	20%	0%	12.5%	0%
14	8	5	2.	37.5%	0%	60%	0%
15	5	6	0	0%	20%	100%	0%
16	5	2.	0	60%	0%	100%	0%
17	7	5	0	28.58%	0%	100%	0%
18	10	5	0	50%	0%	100%	0%
19	9	2.	0	77.78%	0%	100%	0%
20	3.	3.	4.	0%	0%	0%	33.33%
21	5	5	10	0%	0%	0%	100%
22	5	0	0	100%	0%	0%	0%
23	10	8	1.	20%	0%	87.5%	0%
24	10	8	3.	20%	0%	62.5%	0%
25	7	4.	1.	42.86%	0%	75%	0%
26	8	5	2.	37.5%	0%	60%	0%
27	10	4.	0	60%	0%	100%	0%
28	10	2.	0	80%	0%	100%	0%
29	5	3.	0	40%	0%	100%	0%
30	7	0	3.	100%	0%	0%	300%
Medium	7.86	4.36	1.83	44.53%	1.61%	58.03%	21.11%

Source: The authors.

After statistical analysis of the collected data in which they were submitted to the Mann-Whitney test with p<0.05. The following crossings showed p statistically significant:

- a) percentage of pain reduction analyzed using the EVA scale in men comparing data obtained before topical anesthetic x topical anesthetic (p = 0.0008);
- b) percentage of pain reduction analyzed using the EVA scale in men comparing the data obtained from the topical anesthetic vs. local anesthetic; (p =
- c) 0,0101);
- d) percentage of pain reduction analyzed using the EVA scale in men comparing data obtained before topical anesthetic vs local anesthetic (p < 0.0001);
- e) percentage of pain reduction analyzed using the EVA scale in women comparing data obtained before topical anesthetic x topical anesthetic (p = 0.0021);
- f) percentage of pain reduction analyzed using the EVA scale in women comparing data obtained from topical anesthetic x local anesthetic (p =
- g) 0,0152);
- h) percentage of pain reduction analyzed using the EVA scale in women comparing data obtained before the topical anesthetic x local anesthetic (p < 0.0001).

#### 4. DISCUSSION

According to literature, placebo is a Latin word meaning "to please". This action has as a reaction a beneficial effect of improving the symptoms of a disease, through inert substances. According to Teixeira (2009), when the organism needs responses to non-specific factors, it has intrinsic capabilities to improve its own symptoms.

In this sense, in this research, when analyzing the male group with a total of 15 volunteers, a reduction in toothache was found only with the administration of topical mucosal anesthetic in 49.59% of the cases, converging with the one cited by Yashima *et al* (2009), when it points out that placebo analgesia is the result of an analgesic effect when stimulating a non-analgesic substance in an individual. In the case of this research, in spite of the substance being analgesic, its activity is only in mucosa, not having profound action like the injectable anesthetic.

This makes it possible to validate and measure the placebo effect, just like Santos (2007) when he states that this effect is a result of the administration of substances that do not show any pharmacological action, but with similarity to the ative agent that is being compared. Since, the pain reduction potential of topical anesthetic for local anesthesia in the group of 15 male volunteers was 57.10%, i.e., Lower Alveolar Nerve blockade increased the percentage of pain reduction by 7.51%.

From this perspective, when evaluating the group of 15 female volunteers, in the first moment, there was a reduction in pain in 39.98% of the cases, only with administration of the topical anesthetic. Seen as a placebo response cited by Teixeira (2009), in which the improvement of the body's symptoms in response to non-specific factors is associated with the use of substances within the context in which the placebo will contribute to the individual's response.

According to Benedetti (2009), it is important to take into consideration the context in which the patient is inserted, that is, in an environment of dental emergency, which is already a stress factor. When considering that in the female group, the pain values before the administration of the topical anesthetic were higher than the results obtained in the male group, the highest percentage of reduction of pain from topical anesthetic to local anesthesia was noted, 58.50%.

When researching and studying the modulating mechanisms of the placebo response, one finds the study by Teixeira (2009) that classifies the mechanisms in 03 situations: classical conditioning or unconscious operative, conscious expectation and conscious expectation plus the operative conditioning. In the case of classical conditioning or unconscious operant, the occurrence of the placebo response after the exposure of the individual to certain situations that require sensory neural suggestions, such as the care environment and the color of the tablet. Conscious expectation consists of a perspective of improvement of the patient's clinical condition, when associated with verbal suggestions. While, the association of the two conditions: conscious expectation with operative conditioning occurs in placebo analgesia.

It is understood that this research contemplates the classical conditioning or unconscious operant, in which the placebo response is obtained after the exposure of the individual to certain situations that require sensory neural suggestions, such as the self-assessment of pain level before the application of the topical anesthetic in mucosa,

after application of the same anesthetic and later infiltrative local anesthesia, as proposed in its treatment plan.

By acting with the objetive of understanding the patient's pain levels, this moment of understanding is associated with the topical anesthetic, with the effective interventions in the treatment. This resource is used, when administering the topical anesthetic before the administration of local anesthesia, in which an improvement in the pain situation of the patients was obtained, in 44.53% of the 30 volunteers, independent of gender. As well, the percentage of pain reduction from topical anesthetic to local anesthesia in the total group of volunteers was higher by 13.5%.

It is noted, when comparing the results obtained in the 03 groups, that the topical anesthetic in this situation becomes an instrument for carrying out the placebo effect. Thus, this study proves the mechanism of the placebo, by means of the measurement of preemptive analgesia formulated by Crile (1913). It is found that stimulation of nociceptive fibers promotes changes in the human body, as well as in the perception of pain. These fibers are responsible for neural and behavioral changes, which can occur even after the removal of harmful stimuli.

In some volunteers the Nocebo effect was noted. This term is derived from Latin (nocere), which means "inflict harm". It is the event of negative effects that brings losses to the treatments, having as its effects the worsening of symptoms and/or diseases.

This situation coincides with the analysis carried out by Scott *et al.* (2008), in which it related the administration of placebo in the reflex of the activation of the neurotransmission of endogenous opioids. Consequently, placebo responses were associated with higher dopamine and opioid activities in the nucleus accumbens, while Nocebo responses were associated with dopamine deactivation and opioids in the same region.

In this work, this result is visualized only in two female volunteers in which, on average, there is an increase of 3.23% in the total number of participants, after administration of the topical anesthetic. Therefore, in the group of 30 volunteers, men and women, the percentage of increase in pain in relation to the topical anesthetic was 1.61%. It is inferred that this situation occurs due to the blocking of these patients in enabling intrinsic mechanisms for improvement of their own symptoms, including in situations of stress.

## 5. CONCLUSION

After applying the proposed methodology and analyzing the collected results, it is concluded that:

- a) there is an intrinsic/endogenous potential for pain control in dentistry;
- b) in women and men the intrinsic pain control response is similar;
- c) the percentage of pain reduction with the injected anesthetic was greater than that with the topical anesthetic, but was lower in absolute number considering VAS;
- d) as a relevant agent for pain control and useful in the dental environment, it deserves to be further studied, detailed and publicized.

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# **CHAPTER 9**

# THE POTENTIAL OF BULK FILL RESINS TO OPTIMIZE DENTAL RESTORATIONS IN PUBLIC HEALTH: AN INTEGRATIVE REVIEW

# Mariana de Figueiredo Lopes e Maia

Master in Dentistry

Institution: Universidade Federal do Maranhão (UFMA)

Address: São Luís, Maranhão, Brazil E-mail: mariana.unasus@gmail.com

#### Fernanda Belo da Fonseca Josino

Graduate in Dentistry

Institution: Universidade Federal do Maranhão (UFMA)

Address: São Luís, Maranhão, Brazil E-mail: <a href="mailto:fernanda.belo@discente.ufma.br">fernanda.belo@discente.ufma.br</a>

#### **Leily Macedo Firoozmand**

Post-Doctor in Restorative Dentistry

Institution: Universidade Federal do Maranhão (UFMA)

Address: São Luís, Maranhão, Brazil E-mail: <u>leily.firoozmand@ufma.br</u>

**ABSTRACT:** Introduction: Bulk fill resins were developed with the aim of providing an aesthetic material that combines favorable biomechanical properties with a simplified application technique, emerging as an alternative for restorative treatments in public health. However, their clinical application still raises uncertainties among professionals. This study aims to analyze, through a literature review, the characteristics, properties, and clinical applicability of bulk fill resins. Methods: A qualitative bibliographic study was conducted through a critical literature review. The research was carried out in databases such as PubMed/MEDLINE, Scopus, Google Scholar, and SciELO, selecting articles from laboratory and clinical studies published between 2015 and 2020. Results: Randomized clinical trials and in vitro studies show that bulk fill resins with regular consistency have mechanical properties comparable to conventional resins. These resins, with their varying levels of viscosity, allow for timesaving procedures by offering a simplified technique and satisfactory results. The use of bulk fill resins is recommended for large restorations and in situations that require speed, such as in the treatment of children and individuals with disabilities, being an alternative to the use of amalgam or glass ionomer cement, especially in public services. However, the high cost and the increased translucency of some resins, which may cause a grayish appearance in anterior teeth restorations, are factors that limit their use. Conclusion: Bulk fill resins are indicated for direct restorations in posterior teeth, mainly due to the simplification of the technique, making it possible to optimize aesthetic procedures that require longer clinical time, without compromising the quality of the treatment.

**KEYWORDS:** dental restoration, composite resins, physical phenomena, public health dentistry, process optimization.

RESUMO: Introdução: As resinas bulk fill foram desenvolvidas com o intuito de oferecer um material estético, que combine boas propriedades biomecânicas e uma técnica de aplicação simplificada, surgindo como uma alternativa para tratamentos restauradores na saúde pública. No entanto, sua aplicação clínica ainda levanta dúvidas entre os profissionais. Este estudo tem como objetivo analisar, por meio de uma revisão da literatura, as características, propriedades e a aplicabilidade clínica das resinas bulk fill. Metodologia: Foi realizado um estudo bibliográfico de abordagem qualitativa, através de uma revisão crítica da literatura. A pesquisa foi conduzida em bases de dados como PubMed/MEDLINE, Scopus, Google Scholar e SciELO, selecionando artigos de estudos laboratoriais e clínicos publicados entre 2015 e 2020. Resultados: Ensaios clínicos randomizados e estudos in vitro mostram que as resinas bulk fill de consistência regular apresentam propriedades mecânicas comparáveis às das resinas convencionais. Essas resinas, com seus diferentes níveis de viscosidade, permitem uma redução do tempo de trabalho, oferecendo uma técnica mais simples e resultados satisfatórios. Recomenda-se o uso das resinas bulk fill em reconstruções maiores e em situações que exigem rapidez, como no atendimento de crianças e pessoas com deficiência, sendo uma alternativa ao uso de amálgama ou cimento de ionômero de vidro, especialmente em serviços públicos. No entanto, o alto custo e a maior translucidez de algumas resinas, que pode gerar um aspecto acinzentado em restaurações de dentes anteriores, são fatores que limitam seu uso. Conclusão: As resinas bulk fill se mostram indicadas para restaurações diretas em dentes posteriores, principalmente devido à simplificação da técnica, permitindo otimizar procedimentos estéticos que demandam maior tempo clínico, sem comprometer a qualidade final do tratamento.

**PALAVRAS-CHAVE:** restauração dentária permanente, resinas compostas, fenômenos físicos, odontologia em saúde pública, otimização de processos.

#### 1. INTRODUCTION

Although the prevalence of caries has decreased significantly in recent years, the pathology is still considered a public health problem in Brazil and in the world (Gibilini et al., 2012). Treatment of the disease, some years ago, was based on invasive removal, with the total removal of decayed tissue and replacement of the lost structure by a restorative material (Silva et al., 2021). Thus, in view of the need for restorative procedures, amalgam was, for decades, the material of choice for later teeth, especially in public service. This material presents interesting advantages for the Basic Care, such as low cost, simple, fast and not very sensitive to humidity (Opdam et al., 2010). However, such material still has important disadvantages, such as the lack of adhesiveness and a pleasant aesthetic (Chesterman et al., 2017). Another factor is its unfavorable biomechanical behavior due to lack of adhesiveness to the dental structure, which when poorly indicated by leading to coronary fractures in large, composite or complex cavities with little remaining dental structure (da Silveira Pedrosa et al., 2011; dos Santos et al., 2017). In addition, there is a worldwide movement (Hirata et al., 2015) to decrease the use of this material, given the decreased commercialization of mercury-based products.

In parallel, we saw the age of adhesive dentistry emerge and composite resins have gained a prominent place in restorative clinical practice (Soares; de Sá Pinto, 2019). This has led to greater adhesiveness of the materials to the dental structure, which provides better biomechanical interaction and reinforcement of the remainder, and better aesthetics due to the resin's ability to mimic the optical characteristics of the dental substrates, meeting the aesthetic aspirations of society (Chesterman *et al.*, 2017; da Silveira Pedrosa *et al.*, 2011). By combining aesthetics and adhesiveness, it becomes feasible to carry out more conservative preparations and repairs in the restorations, allowing the development of Minimally Invasive Dentistry. In addition to being mercury-free, the resins have progressively replaced amalgam as a restorative material of choice for the posterior teeth. Thus, with the improvement in the physical and adhesive properties of the *materials*, *it is possible to use direct composite resins in various cases, including in cases of extensive cavities with too much loss of dental structure* (Silva *et al.*, 2021).

However, such anxieties are not restricted to patients in the private sector. When we understand, from the concept defined by the World Health Organization (1947), that health is not a mere absence of ailments, but involves "a state of complete physical, mental and social well-being", the esthetics of smiling has a relationship with the fullness of the individual. Thus, it can be considered the object of the Basic Health Care (Brazil, 2012).

Characteristics inherent to traditional resins, however, make them very sensitive to the technique, constituting disadvantages that demand improvement (Chesterman *et al.*, 2017; Almeida *et al.*, 2017). Among them, we can mention the contraction of polymerization, which can result in cracks of enamel, maladjustment, crevices formation and marginal microinfiltration (Chesterman *et al.*, 2017; Soares; de Sá Pinto, 2019; Almeida *et al.*, 2017), which can decrease the longevity of restorative treatment. As one of the strategies to get around this problem, the adoption of the incremental technique is recommended (Almeida *et al.*, 2017). A new problem then arises: the clinical time required by this strategy, especially when it comes to filling large and bulky cavities in posterior teeth (Chesterman *et al.*, 2017), care for pediatric patients, people with disabilities and even in the public service where, for many times, adequate resources for conventional restorative treatments are not available (Olegário *et al.*, 2017).

The dental materials industry has dedicated efforts to develop improvements in resin materials and overcome their limitations (Hirata *et al.*, 2015). Accordingly, composite resins of the bulk fill type have been developed. These materials can be inserted in single increments or 4 to 5 mm thick, as their increased translucency allows a greater depth of polymerization per layer (Soares; de Sá Pinto, 2019; Almeida *et al.*, 2017). They propose to streamline restorative procedures and reduce the chances of error inherent in the incremental technique of conventional composite resins (Chesterman *et al.*, 2017; Hirata *et al.*, 2015; Van Dijken; Pallesen, 2016; Loguercio *et al.*, 2019).

To help dental surgeons learn about and understand bulk fill composite resins, this study aims to verify, in recent literature, the characteristics, properties and applicability of this material, as well as to point out restorative techniques best suited for clinical use. By analyzing the laboratory and clinical performance of the published studies, it is expected to understand whether such resins are capable of optimizing restorative treatment, especially in the public service and situations that require the execution of procedures in an agile manner.

#### 2. METHODOLOGY

This article deals with an integrative narrative review of literature, as described by Souza *et al.* 2010. The guiding question was defined as: is the use of bulk fill resins capable of optimizing restorative treatment? Randomized clinical trials and laboratory studies comparing conventional resins and bulk fill were included in this review. Clinical performance, restorative techniques employed, clinical time and physical properties such as polymerization contraction, degree of conversion and cusp flexion were evaluated.

The bibliographic research was carried out by three independent researchers. PubMed/MEDLINE, Scopus, Scholar Google and SCIELO were used as databases, using the terms "resin" or "composite" AND "bulk fill", published between 2015 and 2020, in Portuguese and English.

In order to schematize the selection of the articles, the initial analysis was carried out of the articles that answered the questions of the guiding question. In this way, the researchers, guided by the title reading and afterwards by the reading of the abstract, kept on eliminating or choosing the articles as they responded to the theme under study. Thus, 45 articles were read, but after the analysis of the content and the synoptic table, only 25 were chosen for complying with the above mentioned criteria.

It is known that the good clinical performance of a dental material such as composite resins is directly linked to a correct indication and the use of appropriate techniques. The professional, in turn, must have a scientific technical basis before beginning clinical use. Therefore, knowing the classification of the material, its properties, advantages and disadvantages is of paramount importance for a correct indication and consequently satisfactory clinical results.

#### 3. RESULTS AND DISCUSSION

#### 3.1 CLASSIFICATION OF BULK FILL RESINS

According to their viscosity, bulk fill resins can be divided into two groups: high viscosity or regular and low viscosity resins or fluids (Chesterman *et al.*, 2017). It is important for the clinician to know this classification (Table 1) in order to understand when each type of material may be used.

Table 1. Classification, characteristics and indications of bulk fill resins.

	Features	Indications		
High viscosity Bulk Fill	- More sculptable and resistant, as it contains a large amount of inorganic load in its composition.	- For extensive restorations in posterior teeth (class I and II), and as a filling nucleus for endodontically treated teeth; - Pediatric dentistry, geriatric dentistry, Dentistry for Special Patients. Ensures faster procedures, compared to the use of conventional resins through the incremental technique;		
Bulk Fill low viscosity	<ul> <li>Fluid consistency adapts best on irregular surfaces, and angles of cavitary preparations;</li> <li>Lower resistance to compression and wear due to its lower load content.</li> </ul>	- They can be used as a base in very deep cavities, since they have good adaptation generating fewer gaps and bubbles; - Filler core for endodontically treated teeth.		
Bulk Fill with Sonic Insert (Sonic Fill)	<ul> <li>It moves between the two forms of presentation, fluid and regular;</li> <li>Requires ultrasonic activation, which "fluidifies" the resin, facilitating the filling of the cavity;</li> <li>When the vibration stops, the resin returns to its viscosity close to the regular one;</li> </ul>	<ul> <li>Extensive restorations to posterior teeth (class I and II);</li> <li>As a filler core for endodontically treated teeth;</li> <li>Pediatric dentistry, geriatric dentistry, Dentistry for Special Patients. Ensures faster procedures, compared to the use of conventional resins through the incremental technique;</li> </ul>		

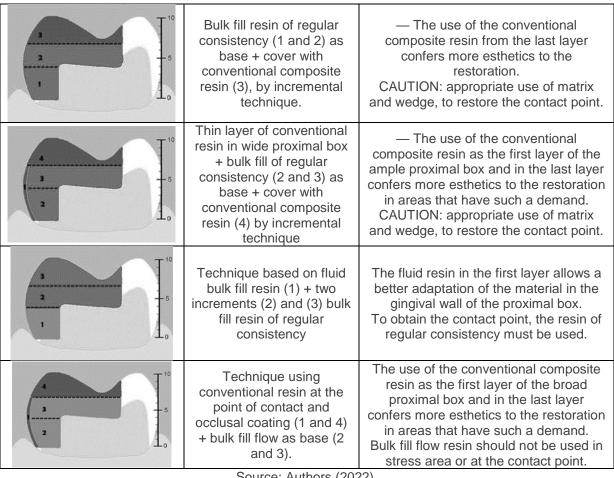
Source: Authors (2022).

## 3.2 TECHNICS

As to the way of restoring the cavity with resins of the bulk fill kind, various techniques have been recommended to depend on the viscosity of the material used. Some of the possibilities of the restorative technique are represented in Table 2.

Table 2. Clinical possibilities of combining the different types of bulk fill consistency, whether or not it is associated with conventional composite resins.

	MATERIAL TYPES	GENERAL REMARKS
5	Bulk fill resin of regular consistency (1).	<ul> <li>In cavities with a maximum depth of 5 mm;</li> <li>Restorations in single increment: agility in treatment (Pediatrics, difficulty or impossibility of isolation) without neglect to the adhesion procedure.</li> </ul>
5	Bulk fill resin with regular consistency in more than one increment (1 and 2).	- Class II cavity or deeper restorations: two increments of about 5mm; - Without much aesthetic involvement; CAUTION: appropriate use of matrix and wedge, to restore the contact point.



Source: Authors (2022).

In addition to the techniques described in Table 2, there are other proposals for inserting the material reported in the literature (Hirata et al., 2015; Han et al., 2016). For example, the sculpting technique similar to that of amalgam restorations (regressive) can be carried out in one or two steps. Amalgam sculpting technique in one step: it consists of the use of bulk fill resin of regular consistency to reconstruct the entire restoration in a single increment of up to 4mm thickness (Hirata et al., 2015). In two steps, it consists of the use of flow type resins for core reconstruction in a single layer of up to 4 mm and the use of conventional composite resin in the last layer of thickness of 1 to 2 mm. It is also suggested to use heated bulk fill resins (60-70°C), in order to increase the polymerization potential of the material, by temporarily decreasing the viscosity and increasing the kinetic potential of the monomers and initiators and thus delaying the "vitrification" stage of the material (Tauböck et al., 2015).

There are also techniques that indicate the application of ultrasonic energy, also in order to increase the fluidity of the material. Both techniques seek to improve resin adaptation to cavitary walls and margins, as well as increasing the polymerization potential (Chesterman *et al.*, 2017).

One of the main advantages in using bulk fill resins is due to the simplicity of the technique and the saving of clinical time, especially when it comes to bulk fill rpreesins of high viscosity (Bellinaso *et al.*, 2019; Güler; Karaman, 2014). Studies have shown that the use of bulk fill resins can reduce clinical time by up to 20% (Vianna-de-Pinho *et al.*, 2017), which is *undoubtedly a great advantage when it comes, for example, to the public service where the demand for restorative procedures is high.* The advantage of bulk fill resin mainly refers to the fact that it can be inserted into the cavity in increments of up to 4 mm thick (Chesterman *et al.*, 2017; Hirata *et al.*, 2015; Soares; de Sá Pinto, 2019; Olegário *et al.*, 2017; Caneppel; Bresciani, 2016), *reducing working time and risk of contamination* (Olegário *et al.*, 2017; Caneppelin; Bresciani, 2016). Bulk fill resins have better flow, ensuring better filling of areas and angles that are difficult to fill; they have reduced photopolymerization time due to their greater translucency, and have low polymerization contraction.

It is also important to remember that the degree of conversion of the composite resins depends on the total energy received by the composite resin represented by the irradiance of the tip of the apparatus as a function of time (de Oliveira Correia *et al.*, 2018). Thus, bulk fill resins show greater translucency compared to regular composite resins for better light penetration and better conversion depth (de Oliveira Correia *et al.*, 2018; Kim *et al.*, 2015). These resins can be used with any adhesive system available on the market, and a specific photopolymerizer for the bulk fill resin is not required. Generally speaking, blue light has a greater capacity to reach great depths than violet light. Thus, the use of a light-polymerizing apparatus with appropriate irradiance (mW/cm²) and a minimum power of 1000 mW/cm² is indicated. Photopolymerizers with little dispersion of light as they move away from the object are a viable option for resins that do not have an alternative photoinitiator system, like Ivocerin, a trademark of Ivoclar-Vivadent (Chesterman *et al.*, 2017).

Thus, among the disadvantages, it is found that the tendency of the restorations with the material is to become more translucent, not being favorable to use in previous restorations for acquiring grayish appearance (Caneppelin; Bresciani, 2016). In this context, although bulk fill resins have mechanical properties favorable to their use in posterior teeth, such composites have high cost (Ferreira *et al.*, 2022). In addition, bulk

fill resins of the flow type have lower mechanical properties compared to conventional resins (Van Ende *et al.*, 2017).

#### 3.3 CLINICAL PERFORMANCE AND POSSIBILITIES OF USING BULK FILL RESINS.

In order to overcome the limitations present in traditional composite resins, bulk fill resins have been developed and introduced to the market. The literature is not yet extensive, but it has encouraged the clinician to add it to his routine. Clinical studies have shown that bulk fill resins have a similar clinical performance to conventional resins, adding time-saving and simplicity of technique (Loguercio *et al.*, 2019; Bellinaso *et al.*, 2019; Heck *et al.*, 2018).

Longitudinal randomized clinical trials were conducted with the aim of comparing bulk fill resins with conventional composite resins in different indications as shown in Table 3. If applied to non-carious cervical lesions or in extensive posterior cavities, bulk fill resins have shown satisfactory results, without significant differences from conventional ones (Loguercio *et al.*, 2019; Canali *et al.*, 2019). This is observed in studies where bulk fill was applied in the making of filling nuclei in endodontically treated teeth, assessing fracture resistance and gaps formation (Thongbai-on *et al.*, 2019).

Table 3. Clinical performance and restorative techniques of bulk fill resins, described in the literature.

Authors	Description of study	Conclusion
Loguercio et. al., 2019.	Randomized, double- blind clinical trial with 72 participants.	The bulk fill Tetric N-Bond resin used in single increment showed excellent clinical performance after 36 months when compared to conventional composite resins by the 2mm incremental technique, regardless of the adhesive technique.
Van Dijken; Pallesen, 2016.	They conducted a randomized controlled study of 86 patients.	The use of bulk fill flow resin from SDR. in 4 mm increments and final layer with 2mm conventional nano-hybrid resin (Ceram X mono) showed a slightly better, but not statistically significant, durability after 5 years compared to conventional resins by the 2 mm stratification technique in later class I or II restorations.
Canali <i>et al.</i> , 2019.	They conducted a randomized, double-blind study of 22 subjects.	Filtek bulk fill fluid and Universal Filtek Supreme ultra have shown good clinical performance for the restoration of non-carious cervical lesions after 1 year.
Karaman <i>et al.</i> , 2017.	47 pairs of class II restorations were performed in 37 patients.	Restorations performed on endodontically treated teeth with bulk fill flow resins (X-tra base) at 4mm thickness at the base or with conventional flow composite resins (Aelite Flo) at 2mm thickness and the remainder by the incremental technique with conventional composite resin (Gradioso) showed good clinical performance during the period and 3 years.

Akalin <i>et al.</i> , 2018.	Prospective clinical study	The nonhybrid bulk fill resin (SonicFill, Kerr Corp.) showed acceptable clinical performance for 2 years, but its coloration showed change from tooth in the first 6 months.
Sarapultsev a et al., 2019.	Prospective case- control split mouth study in deciduous class I molars	Restorations with both materials, nano-ceramic resin (Ceram X mono, Dentsply) and bulk fill regular consistency (SDR., Dentsply), provided almost identical results after 24 months of follow-up.
Heck <i>et al.</i> , 2018.	Randomized 10-year follow-up clinical trial	They compared Class I and II restorations of posterior teeth carried out with bulk fill (QuiXfil) and conventional (Tetric Ceram) resins. They observed that there was no significant difference in clinical performance between the groups after 10 years of follow-up.

Source: Authors (2022).

From the public health perspective, the Atraumatic Restorative Treatment (ART) is a technique that proposes the cement of glass ionomer (CIV) as a restorative material. However, given the mechanical limitations of this material, especially in relation to teeth with extensive losses of tooth substrate (walls, crests and cusps) and low resistance to masticatory forces, studies have proposed the use of bulk fill resins associated with one-step self-conditioning adhesives to replace ART's technique (Olegário *et al*, 2017; Demarchi, 2018).

Dental care for the pediatric patient is more challenging, especially for clinical dentists in primary care and especially for non-collaborating children (Goumans *et al.*, 2004). There is a demand for restorative materials that are easy to handle, with less technical sensitivity and less clinical time for these cases (Gaintantzopoulou *et al.*, 2017). One of the most widely used materials for restoring deciduous teeth is glass ionomer cement (Lohbauer, 2009). Conventional composite resins, despite being an alternative, require an adequate stratification technique, control of saliva contamination and a longer clinical time (Chisini *et al.*, 2018).

In this context, some studies evaluated the use of fluid bulk fill resins in subsequent class I and II deciduous molars in single increments and found clinical performance similar to compomers and nano-ceramic resins (Sarapultseva; Sarapultsev, 2019; Ehlers *et al.*, 2019). Therefore, the use of such material in the public service could be beneficial in that it reduces the application steps, reducing the risk of contamination, failures and treatment time and consequently improving the cooperation of the child (Gaintantzopoulou *et al.*, 2017).

Bulk fill resins can also be indicated to restore non-carious cervical lesions, as they have lower contraction stress, generate lower tension and consequently reduce failure rates (loss of restoration, microinfiltration, postoperative sensitivity) and increase clinical longevity of restoration (de Oliveira Correia *et al.*, 2018).

Likewise, thanks to its technical ease of use, since restorations can be carried out with a single resin increment (up to 4 mm), the resins of the bulk fill type can be an interesting alternative to amalgam for restorations in public health services, in some cases it is scarcer to carry out absolute isolation with rubber dike. As the material is inserted in an increment, the time taken to carry out the treatment can be reduced, minimizing the chance of contamination during the resin insertion and possibly increasing the longevity of the restoration (Olegário *et al*, 2017). However, it should be remembered that the bond to the tooth substrate is based on the adhesion between the resin material and the tooth, failures in the adhesive technique lead to damage in the longevity of the restoration (Loguercio *et al.*, 2019; Han *et al.*, 2016).

Since the introduction of bulk fill resins in the market, several laboratory studies have been carried out and many report contradictory results (Benetti *et al.*, 2015; Tsujimoto *et al.*, 2016), which can be explained by various methodologies, operator training and methodological bias. However, the number of randomized clinical trials available in the literature is small. Still, based on their results, no significant differences were found regarding clinical performance between bulk fill and conventional resins (Loguercio *et al.*, 2019; Canali *et al.*, 2019; Boaro *et al.*, 2019), as described in the literature (Table 3).

As noted, the use of bulk fill composite resins decreases the number of clinical steps, which include incremental insertion of the resin into posterior teeth. Thus, it is characterized as an advantageous material for situations that require the optimization of care without prejudice to the quality of the procedure, being a relevant aspect for dental treatment in public health. However, although there are several possibilities of use for bulk fill resins, these still present their disadvantages in dental practice, such as the high cost for use in the public system. However, with the constant development of the materials and the gradual access to materials with better mechanical properties, there are indications that the optimization of clinical time and the lower number of exchanges of deficient restorations may compensate for the use of the technique.

#### 4. CONCLUSION

The bulk fill resin presents itself as a restorative material of great value for the restorations of posterior teeth, since it allows the realization of a restorative technique with fewer operative steps. This material can be particularly useful when restoring large cavities or in clinical situations where the chance of contamination and/or time of the procedure is a cause for concern. To this end, one can make use of their different combined viscosities and the possibilities of restorative techniques. The optimization of the process also favors the treatment of children and patients with special needs, where a reduction of clinical time is recommended. Such characteristics are important for clinical management in the public service, where demand is high and the necessary agility, without compromising the quality of the result and longevity of the restorative procedure. In a broader context of healthcare provision, in some cases, they can be used in the public service as an aesthetic alternative to amalgam and glass ionomer cement, if there is an equivalence in the cost of purchasing the material. With this in mind, it is suggested that more work be carried out that evaluates the operational feasibility of the introduction of bulk fill resins in the use of clinical procedures of the public service.

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