ECRONICON OPEN ACCESS

EC DENTAL SCIENCE
Research Article

Evaluation of Surface Roughness in Thermoset Acrylic Resins Submitted to Laboratory and Clinical Polishing Technique

Vilton Zimmermann de Souza[1]*, Ely Edson Paiva Barbosa[2], Joao Adolfo Czernay[3] and Silvio Mecca Junior[4]

[1]Master in Implantology, Specialist in Implantology, Dental Prosthesis Specialist, MBA in Business Management and Innovation, Doctoral Student in Implantology, Doctor h.c. in Oral Health, São Leopoldo Mandic - Campinas-SP, Brazil

[2]Master in DTM and Orofacial Pain, Implant Dentistry Specialist, Doctoral Student in Implantology, São Leopoldo Mandic - Campinas-SP, Brazil

[3]Master in Dental Materials, Radiology Specialist, Implant Specialist, Harmonization Specialist, Doctoral Student in Implantology, São Leopoldo Mandic - Campinas-SP, Brazil

[4]Master in Dental Prosthesis, Implant Specialist, Specialist in Periodontics, Doctoral Student in Implantology, São Leopoldo Mandic - Campinas-SP, Brazil

***Corresponding Author:** Vilton Zimmermann de Souza, Master in Implantology, Specialist in Implantology, Dental Prosthesis Specialist, MBA in Business Management and Innovation, Doctoral Student in Implantology, Doctor h.c. in Oral Health, São Leopoldo Mandic - Campinas-SP, Brazil.

Received: December 06, 2021; **Published:** January 31, 2022

Abstract

Background: In fully edentulous patients, especially in the lower region, where the muco-supported total prosthesis was limited in terms of retention, the protocol-type prosthesis, as it is implant-retained, that is, supported only on implants and not on mucosa, guaranteed the so dreamed of chewing comfort. There are also advantages such as: psychological benefits to users and improvement in masticatory and phonetic functions. An important limitation in the protocol-type prosthesis, especially the inferior one, is the difficulty with cleaning. In this type of prosthesis, if there is not good hygiene and adequate maintenance, periimplantitis can occur, being more severe and less sensitive to treatment, when compared to periodontal disease around natural teeth.

Methods: Nine cylindrical specimens were made in thermoset resin with an approximate diameter of 37.3 mm, with an approximate thickness of 4.3 mm. The brand used for the thermopolymerizable acrylic resin was VIPICRIL PLUS. All samples were polished in the prosthesis laboratory, in the following sequence: wear and finish with Edenta maxicut and minicut cutters (10 min), polishing with a Daufenbach flannel brush + pumice stone (15 min), polishing with a Daufenbach flannel brush + white from Spain (5 min). The samples were divided into 3 groups (3 samples in each group), namely: Group 1 (G1) or control group, which were produced and polished in the laboratory and the surface was not altered. Group 2 (G2), where the samples were polished with a new polishing kit, in the following sequence: extra fine cutter for 2 min, green, gray and beige silicon oxide rubber (all for 1 min), and felt for 1 min. Group 3 (G3) were the samples polished with a polishing kit already used for 10 times, in the following sequence: Extra fine milling cutter for 2 min, green, gray and beige silicon oxide rubber (all for 1 min), and felt for 1 min. Manual polishing was performed by the same experienced operator at random. After sample preparation, their roughness was analyzed using a rugosimeter (Mitutoyo, Suzano, SP, Brazil) (Figure 5) with a 2.4 mm path, divided into 3 sequential cut-offs of 0.8 mm, with 3 measurements and profilometer needle speed of 0.25 mm/s. and the mean roughness value (Ra) was obtained.

Findings: The results of mean roughness in micrometers obtained from the samples were: Group 1 obtained 0.34 μm (Standard deviation (sd) 0.18), Group 2 was presented 0.45 μm (sd 0.16) and group 3 was 0. 75 μm (dp 0.19). For statistical analysis, ANOVA was used, obtaining P= 0.0680 (Table 1 and 2).

Conclusions: There was no statistical difference between groups regarding the type of polishing. Studies with a larger number of samples are needed.

Keywords: *Surface Roughness; Dental Implants; Periodontal Diseases*

Introduction

With the advancement of medicine and quality of life, elderly patients are increasingly frequent in dental offices, requiring complete rehabilitation.

Since the consolidation of treatments with dental implants and knowledge of the cellular mechanisms of osseointegration, a new version of oral rehabilitation has thus emerged, with this treatment becoming the gold standard for dental prostheses in fully edentulous individuals [6,4]. In fully edentulous patients, especially in the lower region, where the muco-supported total prosthesis was limited in terms of retention, the protocol-type prosthesis, as it is implant-retained, that is, supported only on implants and not on mucosa, guaranteed the so dreamed of chewing comfort. There are also advantages such as: psychological benefits to users and improvement in masticatory and phonetic functions [2,10].

An important limitation in the protocol-type prosthesis, especially the inferior one, is the difficulty with cleaning. In this type of prosthesis, if there is not good hygiene and adequate maintenance, periimplantitis can occur, being more severe and less sensitive to treatment, when compared to periodontal disease around natural teeth [1,16,17]. It is very common for patients to wrongly report that they wish to replace their natural roots with implants, even when there is no indication for this, thinking of obtaining greater predictability.

Therefore, this prosthetic option with fixed prostheses over implants requires a maintenance program, with the objective of reducing the possibility of periodontal problems occurring [5]. In a systematic review, compared the recommended method for cleaning in different long-term randomized studies, concluding that there is still a lack of data for a correct treatment plan after installation of the prosthesis and that the reduced manual dexterity capacity of older people would justify the more frequent visit of these patients to the office [7].

In a systematic review with 14 studies included, aiming to assess the technical and biological complications of protocol-type prostheses in total edentulous individuals. The results showed that the most common biological complication was peri-implant bone loss (> 2 mm), with rates of 20.1% after 5 years and 40.3% after 10 years. Furthermore, biological changes such as tissue hypertrophy or hyperplasia around the implants of patients who received full dental prosthesis over implant showed 13.0% after 5 years and 26.0% after 10 years [12].

It is important to understand that the biofilm formed under the prosthesis (Figure 1) and the tooth do not differ significantly, so cleaning and hygiene procedures on these prosthetic surfaces must be given special attention [13].

Figure 1

This biofilm accumulation is directly linked to surface roughness. The residual surface roughness of restorations leads to plaque accumulation, resulting in gingival inflammation, secondary caries, and surface staining [19].

Periodic maintenance is essential according to the individual risk of each patient. Protocol-type prostheses over implants, usually with calculus accumulation, must be removed. The removal of this calculus causes changes in the roughness of the acrylic, which may interfere with the adhesion of a new plate when it is reinstalled.

The dental prosthesis, when removed, can be sent to the laboratory for polishing, or even be performed in the office. The biggest disadvantage of sending them is the time the patient must wait, as on average, a period of 4 hours is required for this procedure, in addition to the laboratory cost. When the maintenance procedure for protocol-type prostheses is performed at the office level, instruments related to polishing must have specific characteristics to obtain an ideal polishing, not causing damage to the prosthesis and implant material, nor injuring the peri-implant tissue. When there is the occurrence of gingival calculus, the dental surgeon must scrape it with plastic or Teflon curettes, as they do not leave grooves on the surface of the implants and prosthesis, as occurs in the use of titanium or steel curettes, as well as finishing and polishing with felt tips, horse hair and rubber tips of various abrasiveness [8]. For this, polishing refers to the reduction of roughness and scratches created by finishing instruments, which makes it necessary to polish this area. Mechanical polishing is the most common method of polishing acrylic resin, using polishing wheels and pumice pastes and water [3].

Faced with this situation, this study aimed to evaluate whether the polishing performed in the office is able to replace laboratory polishing and also whether used polishers have the same effectiveness as new polishers.

Materials and Methods

Nine cylindrical specimens were made in thermoset resin with an approximate diameter of 37.3 mm (Figure 2 and 3), with an approximate thickness of 4.3 mm. The brand used for the thermopolymerizable acrylic resin was VIPICRIL PLUS. All samples were polished in the prosthesis laboratory, in the following sequence: wear and finish with Edenta maxicut and minicut cutters (10 min), polishing with a Daufenbach flannel brush + pumice stone (15 min), polishing with a Daufenbach flannel brush + white from Spain (5 min). The samples were divided into 3 groups (3 samples in each group), namely: Group 1 (G1) or control group, which were produced and polished in the laboratory and the surface was not altered. Group 2 (G2), where the samples were polished with a new polishing kit, in the following

sequence: extra fine cutter for 2 min, green, gray and beige silicon oxide rubber (all for 1 min), and felt for 1 min (Figure 4). Group 3 (G3) were the samples polished with a polishing kit already used for 10 times, in the following sequence: Extra fine milling cutter for 2 min, green, gray and beige silicon oxide rubber (all for 1 min), and felt for 1 min. The extra-fine drill used in groups G1 and G2 was used in order to simulate a clinical reality, when the patient goes to the office for stone removal under an acrylic resin protocol prosthesis. Manual polishing was performed by the same experienced operator at random. After sample preparation, their roughness was analyzed using a rugosimeter (Mitutoyo, Suzano, SP, Brazil) (Figure 5) with a 2.4 mm path, divided into 3 sequential cut-offs of 0.8 mm, with 3 measurements and profilometer needle speed of 0.25 mm/s. and the mean roughness value (Ra) was obtained.

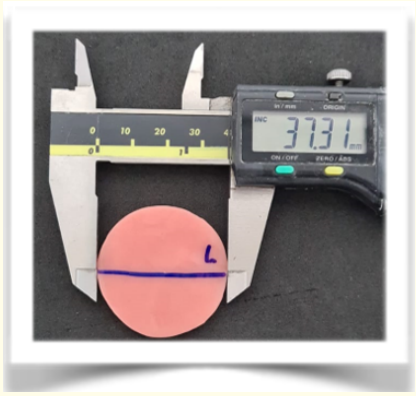

Figure 2

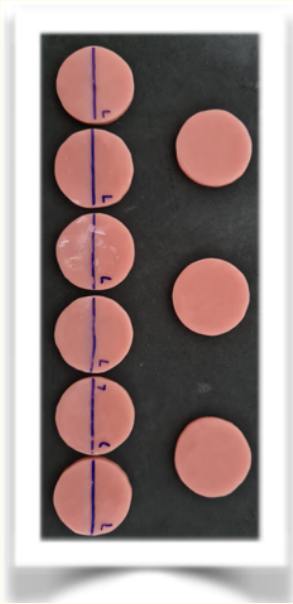

Figure 3

Figure 4

Figure 5

Results

The results of mean roughness in micrometers obtained from the samples were: Group 1 obtained 0.34 µm (Standard deviation (sd) 0.18), Group 2 was presented 0.45 µm (sd 0.16) and group 3 was 0. 75 µm (dp 0.19). For statistical analysis, ANOVA was used, obtaining P= 0.0680 (Table 1 and 2).

		Measure 1	Measure 2	Measure 3	Mean	mean
Laboratory	1	0,285	0,353	0,812	0,48	0,34
	2	0,779	0,121	0,281	0,39	
	3	0,189	0,077	0,128	0,13	
New	1	0,399	0,326	0,358	0,36	0,45
	2	0,285	0,318	0,43	0,34	
	3	0,731	0,48	0,693	0,63	
Used	1	0,844	0,394	0,393	0,54	0,75
	2	0,941	0,953	0,875	0,92	
	3	0,651	0,95	0,781	0,79	

Table 1

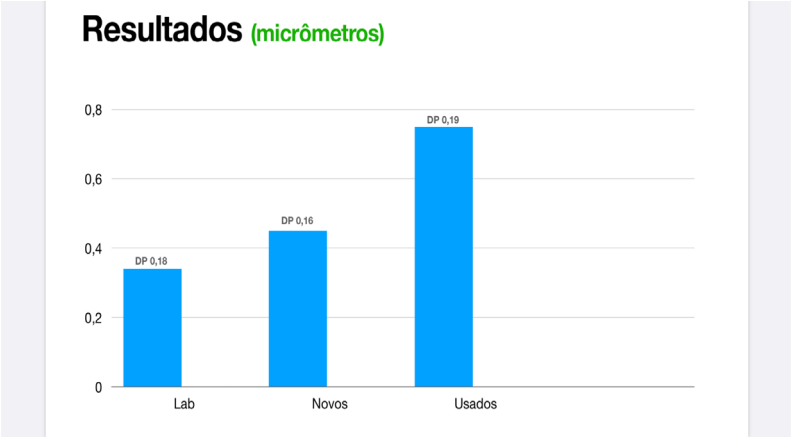

Table 2

Discussion

It is known that the abrasive must have greater hardness than the substrate for a good polishing, therefore, the type of material, size and abrasiveness is importante**.** The best result in numbers was perceived in the laboratory sample, with mean roughness values of 0.34 µm, but still higher than the maximum roughness value of 0.2 µm, suggested in the study [11,18]. Furthermore, in a study evaluating the influence of free energy and surface roughness on the initial formation of bacterial plaque, was suggested that the influence of surface roughness on its accumulation and composition is more prominent than the influence of free energy on surface. It was noticed in this study that the use of new cutters is more effective when compared to used cutters, but the statistical analysis showed that there was no significant difference between the groups, due to P = 0.0680. This last factor is probably due to the small sample size. The authors believe that by increasing the sample size, a statistically significant difference can be found between the groups. Therefore, further studies are needed to elucidate the topic [14,18].

Conclusion

There was no statistical difference between groups regarding the type of polishing. Studies with a larger number of samples are needed.

Bibliography

1. Atsuta Ikiru., *et al.* "Soft tissue sealing around dental implants based on histological interpretation". *Journal of Prosthodontic Research* 60.1 (2016): 3-11.

2. Batista André Ulisses Dantas., *et al*. "Comparações entre overdentures e próteses totais fixas sobre implantes". *Revisão da Literatura* (2005): 208-213.

3. Craig RG., *et al*. "Dental materials, Properties and mani-pulation". 7 edition. St. Louis: Mosby Year Book (2000): 97-113.

4. De Souza VZ., *et al.* "Viability and collagen secretion by fibroblasts on titanium surfaces with different acid-etching protocols". *International Journal of Implant Dentistry* 5.1 (2019): 41.

5. Engquist Bo., *et al.* "Simplified methods of implant treatment in the edentulous lower jaw: a 3-year follow-up report of a controlled prospective study of one-stage versus two-stage surgery and early loading". *Clinical Implant Dentistry and Related Research* 7.2 (2005): 95-104.

6. Fischer Kerstin., *et al*. "Five-year results from a randomized, controlled trial on early and delayed loading of implants supporting full-arch prosthesis in the edentulous maxilla". *Clinical Oral Implants Research* 19.5 (2008): 433-441.

7. Hultin M., *et al.* "Supportive therapy and the longevity of dental implants: a systematic review of the literature". *Clinical Oral Implants Research* 18.3 (2007): 50-62.

8. Jamcoski Vanessa Helena., *et al*. "Importância da orientação e acompanhamento de pacientes portadores de próteses implantossuportadas com enfoque nas lesões peri-implantares". *Revista Odontológica de Araçatuba* 6.3 (2012): 10-21.

9. Júnior Santiago., *et al. "*Manutenção em próteses implantossuportadas: higiene oral". *Revista Odontológica de Araçatuba* (2013): 56-64.

10. Novaes Luana Costa Gomes Ferraz and De Albuquerque Seixas Zélia. "Prótese total sobre implante: técnicas contemporâneas e satisfação do paciente/Complete dentures prosthesis in implants: contemporary techniques and patient satisfaction". *IJD International Journal of Dentistry* 7.1 (2008).

11. Øilo Marit and Vidar Bakken. "Biofilm and dental biomaterials". *Materials* 8.6 (2015): 2887-2900.

12. Papaspyridakos Panos., *et al.* "A systematic review of biologic and technical complications with fixed implant rehabilitations for edentulous patients". *International Journal of Oral and Maxillofacial Implants* 27.1 (2012).

13. Prado AC., *et al.* "Uma técnica de confecção de prótese híbrida com attachments resilientes: relato de caso clínico". *Odontol POPE* 2.3 (1998): 413-425.

14. Quirynen M., *et al.* "The influence of surface free energy and surface roughness on early plaque formation. An in vivo study in man". *Journal of Clinical Periodontology* 17.3 (1990): 138-144.

15. Radford David R., *et al.* "Adherence of Candida albicans to denture-base materials with different surface finishes". *Journal of Dentistry* 26.7 (1998): 577-583.

16. Schierano Gianmario., *et al*. "Organization of the connective tissue barrier around long-term loaded implant abutments in man". *Clinical Oral Implants Research* 13.5 (2002): 460-464.

17. Tzach-Nahman Rinat., *et al.* "Oral fibroblasts modulate the macrophage response to bacterial challenge". *Scientific Reports* 7.1 (2017): 1-11.

18. Ulusoy Mutahhar., *et al.* "An evaluation of polishing techniques on surface roughness of acrylic resins". *The Journal of Prosthetic Dentistry* 56.1 (1986): 107-112.

19. Yap AU., *et al.* "Effects of finishing/polishing time on surface characteristics of tooth-coloured restoratives". *Journal of Oral Rehabilitation* 25.6 (1998): 456-461.

Volume 21 Issue 2 February 2022
© All rights reserved by Vilton Zimmermann de Souza., *et al.*