

## ORIGINAL ARTICLE

# Gingival retraction: thickness measurement and comparison of different cords

Afastamento gengival: mensuração e comparação da largura de diferentes fios retratores

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## ABSTRACT

**Objective:** To measure the thickness of five different brands of gingival retraction cords and verify whether there would be a relationship among the sizes and their numbers and a coherent increasing from the thinnest to the largest thickness. **Material and Methods:** the following cords were evaluated: Gengiret(G), Retraflex(RF), Retractor(RT), Ultrapack(UP), and Pro Retract(PR). Pieces of the cords were placed beside a metallic ruler and photographed standardly regarding to the distance and light. The measurements of the thickness were performed through imaging software (Adobe Photoshop CS6 - Adobe Systems, San Jose, CA, USA). The obtained data were submitted to statistical analysis (one-way ANOVA and post hoc Sheffé test ( $p = 0.05$ )). **Results:** The number and the thickness of the cords mismatched for most of the brands evaluated. Two brands (UP and PR) showed a thickness increasing that mismatched the size increasing between the thinnest and largest cord. **Conclusion:** The number assigned to the cords by the manufactures did not correspond to a standard thickness, so that the dentist must observe the risk of using cords from different brands during gingival retraction procedures during techniques requiring more than one retraction cord.

## KEYWORDS

Glass ionomer cement; Composite resin; Dentin-Bonding Agents; Dental Cements; Tensile Strength.

## RESUMO

**Objetivo:** medir a espessura de cinco diferentes marcas de fio afastador e verificar se há relação entre os tamanhos e as numerações designadas, e se há um coerente aumento da espessura entre os fios de menor para os de maior espessura. **Materiais e Métodos:** os fios avaliados foram Gengiret (G), Retraflex (RF), Retractor (RT), Ultrapack (UP) e Pro Retract (PR). Pedacos dos fios foram posicionados ao lado de uma régua metálica e fotografados de forma padronizada quanto à distância e iluminação. A mensuração das espessuras foi realizada com software para edição de imagens (Adobe Photoshop CS6 - Adobe Systems, San Jose, CA, EUA). Os dados apurados foram submetidos à análise estatística (ANOVA fator único e teste post hoc de Sheffé ( $p = 0,05$ )). **Resultados:** não houve coincidência entre a numeração comum dada pelos diferentes fabricantes e a espessura observada para a maioria das marcas de fios retratores avaliadas. Observou-se que duas das marcas (UP e PR) apresentaram aumento na espessura que não respeitou uma progressão de tamanho consistente entre o fio de menor e o de maior espessura. **Conclusão:** a designação comum dada pelos fabricantes aos fios não se reflete em padronização das espessuras, o que determina que o clínico observe o risco de utilizar fios de diferentes marcas durante um procedimento de afastamento gengival nas técnicas que indicam o uso de mais do que um fio afastador.

## PALAVRAS-CHAVE

Materiais para moldagem odontológica, análise.; Teste de Materiais; Fios retratores, análise; Processamento de Imagem Assistida por Computador.

## INTRODUCTION

To obtain access to tooth preparation margins placed close to the gingiva or subgingivally, gingival retraction is required. This procedure makes viable either the quality of the impression of indirect restorations or the execution of direct restorations because gingival retraction provides the control of the gingival sulcus fluids. The proper impression of the preparation margin is critical for marginal adaptation and the emergence profile of a restoration [1,2].

The goal of temporary gingival retraction is [3]: to retract the gingiva vertically to gain access to the subgingival preparation margin and the underlying not-prepared tooth portion; to retract the gingiva horizontally to gain space between the tooth and gingiva that enables that the impression material enters the gingival sulcus with a volume preventing its tearing; to keep the drying of the surfaces, an important fact for hydrophobic materials.

Many materials and techniques might be used to control the gingival tissue. The gingival retraction techniques are classified into surgical and non-surgical [4]. Retraction cords with or without astringent or hemostatic solutions, electrosurgery, curettage with Rotary instruments, and the use of pastes injected into the sulcus to retract it are examples of the available techniques. No scientific evidence exists on the superiority of one technique over another, so that the choice depends on the clinical situation and operator's preference [3,5]. The main difference among the techniques is the trauma caused in the gingival tissue. While the surgical techniques are the most aggressive, the cordless retraction techniques caused little trauma to gingival tissue than the technique employing the retraction cord [6,7].

The cords available in dental market varied according to the composition, impregnation

with astringent or hemostatic solution, and design. This latter option comprises the knitted, braided, woven or twisted cords. Little scientific evidence exists on which type would have the best clinical performance, so that the choice is based on the operator's choice. A qualitative research compared products with similar diameter and different strand arrangements (knitted or twisted) and verified that the dentists' preferences were knitted cords [8].

The gingival retraction technique is sensible and depends of the ability and expertise of the operator [9,10]. It is important that the cord is carefully placed inside the sulcus to avoid damaging the junctional epithelium and the conjunctive tissue over the bone. The gingival recession associated to the careful use of the cord in a healthy tissue is not observed [3,8,11,12] or limited to a mean value of 0.2 mm [13]. It is highlighted the need of inserting the cord smoothly and in a controlled way, but also the need of selecting cords with sizes compatible to those of the gingival sulcus.

The insertion of the retraction cord is performed with the aid of specific spatulas. Among the possibilities of use of retraction cords, there are the single and double cord techniques. In both techniques, for the best efficacy of gingival retraction, the use of hemostatic or astringent solutions is recommended [5].

Although the sizes of the retraction cords from different manufacturers are similar, to the best of our knowledge, no study evaluated the real thickness of the cords. This study aimed to provide guidelines for adequate thickness selection in function of the gingival sulcus dimensions. The hypothesis of this study was to verify whether there would be similarity between the sizes assigned by the manufacturers of different retraction cords and their real thickness.

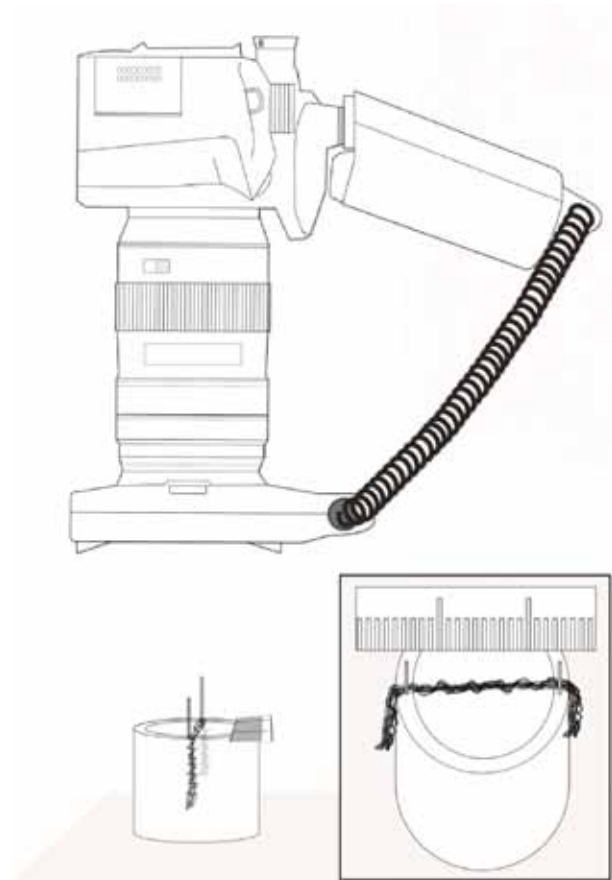
**Chart 1** - Retraction cords used.

Brand	Manufacturer	Size and batch	Composition	Characteristic
Pro Retract (PR)	FGM, Joinville, Brazil	PR 0000 batch 251012, PR 000 batch 191112, PR 00 batch 201112, PR 0 batch 141112, PR 1 batch 291012, PR 2 batch 151112, PR 3 batch 261012	Egyptian cotton	braided
Retraflex (RF)	Biodinâmica, Ibioporã, Brazil	RF 0 batch BC 18613, RF 00 batch Bc 11213, RF 000 batch BC 03713, RF 1 batch BC 04113 RF 2 batch M 10312, RF 3 batch MO 5011	cotton	braided
Ultrapak (UP)	Ultradent, South Jordan, USA	UP 000 batch B7RF3, UP 00 batch B7P3B, UP 0 batch B7GVD, UP 1 batch B79CF, UP 2 batch B7PG9, UP 3 batch B6P11	cotton	knitted
Retractor (RT)	Maquira, Maringá, Brazil	RT 000 batch 085713, RT 00 batch 148913, RT 0 batch 23476, RT 1 batch 54783, RT 2 batch 915612	cotton	knitted
Gengiret (G)*	Dentsply, Petrópolis, Brazil	G thin batch L685139E, G medium batch L706067E	cotton, associated with aluminum chloride	twisted

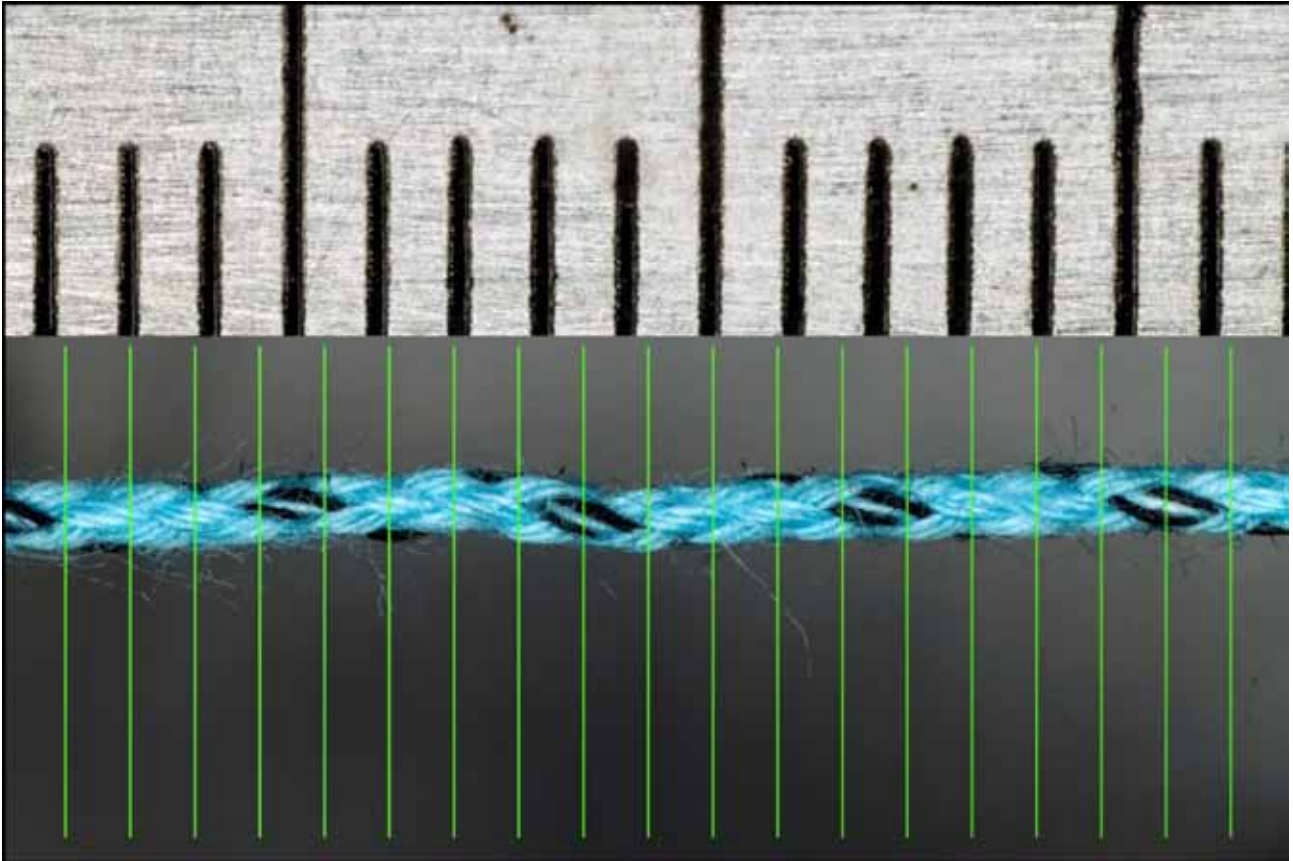
## MATERIAL AND METHODS

On the base of a colorless plastic flask (Frasco Cristal J-15, Injeplast, São Paulo, Brazil), two 1.5-cm orthodontic wires were fixed (Hard elastic wire 50g – CrNi, Morelli, Sorocaba, São Paulo, Brazil) with fluid composite resin (Natural Flow, Nova DFL, Rio de Janeiro, Rio de Janeiro, Brazil). These rods enable supporting the analyzed cords standardly. On the base of the plastic flask, a piece of 15 - cm metallic ruler (Trident Indústria de Precisão, Itapuú, São Paulo, Brazil) was glued with cyanoacrylate (Loctite SuperBonder, Henkel Ltda., São Paulo, SP, Brazil). The camera (Rebel T4i, 100 mm 2.8 macro lens and flash MR- 14EX - Canon, USA) was mounted so that the lens was perpendicular to the horizontal plane and the plastic flask (Figure 1). The flash was used on the E-TTL function, and the camera adjusted to f/13 at Av position. Of each cord sample with 25 cm in length, 6 images were obtained from different parts of the cord.

The cord thickness was measured with the aid of Adobe Photoshop CS6 software (Adobe Systems, San Jose, CA, USA). On the image of each cord, a layer with green vertical



**Figure 1** - Design of the retraction cord holder with the part of the millimetric ruler. The orthodontic wires fixed into the lateral sides of the plastic flask enabled to standardize the position of the retraction cords parallel to the millimetric ruler. The position of the camera was perpendicular to the horizontal cord.



**Figure 2** - Example of the evaluated image. The cord thickness was measured on each one of the sections created by the green line layer that divided the image into 20 sections. This procedure was repeated on the 6 images obtained for each retraction cord type.

lines divided the imaged into 20 sections (Figure 2). On the center of each 20 sections, the cord thickness was measured in pixels with the aid of the tool “ruler” and the values were registered. An image of the millimetric ruler was also measured so that the number of pixels corresponding to the distance of 1 mm was obtained. With this information, the cord thickness values were transformed from pixels to millimeters. Twenty measurements of each one of the six images were carried out, totalizing 120 measurements for each cord type, by a single examiner. Chart 1 shows the retractions cords used in this study.

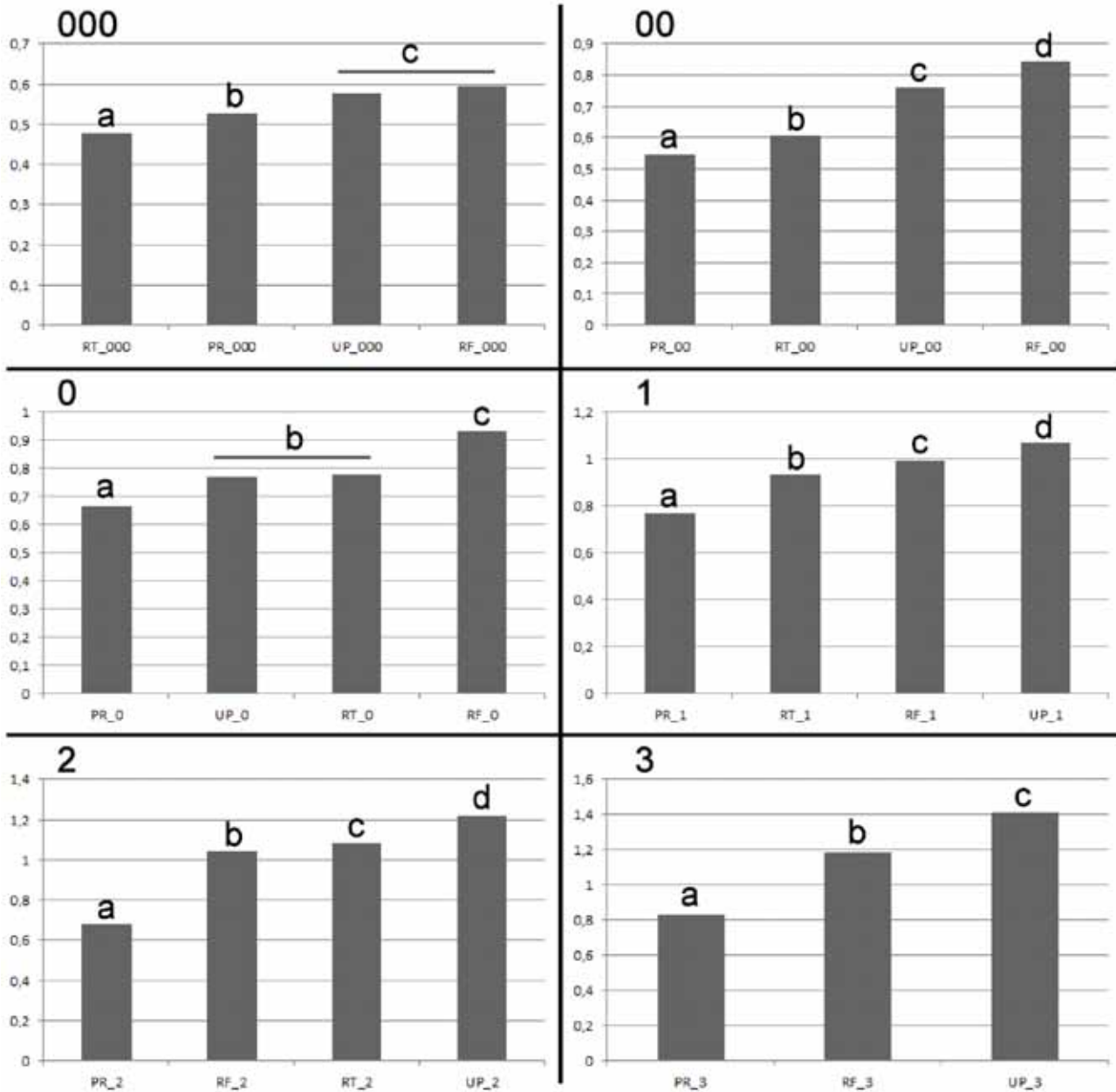
To determine the thickness differences among the different cord types, one-way ANOVA was applied followed by post hoc de Sheffé test (IBM SPSS Statistics V.21.0, IBM

Corp., Armonk, Nova York, USA) with level of significance of 5%.

## RESULTS

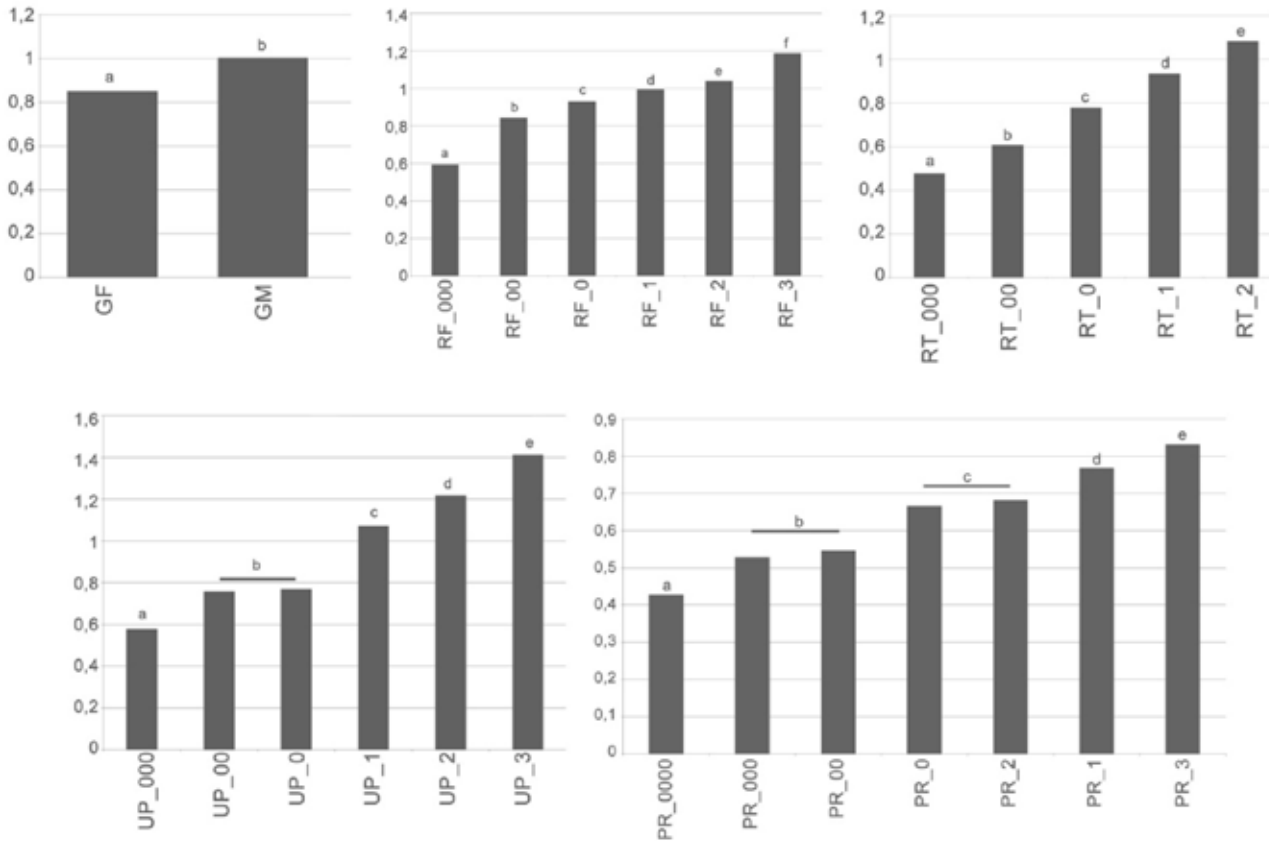
One-way ANOVA identified significant differences in the cord thickness with the same number (000, 00, 0, 1, 2, 3) assigned by the different manufacturers. Graphic 1 displays the comparison of the retraction cord thickness in mm of the different brands. The group G and cord size PR\_000 were not included in this comparison because their numbers were different in other brands. Graph 2 shows the differences among the cords from the same brand.

Table 1 shows the mean values of thickness from the thinnest to the largest cord brand and the corresponding ratio between the largest and thinnest cord.



**Graph 1** - Mean values (mm) of the thickness of different cords regarding the same size assigned by the manufacturers. The horizontal lines represent the cords without significant thickness difference. Lowercase letters identified the different groups. RF – Retraflex; RT – Retractor; UP – Ultrapack; PR – Pro Retract.





**Graph 2** - Thickness of different cords from different brands. The horizontal lines represent the cords without significant thickness difference. Lowercase letters identified the different groups. G – Gengiret; RF – Retraflex; RT – Retractor; UP – Ultrapack; PR – Pro Retract.

**Table 1** - Mean values (mm) of the thinnest and largest cords from each brand and ration between the largest and thinnest cord

Brand	Thinnest	Largest	Number of sizes	Ratio
UP	0.578041	1.414413	6	245
RT	0.477037	1.082291	5	227
RF	0.594406	1.187042	6	200
PR	0.428232	0.831989	7	194
GF	0.852034	1.00399	2	118

**DISCUSSION**

The mean thickness found for the evaluated cords demonstrated that the similar sizes assigned by the manufacturers mismatched the real dimensions (Graph 1). The similar thickness was seen for the brands Ultrapack and Retraflex at size 000 and brands Ultrapack and

Retractor at size 0. This non-standardization of the cords calls for the necessity of caution when using cords from different brands. The single analysis of each brand demonstrated that the groups PR and UP exhibited inconsistency regarding the increasing and coherence between the thickness observed and the size assigned by the manufacturers (Graph 2).

The ratio between the largest and thinnest cord predicts the diversity and variety of sizes of each brand. By evaluating this proportion (Table 1), it was verified that group Ultrapack showed the greatest difference between the cords assigned size UP\_000 and UP\_3 (245%). Although the cord size UP\_000 was not the thinnest cord studied (0.58 mm), the cord size UP\_3 presented the largest thickness (1.41

mm). Conversely, the cords Gengiret exhibited a difference of 118% between the thinnest and largest thickness. Not considering the cords Gengiret, the group Pro Retractor showed the smallest difference between the largest and thinnest thickness (194%). This finding is interesting because this brand presents the greater availability of sizes (7).

By evaluating the largest/thinnest ratio and the size increasing for each brand, the lack of standardization was evident, without evidence of superiority of knitted (UP and RT) over braided cords (PR and RF). The group PR has 7 different cord sizes but sizes PR\_000 and PR\_00 and sizes PR\_0 and PR\_2 did not showed statistically significant differences in thickness ( $p = 0.667$  and  $p = 0.796$  respectively). Moreover, the size PR\_1 showed the largest and significant difference from that of size PR\_2 ( $p = 0.000$ ). In group UP, the sizes UP\_00 and UP\_0 did not showed statistically significant difference in the thickness ( $p = 0.978$ ). The other groups (G, RF and RT) exhibited cords with statistically significant differences in thickness with coherent increasing between the cord thickness and the size assigned by the manufacturers.

The evaluation of the retraction cord thickness provides fundamental information for the dentist because the cord thickness should fit the gingival sulcus space. A larger cord results in unnecessary trauma with possible side effects to gingival health and esthetics. On the other hand, thinner cords might prevent the retraction goals. The manufacturers do not provide the information on the cord thickness. Most of the manufacturers use a size system from 4 zeros to number 3 to make different the cord thickness. The hypothesis that this number system would enable exchanging cords from different brands was not accepted in this study.

The methodology used in this present study, employing photographic images of the samples and imaging software to measure the cord thickness attempted to avoid the difficult of this task. The use of a caliper or other

instruments demanding contact with the cord would lead to deformation and compromise the result. The use of the image was a simple method with one has a good-quality and reliable photographic equipment. The measuring tools of the software are effective. Notwithstanding, this study evaluated the thickness of dry cords, which provided guidelines for selecting the cords, but this methodology was not capable of predicting which would be the real behavior under moisture and pressure inside the gingival sulcus.

## CONCLUSION

Within the limitations of this study, it can be concluded that:

Some of the thickness of the evaluated retraction cord brands matched the size assigned by the manufacturers, but without similar thickness among brands. Accordingly, it is important that the dentists do not exchange cords from different brands or consult the data of this present study to assure the dimensions of each cord. Of the five cord brands, two did not show coherent increasing of the cord thickness from the thinnest to the largest one. The most conflicting results were observed for the group PR, followed by group UP.

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