SUMMARY OF THE PHD THESIS

Analysis of physical and chemical parameters of physiognomic dental materials used in odontotherapy and orthodontics

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Introduction: The dental materials used in orthodontics for the bracket bonding are well known in general dentistry and present a continuous evolution based on the constant modulation of the physical and chemical properties. Accidental loosening of brackets increases treatment time and costs. In addition, rebonding procedures may increase the risk of possible redundant enamel damage. Increasing the average roughness level (Ra) of restorative materials can be considered a risk factor. Above the value of 0.2 μm of the roughness of hard intraoral surfaces, an increase in the accumulation of dental plaque can be observed, the risks of caries and periodontal inflammation are more prominent, because the conditions for adhesion and bacterial colonization are ensured.

General objectives: In this doctoral thesis I proposed the study of some materials used in odontotherapy and orthodontics. Thus, the meta-analysis and in vitro studies had the following specific objectives: (1) Determination and comparison of the bracket failure rate of different orthodontic materials used in the direct bonding technique based on the results of available clinical studies; (2) In vitro evaluation of surface roughness changes in the case of two microhybrid composites induced by the simulation of different brushing techniques under controlled conditions; (3) Determination of intra- and inter-operator reliability of roughness measurements produced by three independent operators with a tactile profilometer on the surfaces of glass ionomer samples.

Study I: Clinical bracket failure rates between different bonding techniques

Introducere: Bracket failure increases the treatment time of orthodontic therapy and burdens patients with unnecessary costs, increased chair time, and possible new appointments. The main objective of this meta-analysis and systematic review was to compare compare the bond failures of different orthodontic materials based on the results of available clinical studies. **Material and methods** A systematic search of clinical trials was performed in the Cochrane, Embase, and Pubmed databases with no limitations according to the PROSPERO registration *(CRD42020163362)* including 34 randomized or non-randomized studies. According to the null hypothesis from the meta-analysis there are no significant differences in the rate of bracket frailure as a result of the used techniques. In the systematic review the time dependence of bracket failure was qualitatively followed. We statistically compared the results of the self-etching technique (SEP) with the acid etching technique (CM-AEP) after 6, 12 and more than 18 months of orthodontic treatment and self-curing resins (SCR) with glass ionomers (GIC), respectively with resin modified glass ionomers (RMGIC) after a follow-up period of 12 and 18 months. **Results:** Thirty-four publications, involving 1221 patients, were included. Our meta-analysis revealed no significant difference in the risk of bracket failures between SEP and CM-AEP. After 6, 12, and 18 months of bonding, the values of RR were 1.04 [95% confidence interval (CI), 0.67–1.61], 1.37 (95% CI, 0.98–1.92), and 0.93 (95% CI, 0.72–1.20), respectively. At 18 months, bracket failure was 4.9 and 5.2% for SEP and CM-AEP, respectively. Heterogeneity was good or moderate ($I^2 < 42.2\%$). The results of RM-GIC at 12 months indicated a 57% lower risk of bracket failure using SCR as compared with RM-GIC (RR: 0.38; 95% CI, 0.24–0.61). At 18 months, bracket failures for SCR and RM-GIC were 15.8 and 36.6%, respectively (RR: 0.44; 95% CI, 0.37–0.52, $I^2 = 78.9\%$), demonstrating three to six times higher failure rate than in the case of etching primer applications. **Concluzii:** The results revealed no significant difference between SEP and CM-AEP up to

18 months after application. RM-GIC had much worse failure rates than acid-etching methods; additionally, the superiority of SCR over RM-GIC was evident, indicating strong clinical relevance.

Study II: Effect of Tooth Brushing on Wear of Microhybrid Composites

Introduction: Changes in the surface roughness of dental restorative materials after tooth brushing are inevitable. The abrasion is known to increase the possibility of dental plaque accumulation which is responsible for several pathologies of the oral cavity. **Material and methods:** Forty eight specimens of two composite materials (Charisma and Super-Cor) were prepared using a silicone template according to the manufacturer's instructions. Each sample was brushed for eight hours. Each group of specimens was divided in two subgroups: half of the samples were brushed using only distilled water and the other half with a mixture of distilled water and toothpaste. The average roughness value (Ra) of surfaces were measured with profilometer three times: the initial measurement was performed before starting the toothbrush simulation, the second was after 4 hours and the third was after 8 hours of brushing. Three different bristle stiffness toothbrush heads were used (medium sensitive, medium and soft). After collecting all numerical data one-way ANOVA and Friedman tests were performed for statistical analysis. **Results:** All examined microhybrid composites exhibited changes in surface roughness after the toothbrush simulation. The simulation of toothbrushing without toothpaste, only with water as cleaning substrate, showed at every measurement the lowest values of roughness in all three toothbrush heads. Significantly increase of mean Ra values were observed in both tested composite samples when medium and soft toothbrushes with toothpaste were used. **Conclusion:** The surface roughness changes of tested microhybrid composites depend on the brushing procedure. The toothpaste has a much greater effect on the abrasion than the type of toothbrush.

Study III: Inter- and intra-operator reliability study of stylus-based tactile profilometer in testing of glass ionomer

Introdution: The roughness measuring instruments, which analyze the roughness degree of sample surface using a stylus, can give limited information about surface alterations. The alternative three-dimensional surface mapping methods have better performance, but their spread is limited. The aim of this study was to determine the intra- and inter-operator reliability of surface roughness measurements by three independent operators with a tactile stylus-based profilometer on glass ionomer specimens. **Material and methods:** Ten light-cured glass ionomer specimens, prepared according to the manufacturer's instructions from premeasured unit dose capsules of GC Fuji II LC CAPSULE, have been selected. Three previously trained operators measured individually in four diagonals the surface roughness of samples with MarSurf XR1 roughness measuring instrument. After ten days the measurements were repeated using the same protocol. The Average Roughness was used to characterize the surface texture. Intra-class correlation coefficients were calculated for both individual and group measurements to check the level of reliability of the used technique. **Results**: Since all calculated intra-class correlation coefficients show high values (> 0.75), our null hypotheses, according to the results obtained with the same methodology and repeated after 10 days using a tactile profilometer can produce high values (> 0.75) of ICC both i) intra- operator and ii) inter-operator, were confirmed**. Conclusion:** Linear surface roughness measurements of dental materials using a tactile roughness measuring device can be performed with high reliability by single or multiple users. This procedure has its limitations and further studies, with more materials, are warranted in this topic.