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Comparative study of fluoride release by two compomers with or without post-polymerization, in water and in artificial saliva (SAGF medium)

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INTRODUCTION: For many years, there has been a need for restorative materials including caries-preventive elements. It is quite clear that fluoride is the most effective agent in caries prevention. Polyacid-modified composite resins (compomers) are fluoride containing and releasing materials [4]. The aim of this study is to investigate if thermal post-polymerization of compomers, well-known for increasing the conversion rate of composite resins [2-3], influence fluoride release.

METHODS: We realized two experiments, the first one was a pilot study to determine the influence of three parameters (product, medium of release and polymerization mode), the second one restart with one product and one medium to refine polymerization's result.

In the first experiment, 24 samples of Dyract AP[®] (Dentsply De Trey GmbH, Konstanz, Germany) and 24 samples of Compoglass F[®] (Vivadent, Schaan, Liechtenstein) were photo-polymerized with an halogen lamp (3M[®] Curing light 2500) according to manufacturer's recommendations. Disk-shaped samples 5 millimeters in diameter and 4 millimeters thick were prepared. 12 samples of each product have been post-polymerized in an oven (Prolabo[®], 20-220C° double control) at 120°C during 10 minutes and the 12 others have been preserved at room temperature (25C°). Half of the post-polymerized samples and half of the preserved at room temperature samples of each product have been immersed in deionized water and other half in an artificial saliva: the SAGF medium [1]. All experiments were carried out at 25C°. The amounts of fluoride released were measured with a potentiometer equipped with an ISE 25F (Radiometer[®]) fluoride ion selective electrode, a reference XR 100 calomel electrode (Radiometer[®]) and a PHM 210 millivoltmeter (Radiometer[®]). The media were renewed after 1, 2 and 7Days. A pH acetate buffer (tafic) was added to the trial solutions before measurements.

In the second experiment, protocols to prepare the samples and to analyze trial solutions are identicals. The experimental protocol is simplified to increase statistic power. We decided to use Dyract AP[®] in water because results were more

stable. 40 samples were prepared and divided in two groups, first group was only photo-polymerized and immersed in deionized water, second was photo-polymerized, post-polymerized and immersed in deionized water. Solutions were renewed and analyzed at day 3, 13, 20 and 27.

Table 1: distribution of samples (1st experiment).

Dyract AP [®] in water photo-polymerized	6
Dyract AP [®] in SAGF photo-polymerized	6
Dyract AP [®] in water post-polymerized	6
Dyract AP [®] in SAGF post-polymerized	6
Compoglass F [®] in water photo-polymerized	6
Compoglass F [®] in SAGF photo-polymerized	6
Compoglass F [®] in water post-polymerized	6
Compoglass F [®] in SAGF post-polymerized	6
Total	48

All tests were performed by non-parametric tests of Mann-Whitney-Wilcoxon or Kruskal-Wallis.

Table 2: distribution of samples (2nd experiment).

Dyract AP [®] in water photo-polymerized	20
Dyract AP [®] in water post-polymerized	20
Total	40

RESULTS: The first experiment can be analyzed in three ways: effect of polymerization, effect of medium and effect of product. Significant differences are signaled by red arrows in figures.

First experiment:

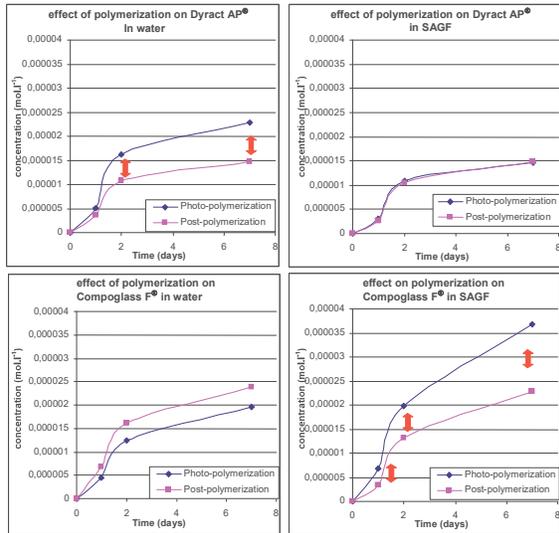


Fig. 1: Effect of polymerization.

For the Dyract AP[®] in water, samples with photo-polymerization only release significantly more on the second and seventh day (1st day : $p_1=0,359$, 2nd day : $p_2=0,008$, 7th day : $p_7=0,003$).

For the Dyract AP[®] in SAGF, we could not find any significant difference at any time of the experiment ($p_1=0,244$, $p_2=0,319$, $p_7=0,653$).

For the Compoglass F[®] in water, we could not observe any significant difference at any time of the experiment ($p_1=0,183$, $p_2=0,214$, $p_7=0,282$).

For the Compoglass F[®] in SAGF, samples with photo-polymerization release significantly more at the three times of the experiment ($p_1=0,0002$, $p_2=0,029$, $p_7=0,003$).

Second experiment:

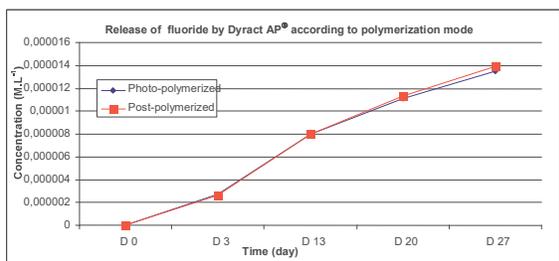


Fig. 2: Release of fluoride by Dyract AP[®] according to polymerization mode.

In the second experiment, the two groups of 20 samples of Dyract AP[®] in water had a very similar behavior. We could not show any significant difference at any time of the experiment. (3rd day: $p=0,7344$, 13th day: $p=0,7251$, 20th: $p=0,6359$ and 27th: $p=0,4953$).

DISCUSSION & CONCLUSIONS: The first experiment demonstrates an effect of the heat

treatment after standard photo-polymerization on fluoride release on these two compomers. We could not demonstrate it in all the conditions probably because of the small numbers of sample in each group (6). The effect underlined in this experiment is at very short time (7 days).

In the second experiment we had no effect of the heat treatment after standard photo-polymerization probably because we renewed releasing medium less often and we had continued the experiment for 27 days.

We can suppose that this difference between the two experiments is due to the profile of compomer's fluoride release. Compomers constantly release fluoride after an initial fluoride "burst". This greater amount of fluoride release during the first days may be the best moment to demonstrate a difference due to polymer matrix conversion.

We can also suppose that the matrix continues its maturation with the water penetration and the initial differences due to heat treatment may be shade by acid base reaction after some days.

The frequency of medium renewal can also influence the pattern of fluoride release. This has been demonstrated in previous experiments and when the medium is changed more often, release is proportionally higher than when the medium is not changed [1].

Dyract AP[®] in SAGF had lower release than in water which confirms previous results in our laboratory [1]. It has been suggested that it is due to CaF₂ precipitate on the surface of the material like Levallois & Coll. observed on glass-ionomers cements with a scanning electron microscope. We hope we could determine in the future if the same type of precipitate can be observed at the surface of polyacid-modified composite resins.

We want to continue these experiments by establishing if thermal post-polymerization of compomers modify their mechanic properties. We also want to study the effect of polishing the surface of the samples on fluoride release.

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