

## INFLAMMATORY RESPONSES TO ESTHETIC RESTORATIVE MATERIALS [COMPOSITE, COMPOMER AND ORMOCER] IN RATS

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### SUMMARY

The aim of this study was to determine the acute non-specific toxicity of esthetic restorative materials in rats. Blood samples for WBC counts were obtained just before and after one week of inoculation of the materials. When we compared the WBC counts, there was a significant difference in WBC ( $p < 0.05$ ) with respect to all selected materials. The esthetic restorative materials were found to be biocompatible in the limits of this study. Nevertheless, the compomers were identified as more biocompatible than resin composite.

The results have shown that the WBC values that occurred as the natural result of the infection are the hematological values that can represent the biocompatibility. The Duncan test made for WBC counts has showed that when compared with PVC, a toxic substance, the other three materials (composite, compomer, ormocer) can be assumed to be biocompatible.

**Keywords:** Resin Composit, Compomer, Inflammatory Response, Ormocer, White Blood Cell

### ÖZET

Çalışmamızın amacı sıçanlarda estetik restoratif materyallerin akut nonspesifik toksisitelerinin belirlenmesidir. Materyaller yerleştirilmeden önce ve yerleştirdikten bir hafta sonra kan örnekleri alınmış ve bu örneklerde WBC değerlerine bakılmıştır. Bu değerler karşılaştırıldığında bütün materyeller arasında istatistiksel olarak anlamlı farklılık bulunmuştur ( $p < 0.05$ ). Estetik restoratif materyaller çalışmamıza göre biyouyumlu bulunmuşlardır. Bununla birlikte kompomeler rezin kompozitlere göre daha uyumlu bulunmuştur.

Sonuçlar göstermiştir ki WBC değerleri enfeksiyon oluşumunu belirleyen hematolojik bulgu olarak biyouyumluluğu yansıtabilir. WBC ortalamalarına uygulanan Duncan testine göre, toksik materyal olarak kabul edilen PVC ile karşılaştırıldığında diğer üç materyal (kompozit, kompomere, ormocer) biyouyumlu kabul edilebilir.

Recently, there has been a considerable development on the esthetic restorative materials such as resin composite and glass ionomers and ormocer have been produced.<sup>1,2</sup>

What makes the biocompatibility important is the continuous relationship of the filling materials (foreign body) with the tooth, the surrounding tissues, and oral environment. The term biocompatibility comprises toxicity, inflammatory response, the effect of the filling

material to its environment and vice versa. It may contain saliva and similar structures that can inhibit the enzymes.<sup>3,4</sup> Filling materials can be biodegraded by enzymes. Toxicity occurs by means of the chemical structure of filling materials.<sup>5-9</sup>

The aim of this study was to compare the hematological results of the inflammatory reactions caused by these materials.

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## MATERIALS AND METHODS

Sixteen Sprague Dawley rats were used in the study. The animals were housed under standardized conditions with free access to food and water throughout the experiment. Their weights were 185 to 220 gr.

We used Hilux 350 (Benlioğlu, Turkey) as the light source for the polymerization. The filling materials tested were composite resin (Quadrant-Cavex, Holland) poliacid modified composite resin (Hytac Aplitip-3M-ESPE, USA) and Ormocer (Admira-Voco, USA), PVC (Poly Vinyl Chloride) was used for comparison. The animals were divided into four groups (each of 4) corresponding to the four kinds of filling materials mentioned above.

### Preparation of the discs

All the discs were prepared in 1 cm diameter and 2 mm in width, and polymerized (except for PVC) according to the instructions. Then the discs, except for PVC, were polished with polishing discs (Sof-lex-3M-ESPE, USA). The powder PVC was transformed into a disc under high pressure.

### The placement of the discs

All rats were anesthetized with a 20 mgr/kg (IM) ketamine hydrochloride. (Kétalar; Eczacıbaşı, Istanbul, Turkey). Each disc was implanted subcutaneously onto the back of the rats.

### Blood Sampling

The blood samples of 1.5 ml were obtained from the rats before and one week after the placement of the discs. The WBC (White Blood Cell) counts were determined. The first counts were subtracted from the second ones (one week later) to determine the difference. The first and

the second values (one week later) were subtracted from each other to determine the hematological values difference for comparing restorative materials and PVC with statistical analyses. Because of the inflammatory response was questioned, the values of WBC were studied.

### Statistical Analyses

These differences were statistically analyzed by using the analysis of variance methods. Duncan's multiple comparison test was used to compare the restorative materials and PVC means.

## RESULTS

Animals blood was taken twice, before and one week after the placement of the discs. The comparison of the materials with PVC on the basis of WBC counts were shown in Table. After analysis of the variance, a significant difference was detected among the groups ( $p < 0.05$ ).

Table. The comparison of restorative materials with PVC on the basis of WBC counts

Groups	Means
Comopomer	- 8.25 A
Ormocer	- 4.82 AB
Composite	- 2.12 B
P.V.C.	3.32 C

Means within a column containing the same letter are not significantly different at  $p < 0.05$  using Duncan's multiple range tests.

The Duncan test was applied to determine the most meaningful difference in the WBC values of the groups. There was a statistically significant difference between PVC and

compomer, ormocer, and composite. Compomer and composite groups were different ( $p < 0.05$ ), while ormocer and composite groups were found to be similar ( $p > 0.05$ ).

## DISCUSSION

The findings also showed that the positive difference in WBC counts in the case of PVC is related directly to inflammatory response and to the disadvantage of PVC with respect to biocompatibility. On the other hand, the absence of any positive difference in WBC counts in the case of the restorative materials selected is related directly to biocompatibility.

Our study was based on the assumption that there is a meaningful relationship between inflammation and WBC counts.<sup>10</sup> Leukocytes are the major cellular components of inflammation and include neutrophils, T and B lymphocytes, natural killer (NK) cells, monocytes, eosinophils, and basophils. These cells have been assigned specific functions, such as antibody production by B lymphocytes or destruction of bacteria by neutrophils, but, no single infectious disease is the exact role of each of the cell types completely established.<sup>11</sup>

Composite resins can contact the soft tissue in various ways. For example composite restorations can be made at the gingival level. While composite restorations are made or finished, some particles could be implanted in the oral mucosa. Any biocompatibility problem of the composite material may emerge at the time of implantation. Thus, inflammation may be inevitable.

Many factors influence inflammations, which include whether the implanted material is

polymerized or not<sup>12</sup> and the quality of polymerization and filling/resin ratio.<sup>7</sup> Because one of the main reasons for toxicity is the composite components<sup>13</sup> that have not participated in the reaction of the composite also affects it (chemically or light cured composite) as we do in general<sup>9</sup>, composites are implanted as polymerized discs as in our cases. However, it was seen that they were injected to blood as monomers or they were implanted in polyethylene tubes as in a nonpolymerized manner.<sup>14,15</sup>

After implantation of the samples, controls were made in various periods. According to the studies, the most meaningful results were obtained in the first 24 hours and on the 7th day. Later it was reported that toxicity or any inflammation continued on decreasing (All freshly prepared composite materials were cytotoxic. These effects diminished with increased preincubation times and were non significant after 7 days).<sup>15-17</sup> For this reason, we remove the samples showing any inflammation one week after implantation.

In our work we used PVC as the comparison group together with the restorative materials. The toxic effects of PVC, especially those on pulmonary cells, are well known<sup>18</sup>.

In this study, WBC counts of PVC group were high as expected. In evaluating biocompatible it was stated by several reports that inflammation was an important criteria in evaluating biocompatibility. It is known that WBC values are good markers of inflammation.<sup>11,12</sup>

There are a lot of studies that accept many modern composites to be toxic at a tolerable level, but there are also some studies that support the opposite view.<sup>2,19-22</sup>

When toxicity of compomers was compared with that of resin composites, it was

found that the combination of compomers and bonding agents demonstrated stronger toxicity than resin composites.<sup>16</sup> However, another study cited that the resin composites were more toxic than compomer.<sup>12</sup>

There is no separate study on ormocer biocompatibility, but there are some assumptions. For instance, one of the assumptions is about the ormocer's content. Ormocer do not anticipate toxicological problems because of the use of the silane-connected acrylates and methacrylates and the resulting linkage to the inorganic polymer structure.<sup>2</sup>

In other words our work is one of the first studies supporting this assumption in a positive way. In our study, WBC values belonging to esthetic restorative materials including ormocer were found to be normal. According to our findings composites, compomers and ormocers are biocompatible.

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