COMPARATIVE STUDY REGARDING THE MICRO-HARDNESS OF SOME AESTHETIC RESTORATIVE MATERIALS

Irina Grădinaru[1*], Elena Raluca Baciu[1], Daniela Calamaz[1], Maria Baciu[2]

[1]"Grigore T. Popa" University of Medicine and Pharmacy - Iaşi, Romania, Faculty of Dental Medicine, Department of Dental Materials

[2]"Gh. Asachi" Technical University - Iaşi, Romania, Department of Material Engineering and Industrial Security

*Corresponding author: Irina Gradinaru, DMD, PhD
"Grigore T. Popa" University of Medicine and Pharmacy - Iaşi, Romania
e-mail: irina.gradinaru@umfiasi.ro

ABSTRACT

Background In recent years and mainly after 2000, the trends in terms of the structure of dental composites have addressed the progressive decrease of filler particle size down to nanometric level. All these result from the need to continuously improve the properties of the composite material such as their hardness, mechanical resilience, contraction to polymerization and polymerization stress. The present study aimed to test the micro-hardness and to determine its variation in case of some coronary esthetic restorative materials commonly used in dental practice. **Material and methods** Experimental researches concerning the determination of the micro-hardness variations were performed on four direct dental restorative light-curing composite (Herculite XRV Ultra, Synergy D6 and Brilliant - nanohybrid composite and Latelux -microhybrid composite). Specimens, with a diameter of 10 × 10 mm and 4 mm thick, were developed in the Dental Materials laboratory of the Dental Medicine Faculty of "Gr. T. Popa " University of Medicine and Pharmacy of Iasi, in accordance with the manufacturer indications. Micro-hardness testing was performed in the Department of Material Engineering and Industrial Security of the Faculty of Materials Science and Engineering from "Gheorghe Asachi" Techncial University of Iaşi. **Results** Tests have revealed that direct composite resin Brilliant from Coltene Whaledent presents the highest values of Vickers micro-hardness. **Conclusions** For the selection and use of direct composite resins dentist must take into account the composition, clinical performance, handling characteristics and their biomechanical behavior, an important parameter being the micro-hardness.

Keywords: composite resins, microhardness, dental restorations

INTRODUCTION

The evolution of the materials used in aesthetic dental restorations from acrylic resins and silicate cements took place at the end of the 20th century through the appearance of composite diacrylic resins.

Starting from the composites with macro-filling which were very hard but they were difficult to finish and polish, there came the composites with micro-filling which met the aesthetic exigencies, but they were not sufficiently hard due to their lower filler content. Thus, we have now the micro-hybrid universal composites. They contain particles of sizes between 0.4 and 1.0 μm obtained by special techniques of milling and grinding.

In recent years and mainly after 2000, the trends in terms of the structure of dental composites have addressed the progressive decrease of filler particle size down to

nanometric level. All these result from the need to continuously improve the properties of the composite material such as their hardness, mechanical resilience, contraction to polymerization and polymerization stress

AIM OF THE STUDY

The present study aimed to test the micro-hardness and to determine its variation in case of some coronary esthetic restorative materials commonly used in dental practice.

MATERIAL AND METHODS

The experimental researches related to the determination of micro-hardness variation were carried out on 4 direct dental restorative photopolymerizable composite materials (*Herculite XRV Ultra*, *Synergy D6* and *Brilliant* – nanohybrid composite and *Latelux* – micro-hybrid composite) presented in table 1.

Table 1. Materials used in the experimental researches

Representative class	Commercial product	Producer
Photopolymerizable RDC	Herculite XRV Ultra	Kerr
	Synergy D6	Coltene Whaledent
	Brilliant	Coltene Whaledent
	Latelux	Lotus

Specimens were made in the Dental material lab from the Faculty of Dental Medicine - U.M.F. "Gr. T. Popa" Iaşi. Each specimen was made in concordance with manufacturers' indications and they were 10×10 mm in diameter and 4 mm thick. Photopolymerizable composites were condensed in a plastic material conformator, in 2 mm layers, each layer being cured for 30 seconds (fig.1).

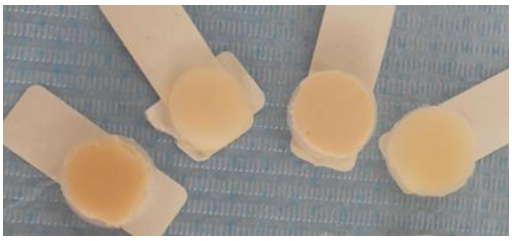

Figure 1. Specimens made from the materials used in the experiment

We made three determinations for each specimen and the measurement of Vickers microhardness was performed by means of *CV Instruments 400 DM* microhardness tester existing in the lab for Surface Engineering of the Faculty of Materials Science and Engineering from "Gheorghe Asachi" Technical University of Iaşi (fig.2).

Figure 2. CV Instruments 400 DM Micro-hardness tester

RESULTS AND DISCUSSIONS

During the determinations for the specimen made from Herculite XRV Ultra (Kerr) we obtained the highest value for the second determination followed in decreasing order by the first and the third determination. The values obtained are given in table 2.

The variation of Vickers microhardness for Herculite XRV Ultra *(Kerr)* is rendered in the graphic representation of fig. 3.

Table 2. Values obtained in the tests run on the specimen made from Herculite XRV Ultra (*Kerr*)

Impression no.	Microhardness, $HV_{0,1}$	Microhardness average
1	50.5	52.56
2	58.9	
3	48.3	

Table 3. Values obtained in the tests run on the specimen made from Synergy D6 (*Coltene Whaledent*)

Impression no.	Microhardness, $HV_{0,1}$	Microhardness average
1	38.7	43.86
2	44.1	
3	48.8	

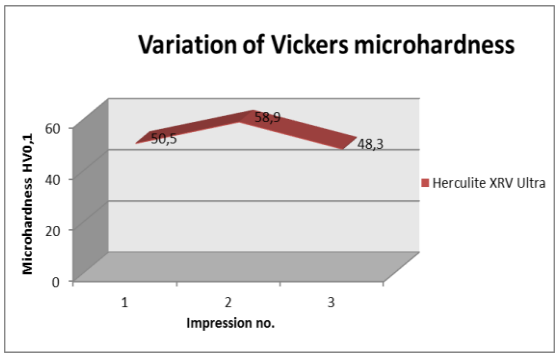

Figure 3. Variation of Vickers microhardness for Herculite XRV Ultra (*Kerr*)

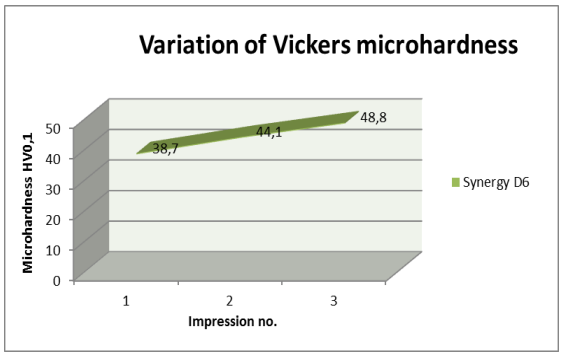

Figure 4. Variation of Vickers microhardness for Synergy D6 (*Coltene Whaledent*)

During the determinations carried out for the specimen made from Synergy D6 (Coltene Whaledent), we obtained the highest value for the third determination followed in decreasing order by the second and the first determination. The values obtained are given in table 3.

The variation of Vickers microhardness for Synergy D6 (*Coltene Whaledent*) is rendered in the graphic representation of fig. 4.

During the determinations carried out for the specimen made from Brilliant (Coltene Whaledent), we obtained the highest value for the first determination followed in decreasing order by the third and the second determination. The values obtained are given in table 4.

The variation of Vickers microhardness for Brilliant *(Coltene Whaledent)* is rendered in the graphic representation of fig. 5.

During the determinations carried out for the specimen made from Latelux *(Lotus)*, we obtained the highest value for the third determination followed in decreasing order by the first and the second determination. The values obtained are given in table 5.

The variation of Vickers microhardness

for Latelux (Lotus) is rendered in the graphic representation of fig.6.

Table 4. Values obtained in the tests run on the specimen made from Brilliant (*Coltene Whaledent*)

Impression no.	Microhardness, $HV_{0,1}$	Microhardness average
1	61.7	58
2	55.7	
3	56.6	

Table 5. Values obtained in the tests run on the specimen made from Latelux (*Lotus*)

Impression no.	Microhardness, $HV_{0,1}$	Microhardness average
1	50.8	50.2
2	46.1	
3	53.7	

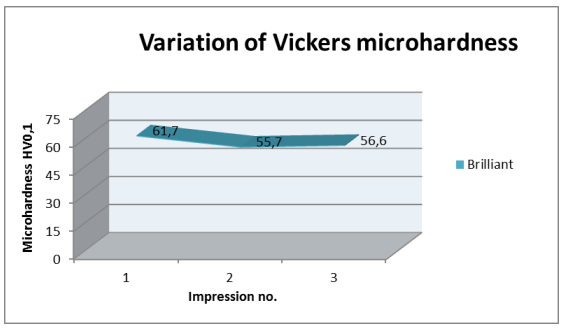

Figure 5. Variation of Vickers microhardness for Brilliant (*Coltene Whaledent*)

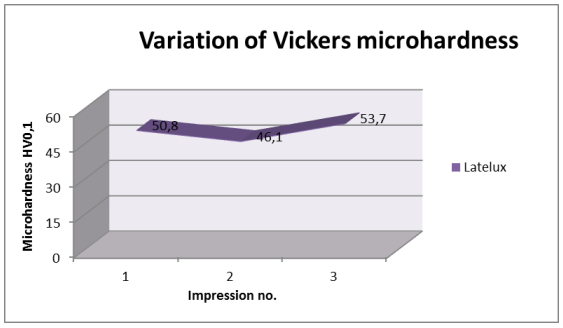

Figure 6. Variation of Vickers microhardness for Latelux (*Lotus*)

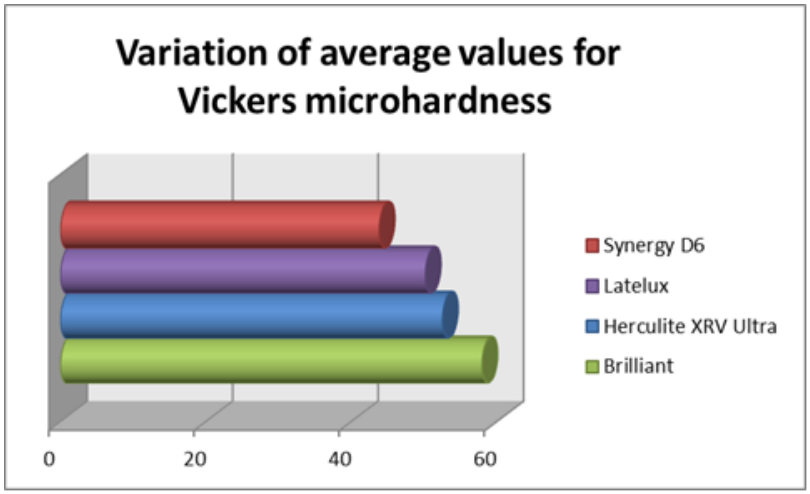

Figure 7. Variation of average values for Vickers microhardness for the materials under study

The figure 7 shows a diagram illustrating the microhardness average for the 4 specimens.

As we may also see in this diagram, the highest average value was obtained in the determinations carried out for the specimen made from Brilliant from *Coltene Whaledent* followed by Herculite XRV Ultra from *Kerr* and the lowest average value of micro-hardness being obtained for Synergy D6 from *Coltene Whaledent.*

CONCLUSIONS

1. Direct composite resins are available in a variety of forms, and for this reason when choosing and using them, the medical practitioner must take into account their composition, clinical performances, lab handling characteristics as well as their biomechanical behavior, micro-hardness being one important parameter.
2. In case of the stomatological materials, hardness represents an indicator measuring their resilience to indentation by means of a harder alloy (steel/diamond). In the technological algorithm for the making of movable prosthetic devices, the hardness value indicates the easiness with which a structure is finished and its resistance to abrasion during usage.
3. The highest values of Vickers microhardness were registered for Brilliant direct composite resin from Coltene Whaledent.
4. The lowest values of Vickers microhardness were registered for Synergy D6 direct composite resin from Coltene Whaledent.

REFERENCES

1 Bratu D. Materiale dentare în cabinetul stomatologic. Editura Helicon, Timişoara, 1994
2 Bratu D. Materiale dentare: bazele fizico-chimice. Editura Helicon, Timişoara, 1994
3 Craig G.R., Powers M.J. Restorative Dental Materials. Ediţia a XIa, Editura Mosby, Inc, 2002