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RESEARCH ARTICLE

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EFFECT OF SLIDING WEAR RATE AND STAINING RESISTANCE ON INDIERECT COMPOSITES

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ABSTRACT

Unlike the direct composites, indirect composites included that can be cured extraorally to improve degree of conversion and other materials properties. Therefore these materials are indicated as long term full coverage dental restorative materials. However the mechanical as well as physical properties of new indirect composites for this particular application have not been fully evaluated. The purpose of the present study is to compare the appropriateness of the four composite resins for application as long term full coverage restorative materials. Staining resistance, two body wear of four indirect composite restorative materials were determined.

Keywords: indirect composite, composite resins, wear, pin-on-disc, staining resistance,

INTRODUCTION

An ideal dental restorative material would have physical properties similar to a natural tooth. The dental restorative would be comparable with living tissue, and would duplicate the esthetics of a tooth. Over the years, many different materials have been used as tooth restoratives. With the development of composite materials for tooth restoration the use of amalgam and other metal alloys for dental repair has diminished. The various composite systems have proved to have superior esthetics and physical properties. Improvements in composite materials are continually developed and verified. [1]

The properties of the composite materials are usually studied on the bulk material. Most of the reported property data is on bulk materials in standard mechanical tests with specimens machined to ASTM standards preparation of these test specimens for dental composites is quite different in volume of materials needed as compared to most tooth restorations. It will be useful to have methods for evaluating the properties of dental composites that accommodate test piece that are the same as those in use as dental restoratives [1]. Since composite materials have been used instead of amalgam it has becomes a matter of concern for manufacturers to achieve ideal composite properties. There are any many restorative composite brands available, and the sevary according to their area of use on tooth and dental arch (anterior, posterior cervival, etc). Modern composites have excellent mechanical properties and are suitable for all restorations, even on the posterior of the dental arch, but they are still not perfect materials. While development of composite materials is proceeding, insufficient material properties can reduce their longevity. Wear and hardness are important factors in materials used in industry. [2] Eugeniusz Sajewicz in his study shows that more reliable approach to evaluation of the wear resistance of human enamel and dental materials is proposed. The procedure is based on the correlation between the volumetric wear and the friction energy dissipated during sliding. The model can be useful to compare the wear resistance of different dental material tested in different ambient conditions. [3] Ahmet Kursad Culhaoglu, Joonge Park in their study proved that indirect dental composite is all ceramic dental composite is relatively more wear friendly than all ceramic restoration. Furthermore, indirect composites are favorable and less offensive. Therefore, the second generation of indirect composites is promising in long life dental restorations [4]. Yoichi Tamura Kiyoshi Kakuta Hideo Ogura investigated the effects of different fillers and

Their contents on the wear of composite resins, four composite [5] J. Kleczewska, D.M.Bielinski studied that in the most cases, composites studied exhibit the surface gradient of hardness. Generally, the harder and the stiffer the material the higher its abrasion, what follows amicro mechanical model of friction[6] .Hu,E.Harrington,P.M.Margnis,A.C.shortall in his study of influence of cyclic loading on the wear of dental composite that wear behavior associated with variable loading patterns divered from that of static loading.[7] , J. Manhart, K.-H. Kunzelmann, H.Y. Chen, R. Hickel suggested that fracture and wear behavior of the composite resins are highly influenced by the filler system. Overall, Surefil demonstrated good fracture mechanics parameters and a low wear rate [8].Natthavoot, Koottathape, HidekazuTakahashi, Naohiko lwasaki, Masafumi kanehira,Warner J Finger used The ball-on-disc sliding device to simulate sliding of an antagonist cusp on an opposing occlusal composite restoration, either in the two- or the three-body wear mode. All tested materials except for the microfilmed composite showed low surface wear when exposed to poppy seed as the third-body medium. [9]. Eduardo Carlos Bianchi, Eraldo Jannone da Silva This article discusses the development of a test bench and a methodology for the study of composite resin abrasive wear. To evaluate the operation of the test bench and to compare the proposed thodology with other existing ones, a study was made of the five composites most commonly used by dentists. The one-way ANOVA method and the Tukey test were used to statistically analyze the results by multiple comparisons of the groups of resins tested. Using the proposed methodology, these resins were classified in an increasing order of abrasive wear strength, as follows: Charisma (the lowest abrasive wear strength), Tetric, TPH, Herculite and Z-100 (the highest abrasive wear strength) ($P<0.05$). In comparison to other methodologies, the results of the proposed methodology presented the lowest coefficient of variation.[10]. Xiaoqiang Hu, BEng showed in result that the wear of Ultrafine Compact-Filled composite and micro filled composite differed and reflects different operative wear mechanisms. For amalgams, the size, shape,and composition of the particles had an effect on the wear resistance of the materials.[11]. Eugeniusz Sajewicz in his study more reliable study, more reliable approach to evaluation of the wear resistance of human enamel and dental materials is proposed. The procedure is based on the correlation between the volumetric wear and the friction energy dissipated during sliding. The model can be useful to compare the wear resistance of different dental materials tested in different ambient conditions. [12]. R.W. Wassell, J.F. McCabe and A.W.G. Walls investigated the wear rate of regular and tempered composite [13].

In these study properties of four indirect composite restorations were investigated. These properties were staining resistance and wear rate testing on pin-on disc machine.

Materials and Methods

Materials

The materials tested are listed in table I. Four indirect composite restorative materials Radica (Dentsply), Sculpture Plus (Pentron), Belleglass-NG (Kerr) and Gradia Indirect (GC America) were determined.

Staining resistance: Staining resistance is a vital property for the longevity of a facing on a removable or fixed partial denture, a crown or direct restorations in esthetic areas, resin based composites are susceptible to staining. [14, 15].Enamel and dentin shade A2 were used in this test. Six specimens for each group with dimensions of 12.5 mm diameter and 2 mm thickness were cured.

Table I

Material	Matrix	Filler
Radica (Dentsply)	Urethane dimethacrylate ((UDMA)	fluoroaluminoborosilicate glass (silanated), Amorphous silica
Belleglass-NG(Kerr corrp)	Dimethacrylate (UDMA	Prepolymerized filler Amorphous Silica
Gradia Indirect(GC, Tokyo,Japan)	Urethane dimethacrylate (UDMA	Silica Powder, SilicaGlass Powder and Prepolymerized filler
Sculpture Plus(Pentron Lab)	Polycarbonate dimethalcrylate, Ethyoxylated Bis-GMA (PCDMA)	Microfiller Barium borosilicate Amorphous silica

Sliding Wear Resistance Determined by a Pin-on-Disc Test: - Enamel shade composite were used in this test. Six discs specimens approximately 12 mm in diameter, 3 mm thick, fabricated from each materials in Teflon molds. They were removed from the mold and stored at 37 ^{o}C in distilled water for 24 hours before testing. Before the test, specimens were mounted in brass cup using a filled auto polymerizing acrylic resin. They were then rinsed with distilled water in an ultrasonic cleaning machine for 10 minutes. The wear test was run for 25,000 cycles at 120 revolutions per minute. The wear field was washed cowith distilled water for the entire period of the test. After the cycles were complete, the sliders were removed and measured under a digital micrometer. The specimens were removed and cleaned with distilled water in an ultrasonic bath. They were then scanned in the Contact Profilometer and area was recorded at six different positions of the wear tract using Taylorlite software and measured as described in three-body wear. Integration was applied to calculate the volume wear loss using the average radius and area from the software [16]

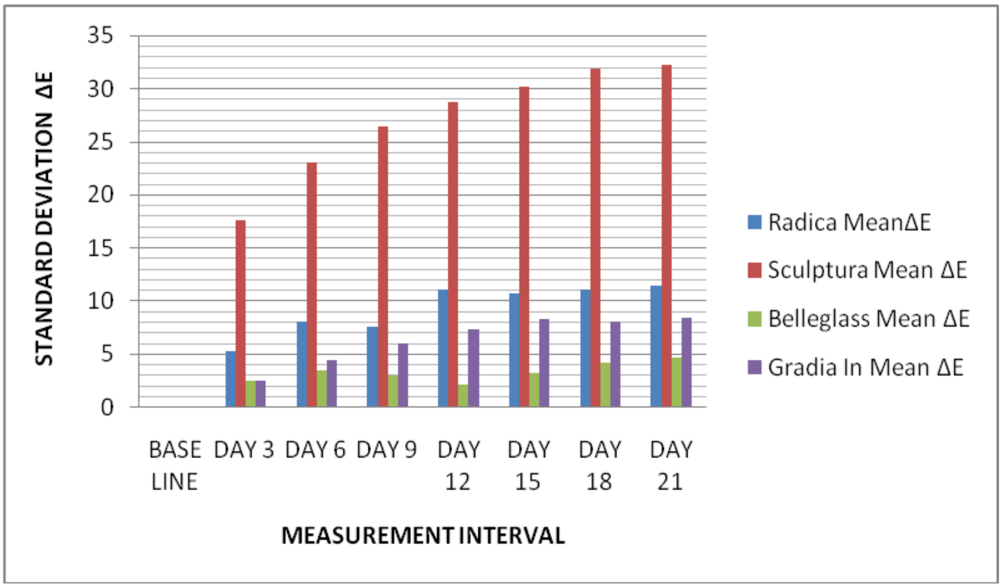
Fig.2.1:-set up to perform sliding wear on pin-on disc.

RESULT AND DISCUSSION

Results of this test are presented in Tables II to III and Figures 4 to 8.Statistically significant changes in ΔE values over a 21 day period were observed in all the laboratory composites for both enamel and dentin shades. The dentin shade of all composites showed more vulnerability to staining then the enamel shade. Belleglass-NG demonstrated the least change in ΔE while Sculpture demonstrated large changes in ΔE. *b** co-ordinate showed maximum changes in its value after each interval for the composites.

Table II Staining Resistance of Enamel Groups (SCE component)

Measurement Interval SCE (ΔE)	Radica Mean ΔE (std dev	Sculpture plus Mean ΔE (std dev)	Belleglass-NG Mean ΔE (std dev)	Gradia Indirect Mean ΔE (std dev)
Baseline	0	0	0	0
Day 3	7.36 (1.17)^{b}	16.32 (3.17)^{a}	2.78 (1.65)^{c}	2.49 (0.94)^{d}
Day 6	9.10 (2.23)^{b}	22.08 (4.23)^{a}	3.58 (2.47)^{c}	4.45 (1.23)^{d}
Day 9	8.65 (1.67)^{b}	25.48 (3.67)^{a}	2.87 (1.78)^{c}	5.98 (1.48)^{d}
Day 12	12.17 (1.85)^{b}	27.25 (5.85)^{a}	3.17 (1.27)^{c}	7.37 (1.62)^{d}
Day 15	11.27 (1.85)^{b}	31.17 (4.85)^{a}	3.78 (1.54)^{c}	8.27 (0.28)^{d}
Day 18	10.38 (1.68)^{b}	32.20 (5.68)^{a}	4.25 (1.78)^{c}	8.03 (1.1)^{d}
Day 21	10.65(2.34)^{b}	31.17(5.34)^{a}	4.87 (2.17)^{c}	8.42 (1.02)^{d}



Staining Resistance of Enamel Groups (SCI componenet)

Measurement Interval SCI (ΔE)	Radica MeanΔE (STD DEV)	Sculptura Mean ΔE (STD DEV)	Belleglass Mean ΔE (STD DEV)	Gradia In Mean ΔE (STD DEV)
BASE LINE	0	0	0	0
DAY 3	4.87 (0.96)^{b}	16.78 (2.48)^{a}	4.87 (0.96)^{c}	2.26 (0.87)^{c}
DAY 6	8.12 (2.25)^{b}	18.57 (3.57)^{a}	8.12 (2.25)^{c}	3.67 (1.15)^{c}
DAY 9	8.25 (1.48)^{b}	23.45(3.48)^{a}	8.25 (1.48)^{c}	5.38 (1.78)^{b}
DAY 12	10.48 (1.87^{b}	24.87 (3.45)^{a}	10.48 (1.87)^{c}	6.78 (1.17)^{d}
DAY 15	9.27 (1.68)^{b}	25.57(3.45)^{a}	9.27 (1.68)^{c}	8.47(0.47)^{d}
DAY 18	10.57 (1.87)^{b}	26.14(3.21)^{a}	10.57 (1.87)c	8.48 (1.18)^{d}

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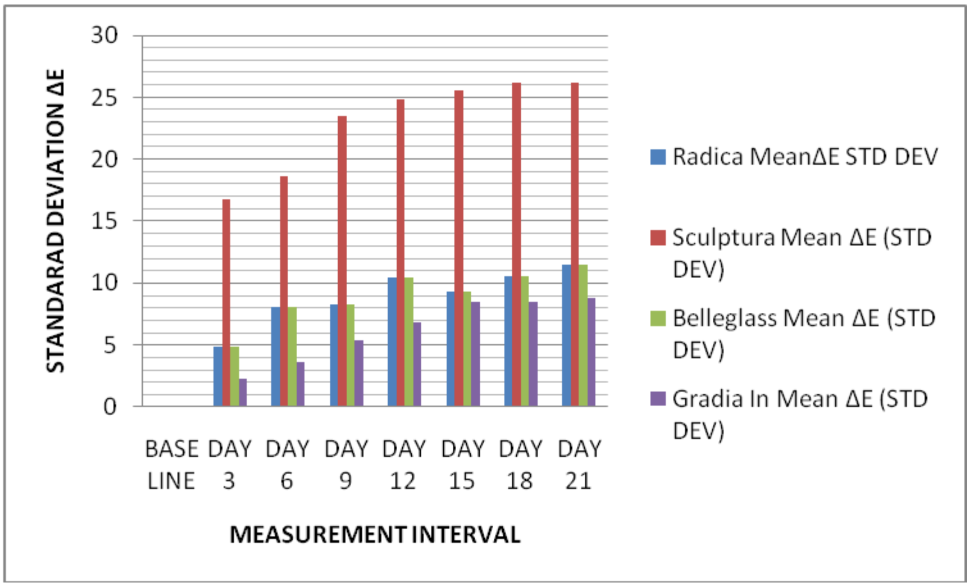
DAY 21	11.45 (4.15) [b]	26.14 (3.16) [a]	11.45 (4.15) [c]	8.78(1.38) [d]

Staining resistance of dentin resins



CONCLUSION.

It is concluded that significant difference are deteremined in stateed composites system evaluated in terms of staining resistance and two body wear . differences in formulations or curring mechanism of these indirect composite offer different advantages .wear resistance and staining resistance is concern for a long term use of indirect composite s in clinical applications.

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