

**REVIEW ARTICLE****ROLE OF ABRASIVES IN DENTISTRY**Kefi I.<sup>1</sup>, Afreen M.<sup>1</sup>, Maria A.<sup>1</sup>, Iftikhar A.<sup>2</sup>, Fareed M.<sup>1</sup> and Adel S.<sup>1</sup>**ABSTRACT:**

A dental abrasive is an important part of dental services. This specialty deals with the finishing and polishing of dental appliances like complete dentures, removable partial dentures, crown and bridges and the direct dental restorative materials. Effective finishing and polishing of direct or indirect dental restorations may not only responsible for good aesthetics but also provide healthy oral environment and the longevity of the restorative material. This review is based on latest technology and the material used in dentistry which provides an overview of basic principles based on dental abrasives. The overall aim is to provide the awareness and broader knowledge of the principles and tools available to produce an optimal surface finishing and Polishing in dental restoratives techniques.

**Keyword:**

Abrasive Material, Finishing and Polishing, Surface Roughness.

**INTRODUCTION**

It is important to understand that the quality of aesthetic results the long term success of the restoration especially in the field of cosmetic dentistry. Finishing and polishing materials are two abrasive procedures which play an important role to develop the proper anatomy and glossiness of the tooth surfaces<sup>1</sup>.

Dental abrasive (DA) can be classified into three<sup>2</sup>: i) Finishing ii) Polishing and iii) Cleansing abrasive. Finishing abrasives are generally hard, coarse and use primarily for maintain and developed the desire contour of a restoration, tooth preparation and the removal of irregularities from the surfaces<sup>2</sup>. Polishing abrasive have fine particles and are generally less hard than the abrasive used for finishing purposes. The polishing abrasive are responsible to smooth the surfaces which roughened typically by finishing abrasive<sup>2</sup>, whereas the Cleansing abrasives are generally soft and the particles are small in sizes which are intended to remove softer material that adhere to enamel or restorative material substrate<sup>2</sup>.

Proper finishing and polishing of dental restorations are important aspects in clinical restorative procedures<sup>3-4</sup>, because it may affect the clinical performance like, plaque adhesion, discoloration and fatigue of the

restoration. It may also create psychological problems like patients' consciousness of the restorations with possible irritation of the tongue, lips, and cheeks; this may also a matter of concern<sup>5-6</sup>.

Sometime the finishing and polishing materials are alarming for health because the airborne particle of abrasive may create a problem to the dental personnel, most commonly silica may cause Silicosis also called "GRINDER'S DISEASE"<sup>3</sup>. Silicosis is a debilitating sometime fatal, yet preventable occupational lung disease caused by inhaling repairable crystalline silica dust although crystalline silica exposure and silicosis have been associated historically with working in mining, quarrying, sand blasting, masonry, founding, and ceramics, certain materials and processes used in dental laboratories also place technicians and dentist at risk for silicosis<sup>7-8</sup>. The Sentinel Event Notification Systems for Occupational Risks (SENSOR) surveillance program was identified through the state's Occupational Lung Disease Registry, and the case in Massachusetts was identified through the state's Occupational Lung Disease<sup>9</sup>.

Aerosol hazard may be controlled in three ways: 1) Use of adequate infection control procedure such as water spray, high volume suction 2) the Personal protection such as: Safety glasses and Disposable face



mask 3) Adequate ventilation: this procedure efficiently remove any residual particle from the air<sup>3</sup>.

The quality of surface finish and polish can be measure by surface roughness test like Profilometer, which is an optical microscope used to measure surface roughness for invitro investigations<sup>10</sup>. Another investigation like Scanning electron microscope (SEM) used to measure the initial surface roughness (baseline)<sup>10</sup>.

The property of the abrasive effects the cutting efficiency include the size, shape, hardness, speed and pressure of the abrasive material<sup>11</sup>. Hardness is an important factor that affects the finishing procedure in which the surface measurement of the resistance of one material to be plastically deformed by intending or scratching another material<sup>1</sup>. Hardness value can be measure by different scale i.e. Moh's scale, Knoop and Vickers hardness<sup>4</sup>.

Finished surface is directly related to the size and shape of the abrasive particle. Irregular shape, spherical object and sharp edges are to enhance the cutting efficiency. Larger particle abrade a surface more rapidly than small one<sup>3</sup>.

Use of greater force results more rapid removal of material, therefore, Care must be taken because pressure create additional heat and raise the temperature causes physical changes<sup>4</sup>, faster the speed resulting higher the cutting rates. Polishing at 10,000 rpm did not appear to substantially strengthen or weaken the ceramic specimens, whereas at 20,000 rpm reduced flexural strength of the ceramic bars<sup>3</sup>.

## LITERATURE REVIEW:

Abrasive materials may classify according to the natural sources and manufacturing<sup>3</sup>. Arkansas stone is one of the examples of natural form which is semi-translucent, light gray in color and used for grinding of tooth enamel and metal alloys<sup>4</sup>. The most common hardest form of stone is diamond which is a transparent, colorless mineral composed of carbon and also called a super abrasive. It's supplied in the form of rotary instrument and flexible metal-backed abrasive strips. Diamond polishing pastes are used on ceramic and resin based composite material<sup>2</sup>. These abrasives usually use with the water to avoid excessive heat buildup and clogging of the particle by the abrasion

debris<sup>3</sup>. It is also used in the manufacturing of diamond saws, wheels, and burs. There are some other natural form of stone which are commonly used as abrasive material like Corundum, emery, Garnet, Pumice. Corundum is the second hardest material and the mineral form of its aluminum Corundum oxide, this usually white in color and used for grinding the metal alloy known as white stone<sup>4</sup>. The pumice is composed of silica dioxide ( $\text{SiO}_2$ ) and it is used for the polishing of tooth enamel, gold foil, dental amalgam, and acrylic resins<sup>3</sup>.

The another manufacturing form of stone is Silicon carbide which is extremely hard and brittle and is available in coated disk as vitreous-bonded and rubber-bonded instrument<sup>4</sup>. These kind of abrasives are responsible for the finishing of metal alloys, composite and ceramic<sup>4</sup>. Rouge is a red color polishing agent available in powder form which is composed of iron oxide and use to polish high noble metal alloys and gold<sup>4</sup> whereas the tin oxide ( $\text{SnO}_2$ ) is a pure white powder used extensively as a final polishing agent for teeth and metallic restoration in the mouth. It can be mixed with water, alcohol or glycerin<sup>2</sup>.

According to Jefferies [1998], dental abrasive instrument can be broadly classified into four groups<sup>11</sup>:

- \* Coated abrasives, e.g. Aluminum oxide abrasive discs;
- \* Cutting devices, e.g. carbide burs;
- \* Bonded abrasives (elastic, e.g. rubber cups; rigid, e.g. white stones);
- \* Loose abrasives, e.g. polishing pastes.

Bonded abrasive consist of abrasive particle that are incorporated through a binder such as points, wheels separating disk and coated thin disk. Particles are bounded by four general method<sup>3</sup>:

1. Sintering is strongest type because abrasive fused together
2. Vitreous bonding fused with ceramic or glassy matrix
3. Resinoid bonding cold pressed or hot pressed and heat to resin
4. Rubber bonding which is made similar to resinoid bonding.

Abrasive disk are used for gross reduction, contouring, finishing and polishing of restoration surfaces and not



losing their properties in the saliva<sup>12</sup>. Abrasive disk are available in different sizes, shape and diameter. Abrasive strips are also available to smooth and polish the proximal surface of a tooth<sup>3</sup>.

The motion of abrasive instrument is classified as<sup>3</sup>

- I. Rotar
- II. Planar
- III. Reciprocating hand piece.

All are used to remove overhangs, finish sub gingival margins and to create embrasures.<sup>3</sup>

Dentifrices are available in the form<sup>3</sup> of i.e. Tooth pastes, Gel, and powder and its primarily perform three important functions<sup>1</sup>. 1) Abrasive and detergent action provide more efficient removal of debris, plaque, stained pellicle, compared with tooth brush. 2) Smooth and polish surface of a tooth is responsible to provide the increased light reflectance and superior aesthetic appearance. 3) Its act as a vehicle for the delivery of therapeutic agent.

Hard deposits like stains are much more difficult to remove from the dentures. Many methods are employed to remove but the most common and easy method is Soaking or brushing the denture on a daily basis at home. If denture cleansers (Table 1) are properly used, the accumulation of dental plaque and stains can be controlled effectively<sup>2</sup>.

**Table 1: TYPES OF COMERCIAL DENTURE CLEANSERS<sup>2</sup>**

TYPES OF CLEANSER	COMPOSITION
I. Tablet form of abrasive enzyme...	Mutanase dextranase, protease <sup>13</sup>
II. Denture abrasive cream (split tube)...	baking soda and peroxide <sup>14</sup>
III. Alkaline hypochlorite .....	Sodium hypochlorite sodium phosphate <sup>2</sup>
IV. Per oxide denture cleanser .....	Hydrogen per oxide <sup>15</sup>
V. Dilute acid .....	Citric acid isopropyl alcohol <sup>2</sup>

For the finishing of dental amalgam we can use the abrasive polishing rubber points (brown, green and blue), followed by polishing with a smooth rubber cup using pumice paste, and then used a Sweeney brush with a paste of zinc oxide.<sup>16</sup>

Gold indirect restorations may finish and polish by careful control to avoid the over finishing of margin and contour. The casting may scrub with alcohol to prepare its surface for the cementation<sup>2</sup>.

Resin-based restorations for anterior teeth such as class III, IV, V, as well as class I and II for posterior direct composite resin restorations need more attention to increase the duration of life span. Polishing requires specific instrumentation and techniques even with the minimal mechanical finishing may result in trauma such as micro cracks to the resin surface due to heat and vibration from finishing instruments. Shade matching and perception can also be altered, if the surface texture of the restoration is compromised and long-term wear resistance in the restoration may diminished from increased surface roughness<sup>17-18</sup>.

Zirconia conditioning with the experimental hot etching solution may enhance ceramic roughness and improve the surface area available for adhesion allowing the formation of micromechanical retention<sup>19</sup>. Air-abrasion plays an important role in bonding to ceramics, therefore, without air-abrasion no durable bonding to zirconia ceramic was achieved regardless of using primers<sup>20</sup>.

Various finishing and polishing materials have been used for many years, this includes: tungsten carbide finishing burs, fine to extra-fine diamond finishing burs, stones, impregnated abrasive rubber or silicone discs and wheels, silicone-carbide coated or aluminum-oxide-coated abrasive discs, polishing pastes. and abrasives embedded in resin polishing points. These finishing and polishing devices are popular among clinicians and have been used for the finishing of composite resins for many years.

More recently a liquid polish system (BisCover, Bisco, Inc., Schaumburg, IL, USA) has been introduced with the aim of reducing the need for manual polishing. BisCover is a light-cured resin formulation used to seal restorations while leaving a smooth polished surface without leaving a sticky, air-inhibited layer<sup>18</sup>. The composition of different finishing and polishing materials are as shown in table 2:



**Table 2: The composition, brand name, finishing and polishing material for composite**

Finishing and Polishing Material	Composition	Brand Name	References
Tungsten Carbide Bur	CF246 Carbide (30-fluted)	Diatech Dental AC, Heerbrugg Switzerland	21
Fine.extra fine Bur	2135f, 135ff Diamond	KG Sorensen	22
Sof-Lex XT Polishing Discs	Coarse, medium, fine, superfine aluminum oxide disc	3M Dental Products, St. Paul, MN 55144 USA	23
Enhance Disc with polishing paste	Aluminum oxide disc, Fine aluminum oxide paste, Extra-fine aluminum oxide paste	Dentsply-DeTrey GmbH D 78467, Konstanz, Germany	21
Edenta Finishing Kit	Extra-fine finishing diamond C850.012, Arkansas stone ASO1, Yellow rubber cup 0735	Edenta AG, Hauptstrasse 7, CH-9434 AU/SG Switzerland	21
BisCover Liquid Polish	Ethoxylated Bisphenol A Diacrylate, Urethane acrylate ester, Polyethyleneglycol Diacrylate	Bisco Inc. 110 W Irving Park Rd., Schaumburg, IL USA	23

Dental ceramics are able to mimic natural teeth due to their excellent physical properties such as esthetics, biocompatibility, low thermal conductivity, and wear resistance. Because of these features, dental ceramics have been extensively used in several rehabilitation procedures, including inlays, onlays, crowns, and porcelain veneers<sup>24-25</sup>. In the dental laboratory, porcelain is fired and traditionally subjected to a "glaze" that results in a surface texture and appearance resembling that of a natural tooth surface, however, the dentist often removes part of the glazed surface after cementation of the ceramic restoration because of the need for occlusal adjustment, correction of inadequate

contour, or improvement of esthetics<sup>26-27</sup>. This has to be important that to avoid any kind of occlusal adjustment to prevent the glazed surface which lead to be long term smoothness and durability of the restoration.

### DISCUSSION:

Surface quality is an important parameter that influences the clinical behavior of dental Restorations. Inadequate surface texture of a restoration can cause gingival irritation, surface staining, plaque accumulation, and secondary caries<sup>28</sup>. A variety of materials and techniques have been introduced for contouring, finishing, and polishing but there is not a single universally accepted method for finishing procedures<sup>29</sup>. Different method is used to measure the surface roughness of restoration material like mechanical profilometers, although it provides two-dimensional information which is responsible for an arithmetic average roughness which is calculated and used to represent various material Polishing surface combinations in treatment decisions. Other method which is used to measure surface roughness is Scanning electron microscope (SEM)<sup>10</sup>. There is a significant relationship between the methods used for the finishing and polishing procedures and the content of the material itself with regard to the achieved surface finish. High-quality finishing and polishing of dental material are important steps to enhance both the esthetics and longevity of restored teeth. Unfortunately, polishing is complicated by the heterogeneous nature of these materials. For restorative materials, it is generally inadvisable to polish the interfacial marginal surface immediately after light-activation or setting. The polishing procedures should be carried out not less than 24 hour.<sup>30</sup>

Both surface gloss and surface roughness were material-dependent and influenced by the polishing time and applied force. As gloss and roughness proved to be closely associated with each other, gloss assessment may be a sufficient method to screen materials with regard to their polishability. The lifetime of porcelain prostheses can be improved by removing the micro-fractured layer with final polishing.<sup>31</sup>

Based on the different studies, the range in surface roughness of different intraoral hard surfaces was found to be very wide, and the affect of dental treatments on the surface roughness is material-



dependent. Some clinical techniques result in a very smooth surface (compressing of composites against matrices), whereas others made the rather rough surface (application of hand instruments on gold). These findings show that every dental material needs its own treatment modality in order to obtain and maintain a surface as smooth as possible.

### CONCLUSION:

Finishing and polishing technique are important factors for the success of any restoration used in the mouth. The procedure should begin with the coarse abrasive and end with fine ones. Clinically it is easier to control the rate of the speed rather than pressure and care must be taken to avoid over finishing and heating the restorations. The uses of cleansing and dentifrices should be carefully considered before the application on the tooth structure or restorative material.

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