Republic of Iraq
Ministry of Higher Education and Scientific Research
University of Mosul
College of Dentistry

Finishing and Polishing of Direct Composite Restoration

A Project Submitted to
The College of Dentistry, University of Mosul, Department of Conservative Dentistry in Partial Fulfillment for the Bachelor of Dental Surgery.

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February , 2025

Certification of the Supervisor

I certify that this project entitled "**Finishing and polishing of direct composite restoration**" was prepared by the fifth-year student **Anmar Mohammed Hussein** under my supervision at the College of Dentistry/University of Mosul in partial fulfilment of the graduation requirements for the Bachelor Degree in Dentistry.

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ACKNOWLEDGEMENTS **I**

First and foremost, I thank "Almighty Allah" for giving me the courage, willingness and patience to finish my thesis, and I also pray that His blessings upon me continue throughout my life, praying and peace be upon His Prophet Mohammed and his Household.

I am deeply indebted to the College of Dentistry, University of Mosul, particulary for the dean Asst. Prof. Dr. Rayan S. Hameed .

The head of the conservative dentistry Asst. Prof, Dr. Alaa Edrees Dawood, has my sincere gratitude for his scientific support, excellent guidance, caring, and continuous helpful advices throughout my master program. To my supervisor Asst. prof. Dr. Fanar Turki Al-jadwaa, I would like to convey my profound appreciation and respect for her excellent guidance, parental care, patience, high ethics, support, and advise. Her guidance and encouragement have been invaluable in helping me understand and complete this project.

Finally, I extremely grateful to my parents for their love, prayers, caring and sacrifices for educating and preparing me for my future.

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Table of content

List of figures **III**

INTRODUCTION 1

Introduction

Resins have been increasingly used as composites in direct restorations of anterior and posterior teeth for their excellent esthetics, improved mechanical properties, strong bonding with tooth tissues, and patient preference for amalgam (Lee et al., 2008).

In order to achieve optimal aesthetic results, appropriate finishing and polishing procedures must be available. However, successful techniques require precise pre-selection and avoidance of over-sizing of the composite material (Mopper, 2011).

Finishing the process of shaping and smoothing the restoration to fit the natural tooth anatomy and removing excess material.

Polishing is an important process that polishes the surface to a high gloss and enamel-like texture.

Smoothness It is of great importance not only from an aesthetic point of view but also to prevent problems such as plaque buildup, stains, gum irritation, recurrent tooth decay, and erosion (Silva et al., 2021).

There are a variety of finishing and polishing tools and discs to achieve the desired surface smoothness and gloss..

Aim of the study

This work is carried out in order to identify the most effective finishing and polishing techniques to achieve a smooth and wear-resistant surface on direct composite restorations.

CHAPTER ONE

Chapter One

Finishing and polishing restorations are essential steps to ensure long-term success and patient satisfaction. There are several compelling reasons why careful attention to these procedures is essential (Jeffries, 2007).

1.1 Importance of finishing and polishing:

1.Improve margins: Excess flashing is removed, resulting in a well-defined and restoration border.

2. Reduce the risk of fracture: Rough surfaces are more susceptible to fracture than rough surfaces.

3. Reduce surface failure: Imperfections increase the surface area, making them more susceptible to wear and tear. Polishing reduces this vulnerability.

4. Reduce plaque buildup: Smooth surfaces make it more difficult for plaque to adhere to, which contributes to improved oral hygiene.

5. Enhance oral function: Polished surfaces allow food to slide more easily across tooth surfaces, which promotes effective chewing.

6. Facilitate oral hygiene practices: Smooth surfaces allow all restoration including margins and interproximal areas, to be cleaned with brushing and flossing.

7. Reduced wear and tear: Soft restoration materials reduce wear and tear on opposing and adjacent teeth, thus preserving their longevity.

8. Aesthetic appearance: Polished, light-reflecting restorations improve the naturalness and visual appeal of the patient.

1.2 Classification of finishing and polishing instruments

Finishing and polishing devices and instruments can be classified as:

1- Diamond finishing burs.
2- Carbide finishing burs.
3- Finishing stones.
4- Finishing discs.
5- Strips.
6- Oxide Cups and Points.
7- Polishing paste.
8- Abrasive-impregnated brushes and felt devices.

1.2.1 Diamond finishing burs

The first use of diamond tools in dentistry was in the United States in 1942, even before the widespread use of carbide-tipped burs. Diamond burs were specifically used to contour, modify, and smooth restorative materials, such as composites and porcelain. Unlike their carbide-tipped counterparts, diamond burs rely primarily on abrasive action rather than blade cutting (Figure 1).

Figure 1: Diamond finishing burs

These burs feature industrial diamond particles embedded into their working surfaces. Each diamond instrument consists of three main parts:

- **Metal shank or blank**: This forms the base of the bur.
- **Powdered or particulate diamond abrasive**: These tiny iamond particles are responsible for the bur's abrasive capabilities.
- **Metallic bonding material**: This special material securely bonds the diamond powder onto the shank.

Diamond burs come in a wide variety of shapes and sizes, and the grit size (ranging from 7 to 50 µm) can vary depending on the manufacturer. Typically, dentists use them in a sequence, starting with a coarser grit and gradually progressing to a finer one for a smoother finish. (Jeffries, 2007).

It's crucial to always use diamond burs with water spray to prevent overheating and ensure optimal performance. Additionally, they should be operated within the lower range of the high-speed turbine's speed settings

Diamond finishing burs are highly efficient in rates of materials removal, but leave a significantly rough surface, which requires further finishing and polishing.

As a result, other finishing and polishing instruments most be used flow to Diamond finishing bur (Jeffries, 2007).s, such as:

- Fluted carbide finishing burs
- Coated abrasive discs
- Bonded abrasive rubber polishing instruments
- Loose abrasive polishing pastes.

1.2.2 Carbide finishing burs

Carbide finishing burs are a popular choice for contouring and finishing various restorative materials and tooth structures due to their versatility and relative gentleness on soft tissue (Figure 2).

Available in a wide range of shapes for precise contouring.

Typically have 8 to 40 fluted blades, with 12, 20, or 40 blades being the most common.

Figure 2: Carbide finishing burs

Advantages :

1. Versatility: The variety of shapes allows for precise shaping and finishing of different materials.

2.Reduced risk of soft tissue damage: Their gentler abrasion makes them safer for use near soft tissues.

3.Less abrasive compared to diamond burs or bonded abrasive instruments, making them kinder to soft tissue at the gingival margin (Jefferies, 2007).

1.2.3 Finishing stones

Finishing stones are essential tools for dentists, offering precise control and a gentler touch compared to diamond burs (Figure 3).

figure 3: Finishing stones

Made of abrasive particles (silicon carbide or aluminum oxide) bonded together for a cohesive structure.

Color indicates the abrasive: Green for silicon carbide, white for aluminum oxide .Mounted on a rotary metal shank for use with dental handpieces. (Jefferies, 2007).

Function:

Used for contouring and finishing various dental restorations.

Offer lower cutting efficiency compared to diamond burs, reducing the risk of over-removal of material.

Available in coarse, medium, and fine grades depending on the desired level of abrasiveness (Jefferies, 2007).

Advantages:

1.Precise control: The variety of shapes and grit sizes allows for targeted shaping and finishing.

2.Gentle on tooth structure: Less aggressive than diamond burs, making them suitable for delicate work near enamel and soft tissues.

3.Durable: With proper care, they can last for a long time.

1.2.4 Finishing discs

Finishing discs provide versatility and efficiency for shaping and polishing various tooth surfaces.

Contouring all tooth surfaces: This includes shaping and refining both facial (labial) and lingual surfaces, cervical areas, incisal edges, and marginal ridges.

Bulk reduction of excess material: Discs can efficiently remove excess composite material.

1.2.4.1 Four-Disc Grit Sequence (Aluminum-Oxide Discs):

This sequence gradually reduces roughness for a smooth, polished finish Use under low-speed/high-torque (7 rpm to 30,000 rpm) for optimal control. *(Mopper, 2011).*

1. **Coarse:** This is the stiffest disc and is used in conjunction with multi-fluted finishing burs for **gross contouring and shaping**. When used with moderate pressure, the coarse disc can effectively blend the composite with the tooth surface, eliminating the white line and raised margins.

2. **Medium:** The medium grit disc is used to further **smooth the restoration surface**. It removes any remaining imperfections and marks left by the coarse disc.

3. **Fine:** This stage marks the beginning of the actual polishing process. The fine grit disc removes even finer imperfections while adding a subtle shine to the restoration.

4. **Superfine:** The superfine grit disc is the final step, further refining the surface smoothness to achieve a highly polished restoration (Figure 4).

figure 4: Finishing discs

1.2.5 Strips

Diamond Strips:

These strips initiate the interproximal finishing process while preserving the interproximal contact's integrity.

- **Larger grit (45 µm):** Used for interproximal stripping of natural teeth or for gross removal of material.

- **Smaller grits (15 µm and 30 µm):** Employed to initiate interproximal polishing *(Mopper, 2011)* (Figure 5).

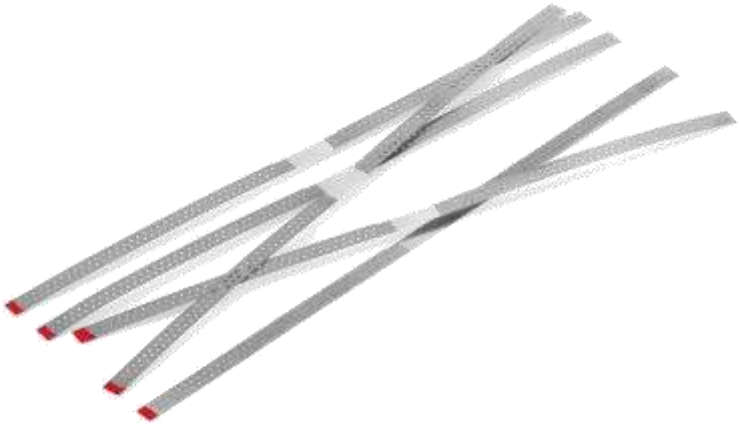


Figure 5: Diamond Strips

1.2.5.1 Aluminum Oxide Strips:

These strips are used to contour and polish interproximal areas. High-quality strips effectively remove stubborn stains and achieve a high polish without damaging soft tissues. They should be thin and maintain their integrity during interproximal contact manipulation *(Mopper, 2011)* (Figure 6).

Figure 6: Aluminum Oxide Strips

1.2.6 Aluminum Oxide Cups and Points

Aluminum oxide cups and points are used for various finishing and polishing tasks in dentistry (Figure 7).

1.2.6.1 Applications of Aluminum oxide Cups:

1. Polishing gingival margins.
2. Achieving labial characterization and anatomy.
3. Reaching specific areas like the gingival third and margins of anterior teeth *(Mopper, 2011).*

1.2.6.2 Applications Aluminum Oxide Points: *(Mopper, 2011).*

1. Creating labial grooves in veneers.
2. *Finishing and polishing:*
3. Occlusal surfaces of posterior teeth.
4. Lingual surfaces of anterior teeth

Figure 7: Aluminum Oxide Cups and

1.2.7 Polishing Paste for Composites:

Polishing paste, used in combination with a polishing cup, offers an alternative technique for achieving a smooth and lustrous finish on composite restorations. Used in the final step of finishing and polishing.

Can be combined with felt discs and points for polishing various materials, including composites, metals, porcelain, and natural teeth after prophylaxis *(Mopper, 2011)* (Figure 8).

Micro-filled composites: Use a paste specifically designed for them, such as Prisma-Gloss (DENTSPLY Caulk).

Hybrid composites: Employ a combination of fine and extra-fine pastes, like using Prisma-Gloss followed by Prisma-Gloss Extra-fine *(Jefferies, 2007).*

Figure 8: Aluminum Oxide polishing

1.2.8 Abrasive-Impregnated Brushes and Felt Devices

In the late 1990s, abrasive-impregnated, latch-type polishing brushes were introduced to dental professionals. These brushes offer several advantages for polishing dental restorations (Figure 9).

Applications of Abrasive-Impregnated Brushes and Felt Devices :

Variety of shapes: These brushes come in various shapes, including pointed and cup-shaped, allowing access to different tooth surfaces.

Abrasive particles: The polymer bristles of the brushes are impregnated with various abrasive polishing particles, enabling effective polishing.

Targeted application: The brushes are specifically designed to reach into intricate areas like grooves, fissures, and interproximal regions of ceramic and resin composite restorations. This targeted approach helps prevent unintended removal of crucial anatomical features during the polishing process *(Jefferies, 2007).*

Figure 9: Abrasive-Impregnated Brushes and

1.3 Polishing Systems for Composite Restorations

A Multi-Step approach recommended, dental professionals have three main options for polishing composite restorations: *(Heintze et al., 2019).*

Three-step systems: These comprehensive systems include a finisher for contouring, a polisher for initial polishing, and a high-gloss polisher for achieving a final, smooth surface.

Two-step systems: These offer a finisher and a polisher, combining some steps for quicker treatment.

One-step systems: These aim to complete both finishing and polishing in a single step.

One- or two-step systems may be suitable for quick polishing, research suggests using a comprehensive three-step system for achieving the best long-term results *(Babina et al., 2020).*

The dentists were allowed to use all shapes of the polishing system (small flame, large flame, cup, lens) (Figure 10).

Figure 10: Optra Pol polishing system (from left to right): small flame, large flame, cup, lens.

1.4 Effect of finishing and polishing on discoloration of the composite restoration:

Staining or discoloration is one of the primary reasons for replacement of composite restorations. Various finishing and polishing techniques have been examined with different types of composite resins in order to produce a smooth surface. Discoloration of tooth-colored, resin-based materials may be caused by intrinsic and extrinsic factors *(ChungK,1994).*

1.4.1 Intrinsic factors: Discoloration of the resin material itself, such as the alteration of the resin matrix and of the interface of matrix and fillers. Every component may contribute to this phenomenon.

1.4.2 Extrinsic factors: Staining by adsorption or absorption of colorants as a result of contamination from exogenous sources *(Guler et al., 2008).*

1.5 Types of Composite Materials and Polishability:

Micro-fill: In terms of color stability and polishability, micro-fill is considered the best composite material for long-term restorations. It provides the best polish, surface smoothness, and wear resistance.

Nano-hybrids or nano-fills: These materials offer good initial surface smoothness and shine, but lose luster and wear resistance over time.

Micro-hybrids: They are the least polishable and most susceptible to staining among the three main types *(Barucci-Pfister and Gohring, 2009).*

Recommendations for Achieving a Beautiful and Long-lasting Polish:

Use a microfill composite as the final layer for superior polish,smoothness, and wear resistance *(Barucci-Pfister and Gohring, 2009)* (Figure 11)

Figure 11: Before and after finishing and polishing on the color of composite restoration

1.6 Effect of surface sealant on composite restoration:

Liquid polishers (surface sealant) are low viscosity fluid resins that provide a gloss over composite resin restoration, improving final esthetics and reducing micro-leakage at composite margin *(Owens BM, Johnson WW,2006).*

1.6.1 Advantages of Surface Sealants:

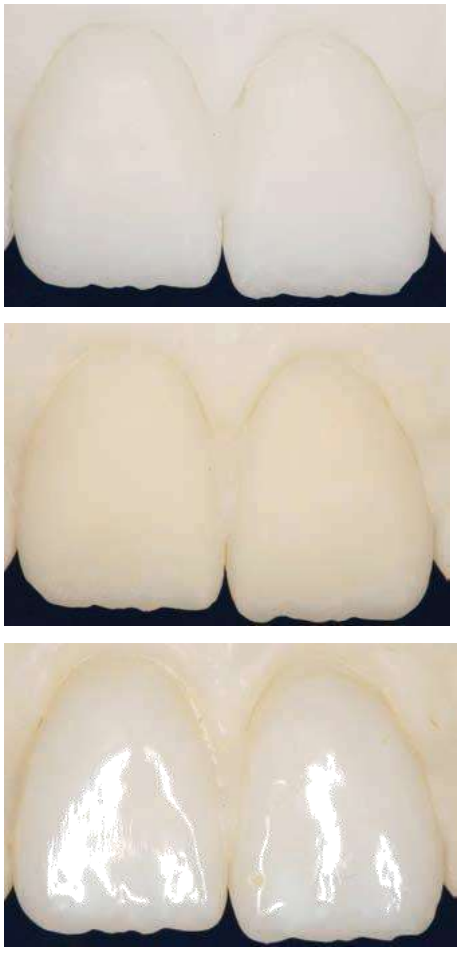
Reduced Microleakage : Microleakage, a major contributor to restoration failure, occurs when bacteria and fluids infiltrate the microscopic gap between the restoration and the tooth structure. Surface sealants effectively fill these micro-gaps, minimizing microleakage and enhancing the long-term success of the restoration *(Jefferies, 2007).*

Improved Wear Resistance: Studies have shown that surface sealants applied to large-particle composites can significantly reduce wear, with some reports indicating up to 50% less wear compared to untreated restorations. This benefit can extend for up to two years *(Blank, 2008).*

Enhanced Stain Resistance and Shade Stability: In vitro studies have demonstrated the effectiveness of surface sealants in preventing stain penetration and discoloration of composite resins, leading to greater shade stability (figure 12).

1.6.2 several factors should be considered ,when choosing a surface sealant (Liquid polish),including:

- Wear resistance.
- Stain resistance.
- Clarity (clear polish will not alter the appearance of the shade of the finished restoration).
- Ability to fluorescence (if desired).
- Delivery system (Figure 13).



Resin-based composite
before immersion in coffee

Resin-based composite
after immersion in coffee

Resin-based composite
after immersion in coffee
with prior application of liquid polish

Figure 12: In vitro stain resistance using liquid polisher

1.7 Effect of wet and dry finishing and polishing on surface hardness and roughness of composite restoration

Several studies have evaluated the effect of wet and dry finishing and polishing on surface roughness and hardness of composites, finishing and polishing without water coolant increased the surface roughness and hardness of composite sample *(Başeren, 2004; Jung et al., 2007).*

1.7.1 Impact on Surface Roughness:

Several studies have reported that dry finishing and polishing generally leads to higher surface roughness compared to wet methods *(Başeren, 2004; Jung et al., 2007).* This observation can be attributed to several factors:

1. **Embedding of abrasive particles**: During dry finishing and polishing, abrasive particles separated from the tool may become embedded in the composite surface, increasing its roughness.
2. **Decreased tool efficiency**: Accumulation of separated particles on the polishing tool can hinder its ability to effectively smooth the surface.
3. **Heat generation**: Dry finishing and polishing generate higher heat, potentially degrading the filler/matrix bond and causing filler particles to detach from the matrix, ultimately contributing to increased roughness *(Nasoohi et al., 2017).*

Surface roughness, as an indicator of finishing and polishing efficacy, can be assessed using both qualitative and quantitative methods *(Endo et al., 2010).*

According to existing literature, the clinically acceptable final roughness after polishing should be lower than 0.2 micrometers *(St-Pierre et al., 2019)*. This threshold helps prevent plaque accumulation, thereby promoting long-term restoration longevity.

CHAPTER TWO

Chapter Two

Discussion:

Finishing and polishing procedure is a significant step to achieve successful restorations clinically. The type of abrasive being used, its properties, and the material being abraded are some significant properties affecting the process of abrasion. Finishing and polishing is a guided procedure which follows a sequence descending from coarse abrasives to fine abrasives to achieve mirror like polish. Clinically the rate of abrasion is easier to manage in terms of speed in comparison to the pressure. One must keep in mind to avoid over finishing margins and contours of restorations and to abstain from overheating. Adoption of a definite sequence is the key factor in finishing and polishing of each restoration. The objective of any new office technology or innovation is to accelerate the workflow process, giving clinicians a definite asset – additional time – to concentrate on and deliver the precision.

CHAPTER THREE

Chapter Three

Conclusion:

1- This research project comprehensively explored the crucial role of finishing and polishing procedures in achieving successful and long-lasting direct composite restorations.

2- The research also looks into various finishing and polishing instruments and techniques, along with the influence of factors like composite type and polishing systems on the final outcome.

3- Furthermore, the project emphasizes the benefits of surface sealants in reducing microleakage, enhancing wear resistance, and minimizing staining.


FINISHING
Class III & IV


POLISHING
Class III, IV &
Rubber Points
Wheel


POLISHING
Class III & IV
Rubber Points
Flame / Torpedo

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