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Polishing devices and techniques on Resin-Based composite restorations – Systematic review

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Trabalho apresentado à Universidade Fernando Pessoa
como parte dos requisitos para obtenção do
grau de Mestre em Medicina Dentária sob a orientação
da Prof.ª Doutora Patrícia Manarte Monteiro

RESUMO

Objetivo: Esta revisão descreve os principais sistemas de polimento ("Um passo" e "Vários passos") e analisa evidências *in vitro* sobre procedimentos técnicos.

Desenvolvimento: PubMed e B-on foram usados para identificar os estudos "*in vitro*" sobre técnicas de polimento e o modelo PRISMA foi aplicado para a seleção. Os critérios de inclusão foram: artigos redigidos em inglês, publicados entre os anos 2010 e 2020, estudos "*in vitro*" que avaliavam a rugosidade superficial (RS), o brilho e a microdureza (MD) em resinas compostas. As instruções de utilização e as fichas de segurança foram recolhidas *online* dos fabricantes.

Conclusões: Vinte e oito sistemas de polimento foram identificados: 8 de "Um-passo" e 20 de "Vários-passos". Dezasseis estudos *in vitro* foram incluídos; apresentados e descritos dez sistemas de polimento e seus protocolos. A RS, o brilho e a MD variam de acordo com a técnica usada. É essencial consultar o manual de instruções de cada resina composta e do sistema de polimento de forma a fazer uma escolha racional.

Palavras-Chave: *composite resin, materials analysis, polishing techniques, polishing systems*.

ABSTRACT

Aims: This review describes the main polishing systems (Single- and Multi-Step) commercially available and analyses *in vitro* evidence about its technical procedures.

Development: PubMed and B-on were used to identify all *in vitro* studies about different polishing techniques and PRISMA selection process was applied. Inclusion criteria were: Only papers written in English, published between the years 2010 and 2020 and, in vitro studies that evaluated surface roughness (SR), surface gloss (SG) and microhardness (MH) on different RBC. Directions for use (DFU) and Safety data sheet (SDS), were accessed directly from polishing manufacturers' online sites.

Conclusion: Twenty-eight different polishing systems: 8 Single-Step (1S) and 20 Multi-Step (2S, 3S, 4S…) were found as commercially available. 16 *in vitro* studies were included. Four 1S and six Multi-Step devices and their technical protocols described. SR, SG and MH vary according to techniques. It is essential to read the DFUs of each RBC and polishing system to make a rationale choice.

Keywords: *composite* resin, *materials analysis, polishing techniques, polishing systems*.

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“If you can´t fly, then run,
If you can’t run, then walk,
If you can’t walk, then crawl,
But, whatever you do,
You have to keep
Moving forward.”
– Martin Luther King Jr.

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LIST OF ABREVIATIONS

AFM – Atomic force microscope

Bis-EMA – Ethoxylatedbisphenol-A-dimethacrylate

Bis-GMA – Bisphenol A-glycidyl methacrylate

F/P – Finishing/Polishing systems

GU – Gloss Units

HEMA – 2-Hydroxyethyl methacrylate

DFU – Directions for use

MH – Microhardness

NF – Not found

NM – Not mentioned

µm – Micrometres

P – Polishing

Ra – Roughness

RBC – Resin-based composite(s)

rpm – Rotation per minute

s – seconds

SDS – Safety Data Sheet

SEM - Scanning electron microscopy

SG – Surface gloss

SR – Surface roughness

TEGDMA – Triethylene glycol dimethacrylate

UDMA – Urethane dimethacrylate

1S – Single-Step

2S/3S/4S – Two-steps/Three-steps/Four-steps/...

I. INTRODUCTION

The main goal in restorative dentistry is to increase the lifetime of dental restorations. Surface smoothness and gloss are keys for a successful resin-based composite (RBC) restoration. In way of achievement of this goal there are three important and different steps that are used to finalize composite restoration: contouring, finishing and polishing (Antonson *et al.*, 2011). Noticeably, polished composite surface ensures aesthetic and functional attributes and significantly decreases the risk of bacterial adherence and subsequent colonization (Pereira *et al.*, 2011).

One of the biggest problems affecting the surface properties and long-term clinical success of resin-based composite restorations is the surface roughness (Avsar, Yuzbasioglu and Sarac, 2015; Kemaloglu, Karacolak and Turkun, 2017). A significant and positive correlation was found between surface roughness and bacteria adhesion (Aykent et al., 2010). Less roughness, smoother the surface of RBC– less adherence of the biofilm (Marghalani, 2010). Additionally, a smooth surface adds comfort to the patient, since a change in roughness on the order of only 0,3 µm can be detected by the tip of the tongue (Wheeler, Deb and Millar, 2020).

Poor aesthetic of the restorations, increased plaque and malignant microorganisms retention, surface discoloration, tissue inflammation, secondary caries and, even, periodontal disease (with roughness values above 0.2 µm - Aytac *et al.*, 2016) are some conditions that may be evident of a non-existent polishing procedures after applying a RBC restoration (Pereira *et al.*, 2011; Ereifej, Oweis and Eliades, 2013; Yildiz *et al.*, 2015). So, it is important to develop a proper polishing of the RBC restorations, as it is a step that enhance the aesthetics, functional, biological material properties and clinical longevity (Alfawaz, 2017).

Several studies reported that a smoothest surface can be achieved using an acetate strip covering the RBC during the light-curing process (Avsar, Yuzbasioglu and Sarac, 2015; Cazzaniga et al., 2017; Kemaloglu, Karacolak and Turkun, 2017). However, the surface result is produced as good as the acetate matrix itself; any imperfections present are also reproduced at the surface of the restorations and, at the end, it is rich in structures that easily accumulate organic matter (Avsar, Yuzbasioglu and Sarac, 2015; Sahbaz *et al.*, 2016). Resultantly, finishing and polishing the surface of a restoration until achieve a high gloss result is almost an obligatory act to be

done on behalf of RBC low surface properties and higher organic content and also, to reproduce the anatomical shape and occlusions adjustments of the restored tooth (Kemaloglu, Karacolak and Turkun, 2017).
The composition of RBC and the polishing system used plays an important role in influencing surface roughness, surface gloss and microhardness (Nithya *et al.*, 2020).

Therefore, because there is a large array of polishing systems and different techniques available at the markets nowadays, it turns to be imperative to search for the criteria of its selection and clinical appliance, considering different the types of RBC selected. As a result, this review aims to describe the main polishing systems (Single-Step and Multi-Step), the available technical steps and eligible criteria that will help at the selection of clinical polishing devices and techniques. Also intends to analyse descriptive scientific evidence *in vitro* studies about polishing systems technical procedures.

1.1 Materials and Methods

PRISMA (Preferred Reporting Items for Systematic Review and Meta-Analysis) selection process (**Figure 1**) was used in this review. Electronic databases as PubMed and B-on were used to identify all *in vitro* studies about different polishing techniques and its effectiveness on surface roughness (SR) of restorative RBC. The keywords/terms used in each electronic research are listed in **Table 1**.

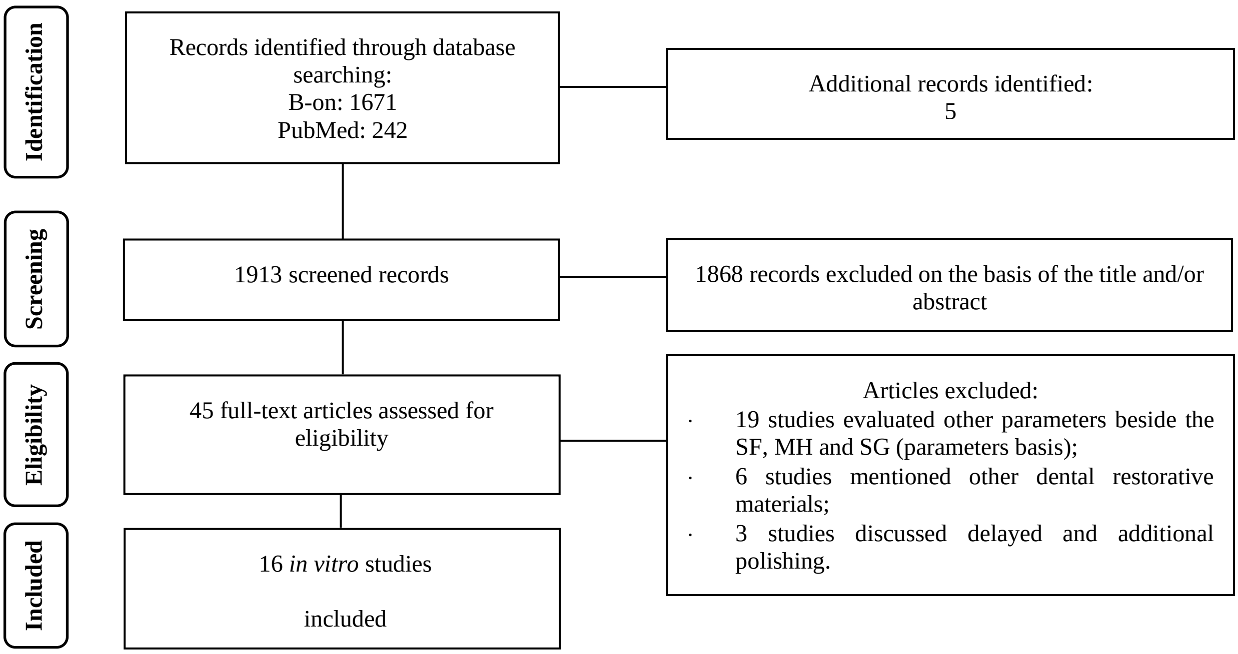
A total of 1913 papers were assessed. After being analysed, all articles were imported to Mendeley desktop 1.19.4 software to remove duplicates. The last search in the database was accomplished in July of 2020.

Table 1. – Search strategy used in electronic databases

Database	Terms used	Filters
PubMed	#1 (Restorative resin-based composite) OR (resin-based composite) OR (resin based composite) OR (dental composite) OR (composite resin) #2 (polishing techniques) #3 (polishing systems) #4 Search #1 AND #2 AND #3	-Articles written in English -Articles/studies from 2010 to 2020
B-on	“Restorative resin-based composite” AND “polishing techniques” AND “polishing systems”	

The selection of the articles was made by pre-defined eligibility criteria. Only papers written in English and published between the years 2010 and 2020 were considered for the *in vitro* studies review. To check the inclusion criteria – *in vitro* studies referring to Polishing Techniques on different RBC – all titles and abstracts were verified. Only studies that evaluated surface roughness (SR), surface gloss (SG) and microhardness (MH) on different RBC were included. Thus, articles that discussed polishing pastes and finishing diamond burrs, other dental restorative materials in place of RBC, delayed or additional polishing rather than immediate/initial, data as colour stability, staining susceptibility, marginal adaptation and others were not considered. After analysis of the full text of previously selected articles, only papers that incorporated all the mentioned criteria were included. A total of 16 *in vitro* were included and analyzed. The resume of all studies and its' "Different Polishing systems on RBC" (with information of authors, year, objectives, materials and methods, results and conclusions) is shown in **Chart 2. (ANNEXES)**.

Figure 1. – Review search strategy PRISMA flowchart



Directions for use (DFU) and other technical details, as Safety data sheet (SDS), were accessed directly from polishing materials manufacturers' online sites. The criteria used to access it was the polishing devices, with Single and Multi-Step, used in each different selected study for this review. Furthermore, the most part of the RBCs, described and tested, were also examined for technical details.

II. DEVELOPMENT

2.1 Resin-based composites (RBC) main composition and restorations polishing

Until the date, RBC can be categorized according to the chemistry of the resins matrix composition and its' filler particle size and distribution as hybrid, microhybrid, microfilled, nanohybrid, nanofilled, packable, ormocer-based, silorane-based and polyacid-modified composites (compomers) and flowable composites (Pratap *et al.*, 2019).

RBCs are composed of specifically developed monomers like Bis-GMA (bisphenol A-glycidyl methacrylate), TEGDMA (triethylene glycol dimethacrylate), UDMA (urethane dimethacrylate), HEMA (2-Hydroxyethyl methacrylate), Bis-EMA (ethoxylatedbisphenol-A-dimethacrylate) and various fillers with diverse particles sizes that offer better aesthetic, mechanical/physical and wear properties. The resin matrix and loaded particles/fillers have different hardness and do not promote "wear" in the same proportion, what makes it an inherent problem found because of the irregularities on the material surface (de Morais *et al.*, 2015).

Composites' fillers that are greater size than one (1) micrometer (µm) are macrofilled and those with fillers with less than one (1) µm are considered microfilled. New classifications of RBCs include the nanoparticles and a mixture of different particle sizes known as a "hybrid", "microhybrid" or "minifill" (Berger *et al.*, 2011). The smaller the particles, the better the polish and the gloss. Microfilled composite resins are known to obtain the highest gloss and surface quality because of their small particles and high resin content (St-Pierre *et al.*, 2019). But, on the other hand, the filler size reduction and subsequent increase in surface area to volume ratio limits the achievable filler loading and results in decreased handling and mechanical properties (Ilie and Hickel, 2011). Nowadays, advances have been introduced by nanotechnology, adding nanoparticles to RBC. This filler technology improved and organic matrixes have been modified, which help to provide higher degrees of monomers polymerization and more improved surface roughness of the those RBC (Alfawaz, 2017). Nanomaterials or nanocomposites can be divided into two main groups: nanohybrids and nanofilled composites; high concentration of only nanosized fillers in RBC are designated as "nanofills". Nanofilled RBC were designed to apply in all tooth cavity preparations, with excellent polish ability as well as superior polish/gloss durability, compared with microfilled RBC, and also having excellent mechanical properties that respond to high stress forces, typical of a hybrid composites (Rodrigues *et al.*, 2015; Aytac *et al.*, 2016).

Nanohybrids consists of particles of various sizes, including particles in the micrometric and nanometric size ranges; Nanofills consist of particles of nearly uniform sizes, all in nanometric dimensions and have the ability to create nanoclusters as secondarily formed fillers (Chen, 2010). **Chart 1. (ANNEXES)** shows all the RBC reported in the i*n vitro* reviewed studies, commercially available, and described the technical details as manufacturer, RBC type, product name (Batch number), inorganic filler composition, average particle size, SDS, DFU and link to brochure.

2.2 Surface roughness, surface gloss and microhardness of RBC

Surface roughness (SR) is the finer irregularities of the surface texture that usually result from the elaboration process in combination with the specific composition of the material used (Da Costa, Goncalves and Ferracane, 2011). This surface topography depends on the filler content, size, shape and interparticle spacing, the monomer type, the degree of cure and the efficient filler-matrix bonding (Ereifej, Oweis and Eliades, 2013). The arithmetic mean SR, Ra, is one of the several different parameters that are used in order to describe the deviation of a surface from an ideal level and is defined according to the international standard (ISO 4287:1997, 2015) (Ståhl, Schultheiss and Hägglund, 2011). A surface roughness value of 200 nm has been established as the threshold under which bacterial adhesion could be prevented (St-Pierre *et al.*, 2019). The SR (Ra) measurement, as stated by literature, is made by qualitative methods (optical and scanning electron microscopy (SEM)) and quantitative method such us, contact stylus profilometry, optical/laser noncontact profilometry (with µm as units) and atomic force microscope (AFM) (Ereifej, Oweis and Eliades, 2013; Soliman *et al.*, 2020). Scanning electron microscope (SEM) examination is used to evaluate and detect surface texture differences at each treatment.

Surface gloss (SG) measurement is an additional parameter to roughness, while evaluating the effectiveness of topography surface polishing (Antonson *et al.*, 2011). Gloss is an important property used to measure surface shine and may be defined as “angular selectivity of reflectance, involving surface-reflected light, responsible for the degree to which reflected highlights or images of objects may be seen as superimposed on a surface” (Da Costa, Goncalves and Ferracane, 2011). It is affected by the measuring angle, surface roughness, particle size, chemical heterogeneity, surface defects and presence of other surface irregularities (Ereifej, Oweis and Eliades, 2013). SG measurement is made by small area glossmeter and the units are expressed in gloss units (GU). With a 60º measuring angle (according to ISO 2813), generally poor finish is considered below 60 G.U., acceptable finish between 60 and 70 G.U., good finish between 70 and 80 G.U. and excellent finish above 80 G.U. (Ereifej, Oweis and Eliades, 2013).

Microhardness (MH) derives from the definition of hardness that is a quantitative measure of resistance to deformation and is calculated as the maximum applied load divided by the projected contact area. Thereby, microhardness is associated to the composite mechanical property that is, the material's resistance to masticatory forces and its appearance, influencing the longevity of the RBC restorations (Alfawaz, 2017). Two different tests can be done to measure the RBCs' MH – the Vickers or Knoop tests (differ by the shape of their indenters) (Ehrmann, Medioni and Brulat-bouchard, 2019). Microhardness values are reported as the Vickers hardness number (VHN, kg/mm^2).

2.3 Main polishing systems devices

Polishing is the final step of a restoration that refers to the reduction of roughness and scratches created by finishing instruments and provides an enamel-like appearance as well as reduces the surface energy of the restoration (Antonson *et al.*, 2011; Erdemir, Sancakli and Yildiz, 2012). Proper finishing and polishing procedures should establish a smooth, glossy surface texture with optimal RBC restoration contour. Nowadays, different polishing systems and technical protocols are commercially available for clinical use. They can be namely divided in two distinct groups: the Single-Step (1S) and the Multi-Step (2S/3S/4S) (Erdemir, Sancakli and Yildiz, 2012). The classification of the polishing devices englobes six major categories including burs (diamond or tungsten carbide), rubber-based cups, points, wheels, coated abrasive discs and strips; polishing pastes and silicon carbide brushes (Da Costa, Goncalves and Ferracane, 2011). This polishing devices normally are impregnated with diamond particles, aluminium oxide or silicon carbide (De Carvalho Justo Fernandes *et al.*, 2016). Moreover, there is also a distinct type of polishing systems namely known as "abrasive polishing". For this, it is chosen tungsten carbide burs with more flutes possible (normally 30-fluted), to enable a very gentle polishing vibration on the surface of RBCs (Ehrmann, Medioni and Brulat-bouchard, 2019).

The hardness of the cutting particles and materials are very important for the effectiveness of the polishing system (Alfawaz, 2017). To obtain a smoothest surface possible it is necessary to resort to abrasive polishing system that relies on using progressively finer grits, that afterwards comes to an exceptionally fine-grained grit (final polish) (Ehrmann, Medioni and Brulat-bouchard, 2019). In order to produce better results it is important that the grit in the polishing material is smaller than the particle size of the restorative material that is being polished (Avsar, Yuzbasioglu and Sarac, 2015).

2.4 Polishing devices and *in vitro* evidence

Polishing systems were tested in the *in vitro* studies reviewed **(Chart 2., ANNEXES)** by measuring the SR, SG and MH. The SEM was used in all of the 16 studies reviewed, for SR measurement; the AFM in preliminary study of Giacomelli (2012), was operating in tapping mode with scan size of 50x50µm; using WSxM software to analyse the images and calculate the root mean square (RMS) of the average height (µm, reliable index of SR) of every RBC specimen (Giacomelli, 2012). Beyond that study, AFM was applied in studies of Erdemir, Sancakli and Yildiz, 2012; Ereifej, Oweis and Eliades, 2013; Lopes *et al.*, 2018; Nithya *et al.*, 2020; Soliman *et al.*, 2020. The SG was measured in five of the *in vitro* studies - Antonson *et al.*, 2011; Ereifej, Oweis and Eliades, 2013; Rodrigues *et al.*, 2015; Lopes *et al.*, 2018; Nithya *et al.*, 2020. Microhardness was evaluated in four of the *in vitro* studies reviewed (Erdemir, Sancakli and Yildiz, 2012; Alfawaz, 2017; Ehrmann, Medioni and Brulat-bouchard, 2019; Nithya *et al.*, 2020) and it was used, for optimal accuracy, the Vickers microhardness test that is "based on the ratio between the applied load and the true area of the contact". Polishing Single-Step (1S) devices commercially available and technical details are presented in **Chart 3. (ANNEXES).**

In total, eight Single-Step (1S) polishing devices were tested – Composipro® (St-Pierre *et al.*, 2019), PoGo® diamond micropolisher (Erdemir, Sancakli and Yildiz, 2012; Giacomelli, 2012; Ereifej, Oweis and Eliades, 2013; Rodrigues *et al.*, 2015; Alfawaz, 2017; Daud *et al.*, 2018; Nithya *et al.*, 2020), Enhance® aluminium oxide polisher (Giacomelli, 2012; Rodrigues *et al.*, 2015), Optrapol® (St-Pierre *et al.*, 2019), Rubber cup® (Kemaloglu, Karacolak and Turkun, 2017), Occlubrush® (Aytac *et al.*, 2016), Opti1Step® (Ereifej, Oweis and Eliades, 2013), One-Gloss® (Kemaloglu, Karacolak and Turkun, 2017). The approximate average particle sizes (granulometry) of these systems goes from 4.0 µm to 80 µm. Polishing Multi-Step devices commercially available and technical details are presented in **Chart 4. (ANNEXES).**

Twenty Multi-Step polishing devices were tested in the reviewed *in vitro* studies – Diacomp® and ET Illustra® (St-Pierre *et al.*, 2019), D◆FINE Double Diamond® polishers (St-Pierre *et al.*, 2019), DIATECH *ShapeGuard*® composite polishing plus kit and SwissFlex® discs (Lopes *et al.*, 2018), Enhance&PoGo® (Antonson *et al.*, 2011; Kemaloglu, Karacolak and Turkun, 2017; Daud *et al.*, 2018; St-Pierre *et al.*, 2019) and Enhance Flex NST-EF® (Da Costa, Goncalves and Ferracane, 2011), Diamond Pro® (Rodrigues *et al.*, 2015), Venus Supra® (Giacomelli, 2012; Kemaloglu, Karacolak and Turkun, 2017), Astropol® (Antonson *et al.*, 2011; St-Pierre *et al.*, 2019), Kenda C.G.I. ® (Ereifej, Oweis and Eliades, 2013), HiLuster Plus® (St-Pierre *et al.*, 2019; Soliman *et al.*, 2020) and OptiDisc® (Ereifej, Oweis and Eliades, 2013), EVO-Light® polisher (Ehrmann, Medioni and Brulat-bouchard, 2019), CLEARFIL Twist DIA® (Aytac *et al.*, 2016; Kemaloglu, Karacolak and Turkun, 2017), Super-Snap® (Da Costa, Goncalves and Ferracane, 2011; Kemaloglu, Karacolak and Turkun, 2017; St-Pierre *et al.*, 2019), Superfix® (Rodrigues *et al.*, 2015), Jiffy® natural universal wheels (Soliman *et al.*, 2020), Sof-Lex® discs (Antonson *et al.*, 2011; Da Costa, Goncalves and Ferracane, 2011; Erdemir, Sancakli and Yildiz, 2012; Rodrigues *et al.*, 2015; Aytac *et al.*, 2016; Sahbaz *et al.*, 2016; Daud *et al.*, 2018; Lopes *et al.*, 2018; St-Pierre *et al.*, 2019; Nithya *et al.*, 2020) and Sof-Lex Spiral Finishing&Polishing® wheels (Aytac *et al.*, 2016; Kemaloglu, Karacolak and Turkun, 2017; Lopes *et al.*, 2018; St-Pierre *et al.*, 2019; Nithya *et al.*, 2020; Soliman *et al.*, 2020). The approximate average particle sizes (granulometry) of these systems goes from 1 µm to 100 µm.

Multi-Step polishing system requires a sequential use of at least two or, generally, more instruments with gradually smaller abrasive particles (Endo *et al.*, 2010). The Multi-Step polishers – such as, the 3S polishers Opti Disc® aluminum oxide discs (Kerr), Kenda CGI® synthetic/silicone rubber (Kenda AG), and the 4S devices Sof-Lex® aluminium oxide discs (3M ESPE) are the most common devices tested (Ereifej, Oweis and Eliades, 2013). Like wisely, there are some other Multi-Step polishers like DIATECH *ShapeGuard*® – Composite polishing Plus kit, with only two clinical steps (2S), and SwissFlex® discs with three step (3S) polishing discs (three grit: coarse to fine) – analogue to Sof-Lex® system (four grit) (Lopes *et al.*, 2018), both from COLTENE Group. As well, there are spiral discs with two steps (2S) from 3M – Sof-Lex Diamond Polishing System® spiral finishing & polishing diamond wheels (Aytac *et al.*, 2016; Kemaloglu, Karacolak and Turkun, 2017; St-Pierre *et al.*, 2019; Soliman *et* *al.*, 2020) – and from Kuraray – CLEARFIL Twist DIA® with diamond grains (Aytac *et al.*, 2016; Kemaloglu, Karacolak and Turkun, 2017). The spiral shape provides the possibility to adapt easily to all tooth surfaces, from any angle.

Three step (3S) polishing devices that can also be taken in account is Astropol® and it was tested in Antonson *et al.*, 2011 and St-Pierre *et al.*, 2019 studies. It is composed by "Disc F", used in pre-polishing applications; "Disc P" – ensures great results to microfilled composites; "Disc HP", recommended for hybrid composites (Ivoclar Vivadent. [In line]. Available at <https://www.ivoclarvivadent.com/en/p/all/products/clinical-accessories instruments/polishing-systems/astropol> [Accessed in 01/09/2020]). The example of "abrasive polishing" devices, that can be found in the study of Ehrmann, Medioni and Brulat-bouchard, 2019, are QCrosscut® 12/15-fluted finishing bur (blue-and-yellow ring) followed by Crosscut® 30-fluted polishing bur (white ring) from Komet and both, sequentially, yield a very low surface roughness to the RBCs (Ehrmann, Medioni and Brulat-bouchard, 2019).

2.5 Polishing devices and technical protocols in the *in vitro* studies reviewed

The most important factor that must always be obeyed, in polishing RBC protocols is the use of water spray as cooling effect to dissipate the heat generated by the rotatory instruments/discs. Heat can be deleterious to the restoration, the teeth and the surrounding tissues as well. It is recommended that the minimal flow of water should be 50mL/min and the pressure exercised should be moderate - under 2N force - as indicated by many manufacturers as the maximum polishing force (Heintze *et al.*, 2019; Kulzer Mitsui Chemicals Group. [In line]. Available at <https://www.kulzer.com/en/int/dentist/products_from_a_to_z/venus_2/faq_venus_supra.aspx> [Accessed in 02/09/2020]). Normally, the average hand pressure is not controlled in daily clinical care, as well in the studies reviewed in the present work. But, in Antonson *et al.* (2011) study was calculated the average moderate hand pressure and the average light pressure. The conclusion for the pressure the operators had, respectively, was 109.4 ± 15 g and 43.2 ± 6 g. Accordingly, 100 g (0.9807N) for moderate pressure and 40g (0.39N) for light pressure was taken into account for pressure calibrations by the operator (Antonson *et al.*, 2011). It is also known that the time used for the polishing procedure is also an influencing factor, that compromises the SR, at the same way as the particle size and type of abrasives in the polishing system (Gönülol and Yilmaz, 2012). It is possible to achieve a smooth surface in a minimal amount of time with Single-Step polishers (Alfawaz, 2017).

Polishing technical protocols of the reviewed studies are presented in **Table 2** (1S) and **Table 3** (Multi-step). The first protocol (**Table 2**)- PoGo® (Dentsply) - was applied in Erdemir, Sancakli and Yildiz, 2012 study. All of the results had no statistically significant differences between the polishing systems tested - PoGo® (Dentsply) vs. Sof-Lex® (3M). However, PoGo® produced lower SR in the Filtek Supreme XT™ and Ceram-X™ groups of specimens and higher SR in the Grandio™ group; In terms of MH – from least to greatest were: Ceram-X™ < Filtek Supreme XT™ < Grandio™ for PoGo® system (no statistically significant differences were observed between polishing systems) (Erdemir, Sancakli and Yildiz, 2012).

Table 2. – Three Single-Step (1S) polishers with the four technical application protocols registered in the *in vitro* studies reviewed. The protocols describe the time, pressure, rpm (rotations per minute) and the instruments used during the polishing procedures.

Polishing System	**Technical application Single-Step protocols**					***in vitro* references**
	Duration (seconds)	**Pressure**	**Speed (rpm)**	**Handpiece speed**	**Water coolant**	
PoGo® (Dentsply)	30	Light	15000	Slow	No	(Erdemir, Sancakli and Yildiz, 2012)
Enhance® (Dentsply)	40 (1)	Light	**NM**	Slow	**NM**	(Rodrigues *et al.*, 2015)
Opti1Step® (Kerr)	30	**NM**	12000	Slow	**NM**	(Ereifej, Oweis and Eliades, 2013)
Occlubrush® (Kerr)	45 (2)	**NM**	10000	Slow	**NM**	(Aytac *et al.*, 2016)

NM – Not mentioned

(1) Rinse and dry with water/air for 6 seconds
(2) Rinsed for 10 seconds and air-dried for 5 seconds

Rodrigues *et al.*, 2015 tested the second protocol (**Table 2.**) and report that Enhance® system produced low gloss values for all composites (de Morais *et al.*, 2015), thought Enhance® system is stiffer and do not deflect with the applied force as easily as the flexible disks do. Ereifej, Oweis and Eliades, 2013 applied the third protocol (**Table 2.**) and report that Opti1Step® produced one of the lowest SR values and, SG was acceptable to good finish. The fourth polishing protocol presented in **Table 2**, using Occlubrush® polishing system showed the roughest surfaces compared to the other polishing systems for all composite tested (Aytac *et al.*, 2016).

Table 3. – Six Multi-Step protocols registered in the *in vitro* studies reviewed. The protocols describe the time, pressure, rpm (rotations per minute) and the instruments used during the polishing procedures.

Polishing System	**Technical application Multi-Step protocols**					***in vitro* references**
	Duration (seconds)	**Pressure**	**Speed (rpm)**	**Handpiece speed**	**Water coolant**	
Enhance®& PoGo® (Dentsply)	**20** + **20 (1)**	Light	9000	Slow	**NM**	(Antonson *et al.*, 2011)
CLEARFIL Twist DIA® (Kuraray)	Medium grit wheel **30** + High-shine fine grit wheel **30 (2)**	Light	**NM**	Slow	Yes	(Kemaloglu, Karacolak and Turkun, 2017)
Sof-Lex® Diamond Spiral Wheels (3M)	Fine wheel **60** + Fine high-gloss wheel **90**	Light	10000	**NM**	No	(St-Pierre *et al.*, 2019)
Astropol® (Ivoclar Vivadent)	Disk F **60** + Disk P **60** + Disk HP **60+30**	Light	10000	**NM**	Yes	(St-Pierre *et al.*, 2019)
SwissFlex® & DIATECH *ShapeGuard®* (COLTENE)	SwissFlex Finishing coarse disc **30** + SwissFlex Polishing medium disc **30** + DIATECH Spiral pre-polishing silicon bur **30** + DIATECH Spiral polishing silicon bur **30**	**NM**	**NM**	**NM**	No No Yes Yes	(Lopes *et al.*, 2018)
Sof-Lex® (3M)	Red **20** + Dark Orange **20** + Light Orange **20** + Yellow **20 (3)**	Low Low High High	10000 20000-30000	Slow	No	(Da Costa, Goncalves and Ferracane, 2011)
NM – Not mentioned						
(1) - Rinsed and dried with air/water syringe 10 seconds (total), after Enhance® and after PoGo® use. **(2) -** Rinsed and dried between each application step. **(3) -** Rinse and dry with water/air syringe for a total of 6 seconds between each step (24seconds - total).						

The first protocol described in **Table 3** used Enhance® & PoGo® - two-step (2S) polishing systems (Antonson *et al.*, 2011). The results referred that Enhance®&PoGo® provided similar gloss values as Astropol® and Sof-Lex®. CLEARFIL Twist DIA® from Kuraray is a 2S diamond wheel system tested in the second protocol (**Table 3.**). Some defects (porous surfaces) were detected on specimens treated with this protocol, but in general there was no significant difference between CLEARFIL Twist DIA® and Sof-Lex® Spiral Wheels, except that Sof-Lex® Spiral Wheels, that showed a slightly better surface smoothness similar to acetate strips. Sof-Lex® Diamond Spiral Wheels protocol left a SR greater than 200 nm (threshold) on Filtek Supreme Ultra™, Grandio SO™ and Venus Pearl™. Astropol® is a system with silicon carbide, aluminium oxide and diamond type of abrasives distributed by 3S protocols (**Table 3.**). After each step (1, 2 and 3), RBC is rinsed and dried with air/water syringe for a total of 10 seconds. This protocol had a continued improvement in polishing for up to 30 seconds for each of the steps. Lopes *et al.*, 2018 used DIATECH *ShapeGuard*® and SwissFlex® for a four-step (4S) system or "Protocol 3/PRO3" (**Table 3.**). Results evidenced one of the highest SR values (applied at nanohybrid and nanofilled composites) of all protocols and less SG values, but higher gloss value than theoretically expected on nanofilled composite. The most popular four-step (4S) polishing system is a Sof-Lex® (3M) (**Table 3.**); Step 1 of this protocol has not been used generally in all of the studies reviewed, because the Sof-Lex® Red disc produced a coarse, uneven surface (Rodrigues *et al.*, 2015). As a result of this protocol, Sof-Lex® and Super-Snap® showed similar SR values when used on every composite, except for Filtek Z250™. Also, all composites showed similar SR when polished with Sof-Lex®.

III. DISCUSSION

For the purpose of this review, 8 Single-Step (1-S) and 20 Multi-Step (2S, 3S, 4S…) polishing devices were found as commercially available and their technical details described; were included 16 *in vitro* studies; four 1S and 6 Multi-Step devices and their technical protocols presented. It was not found clinical trials, that is *in vivo* studies that report polishing techniques at the oral cavity of patients. A nonexistence of this kind of studies could be explained by the form of evaluating interest parameters, that require immediate examination and high technologies such as AFM and SEM equipment (Faria-Júnior *et al.*, 2015). So, the present work focusses in laboratories findings that examined the surface roughness of RBC restorations after polishing.

The RBCs filler size and shape can influence the SR of dental restorations (Berger *et al.*, 2011). It was reported, by several studies, that composite resins with smaller dimension fillers showed a smother surface after polishing than RBC containing fillers of larger dimension; and that composite resins of nanoparticle fillers could be polished better than hybrid composites. On the other hand, there are also studies that claim particle size is not a factor affecting surface texture after polishing and that it is instead influenced by the monomer structure of the RBC (Sahbaz *et al.*, 2016). Values of gloss generally follows a similar trend to values of SR parameters (Ereifej, Oweis and Eliades, 2013). According to Soliman *et al.* (2020), the SR is affected not only by the RBC composition-restoration but also by the polishing system corresponding on it. Aluminium oxide hardness is higher than most filler particles of RBCs so, in most studies, aluminium oxide discs showed to produce the lowest roughness values and, consequently, the smoothest surfaces (Germain and Samuelson, 2015). It was suggested that silicon-carbide abrasive particles may not be as effective as aluminium oxide particles and diamond abrasives (as Occlubrush®; Ivoclar Vivadent) (Aytac *et al.*, 2016). Besides that, aluminium oxide discs bring out smoother surfaces when compared with rubber cups, diamond and tungsten carbide abrasives, because they do not displace the composite fillers – making the polishing abrasion an homogeneous act (Moda *et al.*, 2018; Dhananjaya *et al.*, 2019).

The best choice for the finishing followed by polishing of microhybrid and nanofilled RBC restorations, after Daud *et al.*, 2018 study, is firstly use tungsten carbide bur, rather diamond bur, and then use Enhance® & PoGo® system, rather than Sof-Lex® system. Kemaloglu, Karacolak and Turkun, 2017 study reported that there were no significant differences between CLEARFIL Twist DIA® and Sof-Lex Spiral Wheels®, but Sof-Lex® wheels showed a slightly better surface smoothness, similar to the acetate strip. Considering other point of the view, relatively to the Single-Step (1S) polishing system – it is showed being more advantageable because of its' convenience and efficiency in producing a highly smooth surface (low Ra/SR) without having to proceed for more steps, with finer polishing items, either having to wash and dry between each step to guarantee a removal of the larger abrasives from the previous step (Gönülol and Yilmaz, 2012). In terms of time, each of the different polishing techniques tested in the *in vitro* studies reviewed, were performed for different amounts of time. Time is an important factor, since it has an effect on the SR of aesthetic RBC (Madhyastha *et al.*, 2017). Normally, the sequential use of "Sof-Lex" four-step (4S) discs caused the longest polishing period.

The image of a material's surface varies not only with viewing and illumination conditions (visual perception), but also with the material's surface properties, including its 3-D texture and

MH determines the degree of deformation of a material and it is generally accepted as an important property and a valuable parameter of comparison with the tooth structure. Changes in this property can be ascribed to the polymerization or maturation status of restorative materials. Enamel and dentin VHN were stated as 348 VHN and 80 VHN, respectively. To assure an optimized clinical performance of restorations, it is of paramount importance to employ materials with hardness at least similar to that of the dentinal substrate, not only superficially, but also in depth, since an accentuated decrease in hardness would adversely affect their mechanical properties and marginal integrity (Chinelatti *et al.*, 2006). Polishing can influence the hardness of RBC, significantly increasing VHN. Although a smooth surface can be obtained after polymerization, the superficial layer is essentially composed by organic matrix, being hence, less dense than the underlying layer. Thus, the removal of the superficial layer of RBC restorations by polishing procedures may increase the surface resistance.

The timing of the finishing/polishing procedure might have an effect on the physical properties of the restorative materials and might increase the risk of premature failures. Although some authors have proposed a 24-hour delay before the completion of finishing procedures, most clinicians perform finishing/polishing procedures immediately after restoration placement (Yazici *et al.*, 2010). Polishing performed immediately after polymerization can affect marginal integrity, leading to gaps formation at the tooth/restoration interface. This can occurs inherently to adhesive restorative materials, due to the stress generated by rotary instruments (Chinelatti *et al.*, 2006). Moreover, polishing can provide a more permanent deformation-resistant surface and, if polishing is accomplished immediately after polymerization, this incomplete maturation could turn composites more susceptible to the effects of heat generation, thereby decreasing their hardness, since approximately 75% of the light-curing process occurs in the first 10 minutes, and the curing reaction can continue for a period of up to 24 hours. Delayed polishing may be recommended in order to allow the hydroscopic expansion of the material, reducing marginal microleakage (Yazici *et al.*, 2010).

Regarding to the theme of immediate (before aging) or delayed (after aging) polishing, in the *in vitro* study of Aytac *et al.*, 2016 was concluded that comparing the SR values before and after aging, the SR values of all polished groups increased with aging in all composite groups.

IV. CONCLUSION

Considering the aim of this review it was possible to state the following conclusions:

– Twenty-eight different polishing systems: 8 Single-Step (1S) and 20 Multi-Step (2S, 3S, 4S…) polishing devices were found as commercially available and their technical details described; 16 *in vitro* studies were included; Four 1S and Six Multi-Step devices and their technical protocols presented.

– Fillers size, shape and loading plays an intrinsic role in how well a certain RBC restoration can be polished; the larger the filler particles, the rougher the surface would be after polishing.

– Fifteen manufacturers commercialize polishing devices for RBC restorations; Most popular time for polishing testing of each device was ± 30 seconds. It is more comfortable and advantageable for a clinician to use a Single-Step device for proceeding to polishing of RBCs. However, the time of the procedure needs to be considerable and never be lower than 30/40 seconds; PoGo® can be used as a 1S polishing device, but it is recommended, by manufacturers, to be used with Enhance® as a pre-treatment; The Sof-Lex® aluminum oxide discs bring out smoother surfaces when compared with rubber cups, diamond and tungsten carbide abrasives, make the polishing abrasion an homogeneous act (comparing with Astropol®, Enhance®&PoGo®; Sof-Lex® Spiral Wheels and CLEARFIL Twist DIA® systems); Single-step PoGo® and multi-step Sof-Lex® polishing devices produce, on the same resin type composite evaluated, similar quality in terms of SR and MH; and both systems resulted in SR values below the iconic 0,3µm, that can be detected by humans' tongue;

Since the parameter of pressure, refrigeration, rpm were not standardized in many of the reviewed studies, it may be valuable to include those for further investigations; Controlled clinical trials on the effects of various polishing devices and techniques on RBCs restorations are necessary to better respond the expectation between RBCs and adequate polishing devices/techniques, in order to avoid adverse events in the selected material and improving the clinical longevity of restoration in the oral environment.

Dental care professionals must be aware about the safely and adequate use of polishing systems; for that purpose, manufacturers' recommendations (time, rpm, pressure, refrigeration and others), devices DFUs, finally which for they were designed, and evidence findings on mechanical results (SR, SG and MH) for RBCs restoration polished is mandatory.

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VI. ANNEXES - CHARTS

Chart 1. – RBC reported in the *in vitro* reviewed studies, commercially available, and described according to technical details: manufacturer, RBC type, product name (Batch number), inorganic filler composition, average particle size, SDS, DFU and link to brochure.

Manufacturer	**Type**	**Product Name** (Batch number)	**Inorganic filler level**	**Average particle size**	**Safety data sheet (SDS) and Directions for use (DFU)**	**Link to Brochure**
Anabond Stedman Pharma Research Pvt Ltd, India	Nanohybrid	**Resto Fill N FLO™**	NF	NF	NF	https://www.dentalkart.com/anabond-restofill-n-flo.html
COLTENE Group, Glattbrugg, Zurich, Switzerland, CH	Nanohybrid	**Brilliant Everglow™**	NF	0,02-1 µm	https://sds.coltene.com/portal/data/83dcefb7/0/EN-GB/Brilliant%20EverGlow_2_GB-en.pdf	https://global.coltene.com/pim/DOC/BRO/docbro60019821-en-03-19-brilliant-everglow-flow-a4-3senaindv1.pdf
Dentsply, Caulk, Milford, DE, USA	Microhybrid	**Esthet-X™** (0611221)	77 wt%	0.85-0.9 µm	https://www.dentsplysirona.com/content/dam/dentsply/pim/manufacturer/Restorative/Direct_Restoration/Composites__Flowables/Universal_Composites/EsthetX_HD/Esthet-X-HD-7ht8bhh-en-1402	https://www.dentalcompare.com/4479-Hybrid-Composites/34683-Esthet-X/
	Nanohybrid	**Ceram-X Mono™**	76 wt%	0,4-4 µm;	https://www.sinclairdental.com/sdmedia/msds/190ck299.pdf	http://www.dentsply.de/bausteine.net/f/9318/SCCeramX130619E.pdf=2
		Ceram-X Duo™	76 wt%	0,4-2,3 µm	https://assets.dentsplysirona.com/flagship/en/explore/restorative/ceram_x/ceramxuniversalduo_IFU.pdf	http://www.dentsply.de/bausteine.net/f/9318/SCCeramX130619E.pdf=2
FGM Produtos Odontológicos, Joinville, SC, Brazil	Microhybrid	**Opallis™** (031011)	78,5-79,8 wt%	0,5 µm	http://www.fgm.ind.br/site/wp-content/uploads/2016/03/MSDS-OPALLIS-LAB.pdf	https://www.fgm.ind.br/produtos/composito-resina-composta-opallis/
GC Corporation, Tokyo	Microfilled hybrid	**Grandia Direct™**	NF	0,85 µm	http://www.gcamerica.com/downloads/SDS_US/SDS_GRADIA%20DIRECT%20(Posterior).pdf	https://cdn.gceurope.com/v1/PID/gradiadirect/manual/MAN_Gradia_Direct_Clinical_Guide_en.pdf
Heraeus Kulzer Gruner, Hanau, Germany	Microhybrid	**Venus™**	NF	0,01-0,7 µm	https://www.kulzer.com/media/webmedia_local/downloads_new/venus_7/venus_8/GBA_Venus_INT.pdf http://msds.kulzer.com/msds/MSDS2220_-_Venus_(GB)_3.pdf	https://www.kulzer.com/media/webmedia_local/downloads_new/venus_7/venus_flow_2/Venus_Venus_Flow_Sellsheet_GB.pdf
	Microfilled	**Durafill VS™** (010200)	52 wt%	0,04 µm	https://www.kulzer.com/media/webmedia_local/downloads_new/further_products_2/durafill/GBA_Durafill_VS_INT.pdf http://msds.kulzer.com/msds/MSDS357_-_Durafill_VS_(GB)_2.pdf	https://www.kulzer.com/en/int/dentist/products_from_a_to_z/moreproducts/durafill_vs.aspx

	Nanohybrid	**Venus Diamond**™	81,2 wt%	0,7-2 nm	https://www.kulzer.com/media/webmedia_local/downloads_new/venus_7/venus_diamond_2/GBA_Venus_Diamond_INT.pdf http://msds.kulzer.com/msds/MSDS40066_-_Venus_Diamond_(GB)_4.pdf	https://www.kulzer.com/media/webmedia_local/downloads_new/venus_7/venus_8/Venus_Family_Produktinformation_GB.pdf
		Venus Pearl™ (010028)	80 wt%	5nm - 5 µm	https://www.kulzer.com/media/webmedia_local/downloads_new/venus_7/venus_pearl_1/GBA_Venus_Pearl_INT.pdf http://msds.kulzer.com/msds/MSDS40519_-_VENUS_Pearl_(GB)_4.pdf	https://www.kulzer.com/media/webmedia_local/downloads_new/venus_7/venus_8/Venus_Family_Produktinformation_GB.pdf
Ivoclar Vivadent, Schaan, Liechtenstein	Nanohybrid	**IPS Empress Direct**™	77,5-79 wt%	0,1-5 µm	https://www.ivoclarvivadent.com/en/p/all/products/all-ceramics/ips-empress-system-dentist/ips-empress-direct	https://www.ivoclarvivadent.com/en/p/all/products/all-ceramics/ips-empress-system-dentist/ips-empress-direct
		Tetric EvoCeram™	82,5 wt%	0,550 µm (550 nm)	https://www.ivoclarvivadent.com/en/p/all/products/restorative-materials/composites/tetric-evoceram	https://www.ivoclarvivadent.com/en/p/all/products/restorative-materials/composites/tetric-evoceram
		Tetric NCeram™	77 wt%	0,040-3 µm	https://highlights.ivoclarvivadent.com/dentist/en-asian/tetric-n-ceram	https://highlights.ivoclarvivadent.com/dentist/en-asian/tetric-n-ceram
Kerr Orange, CA, USA	Nanohybrid	**Harmonize**™ **Universal Composite**	81 wt%	NF	https://www.kerrdental.com/en-dk/resource-center/sds-harmonize-19	https://www.kerrdental.com/kerr-restoratives/harmonize-harmonize-universal-composite#docs
		Premise™ (2719074)	84 wt%	0.02–50 µm	https://www.kerrdental.com/kerr-restoratives/premise-universal-nanofilled-composite#docs	https://www.kerrdental.com/kerr-restoratives/premise-universal-nanofilled-composite
Kuraray, Tokyo, Japan	Nanohybrid	**Clearfil Majesty ES 2**™ (A90026)	78 wt%	0,37-15 µm	https://www.kuraraynoritake.eu/pub/media/pdfs/clearfil-majesty-es-2-classic-and-premium-safety-data-sheet-uk.pdf	https://www.kuraraynoritake.eu/pub/media/pdfs/CLEARFIL_MAJESTY_ES-2_Brochure_2.pdf
		Clearfil Majesty Posterior™	92 wt%	0,02-1,5 µm	https://www.kuraraynoritake.eu/pub/media/pdfs/clearfil-majesty-posterior-and-clearfil-majesty-posterior-plt-safety-data-sheet-uk.pdf	https://www.kuraraynoritake.eu/pub/media/pdfs/20995_1_Majesty_Posterior_brochure_LR_15.pdf
Micerium S.p.A., Italy	Microhybrid	**Enamel Plus HFO**™	NF	0,04-0,7 µm	https://www.bcodental.nl/producten/sdb/Enamel_Plus_HFO_komplKit_20120130_GB.pdf	https://optident.co.uk/product/enamel-plus-hfo-tips-ge1/
Septodont, UK	Nano-dimer	**N'Durance**™ **Universal Composite**	NF	40nm - 8 µm;	https://www.septodont.co.uk/sites/uk/files/2018-06/N%27DURANCE-GB.pdf	http://www.septodont.ca/sites/default/files/NDurance_2.pdf

Shofu Dental Corporation, San Marcos, CA, USA	Nanohybrid	**Beautifil™ Flow**	NF	NF	https://www.shofu.com/wp-content/uploads/Beautifil-Flow-IFU-US-71423-04.pdf https://www.shofu.com/wp-content/uploads/Beautifil-Flow-SDS-US-Version-10.pdf	https://www.shofu.de/wp-content/uploads/2018/06/Beautifil-Flow-Info-UK.pdf
Tokuyama Dental, Italy	Supra-nanofilled	**Estelite ∑ Quick™** (E608)	82 wt%	0,2 µm	http://www.tokuyama-dental.com/tdc/pdf/msds/uk/15CLP_ESTELITE%20SIGMA%20QUICK_UKrev3.pdf	http://www.tokuyama-dental.com/tdc/composites/sigma_quick.html
Voco, Cuxhaven, Germany	Nanohybrid	**GrandiO™** (1139078)	85 wt%	1 µm; 20-50 nm	https://www.voco.dental/pt/portaldata/1/resources/products/instructions-for-use/e1/grandio_ifu_e1.pdf	https://www.voco.dental/pt/produtos/restaura%C3%A7%C3%B5es-directas/comp%C3%B3sitos/grandio.aspx
3M ESPE Dental Products, St. Paul, MN, USA	Microhybrid	**Filtek P90™** (N194550)	82 wt%	0,6 µm	https://multimedia.3m.com/mws/media/495290O/filtek-p90-technical-profile.pdf	https://multimedia.3m.com/mws/media/495289O/filtek-p90-8pg-brochure.pdf
		Filtek Silorane™	76 wt%	NF	https://psdcdn.blob.core.windows.net/coshh/FLM150.pdf	https://multimedia.3m.com/mws/media/598060O/filtek-silorane-study-booklet-ebu.pdf?fn=FS_StudyBooklet_EBU.pdf
		Filtek Z250™ (20051226)	82 wt%	0,6µm	https://multimedia.3m.com/mws/media/219552O/3m-filtek-z250-universal-restorative-instructions.pdf https://multimedia.3m.com/mws/mediawebserver?mwsId=SSSSSuUn_zu8l00xlYtvMYtBOv70k17zHvu9lxtD7SSSSSS--	https://multimedia.3m.com/mws/media/78327O/3m-filtek-z250-universal-restorative-all-around-versatility.pdf
	Nanofilled	**Filtek Supreme Plus™** (20061004)	78,5 wt%	20-70 nm	https://multimedia.3m.com/mws/mediawebserver?SSSSSuUn_zu8l00x4Y_Glxme4v70k17zHvu9lxtD7SSSSSS--	https://multimedia.3m.com/mws/media/341234O/filtektm-supreme-plus-universal-restorative.pdf?fn=supr_pl_tp.pdf
		Filtek Supreme Ultra™ (N495465)	78,5 wt%	4-20 nm	https://multimedia.3m.com/mws/mediawebserver?mwsId=SSSSSuUn_zu8l00xM829oYtx4v70k17zHvu9lxtD7SSSSSS--	https://multimedia.3m.com/mws/media/629066O/filtektm-supreme-ultra-universal-restorative.pdf
		Filtek Supreme XTE™	78,5 wt%	11 nm	https://multimedia.3m.com/mws/mediawebserver?SSSSSuUn_zu8l00xM829oYtZPv70k17zHvu9lxtD7SSSSSS--	https://multimedia.3m.com/mws/media/643070O/filtek-supreme-xte-technical-profile-anz.pdf
		Filtek Z350 XT™ (N186543)	73,2 wt%	5-75 nm; 0,6-1,4 µm	https://multimedia.3m.com/mws/mediawebserver?SSSSSuUn_zu8l00xM82	https://www.3m.com.my/3M/en_MY/company-my/all-3m-products/~/3M-Filtek-Z350-XT-

					BMYt1Mv70k17zHvu9lxtD7SSSSSS--	Universal-Restorative-Body-Shade-Refill-1-4g-Syringe-XWB-7018XWB/?N=5002385+8711017+3292776908&rt=rud
		Filtek Z500™	78,5 wt%	5-20 nm; 0,6-1,4μm	https://multimedia.3m.com/mws/mediawebserver?mwsId=SSSSSuUn_zu8l00xMYtSO8_xov70k17zHvu9lxtD7SSSSSS--	https://multimedia.3m.com/mws/media/1582456O/3m-filtek-z500-universal-restorative-folder-uk.pdf
		Filtek Z550™ (N581690)	82 wt%	0,02-3 μm	https://multimedia.3m.com/mws/mediawebserver?SSSSSuUn_zu8l00xM82BoYt9nv70k17zHvu9lxtD7SSSSSS--	https://multimedia.3m.com/mws/media/744411O/filtek-z550-technical-data-sheet-cee.pdf

Chart 2. – Different Polishing systems on RBC - *in vitro* evidence.

Study (Author, Year)	Objective	Materials	Methods	Results	Conclusion
(Antonson, S. A. et al., 2011)	Compare four finishing/polishing systems (F/P) on surface roughness and gloss of different resin composites.	**Composites:** Microhybrid - Esthet X™ (EX); Nanofill - Filtek Supreme Plus™ (FS) **Polishing systems:** Astropol® (AP) PoGo® (EP) Sof-Lex® (SL)	Samples from each RBC group were subjected to finishing steps for 20seconds (each). Was used a slow-speed hand piece with 9000 rpm; after each step - rinsed and dried with air/water syringe for a total of 10s. Each RBC group was divided into four polishing groups.	Sof-Lex® F/P provided the smoothest surface although there were no statistical significance differences between the F/P systems. EX-composite treated by Sof-Lex® revealed the least gloss. SEM images revealed comparable results for F/P systems but EX-composite surfaces included more air pockets.	Different F/P systems provided comparable surface smoothness for both composites. SEM evaluation revealed that the EX-composite surface contained more air pockets, but F/P systems were compatible.
(Da Costa, J. B., Goncalves, F. and Ferracane, J. L., 2011)	Evaluate surface finish and gloss of a two-step (2S) composite finishing/polishing (F/P) disc system compared with two multistep systems on five composites.	**Composites:** Microhybrid - Filtek Z250™ (FZ), Esthet X™ (EX); Microfill - Durafill VS™ (D); Nanohybrid - Premise™ (PR); Nanofill - Filtek Supreme Plus™ (FS); **Polishing systems:** 2S - Enhance Flex NST® (EF) 4S - Sof-Lex® (SL), Super-Snap® (SS).	Each RBC disc was polished with low (10000) and high (2000-30000) rpm with slow-speed hand piece; 20s between each step; The polishing motion was circular and constant, and the discs were used dry. After each step - rinsed and dried with water/air syringe for a total of 6s.	SL and EF polishing systems showed similar surface roughness when used on all composites, except for EX. SS and EF showed similar surface roughness on PR composite. SL and SS showed similar surface roughness, except for FZ composite. No difference in gloss was noted among the three F/P systems when used with D and EX composites; No difference between SL and EF, when used with any composite, except for FS; No difference between SL and SS, when used with any composite.	Only 2S EF was capable of providing similar gloss and surface roughness to those attained with 4S SL on four of five composites evaluated; But was not able to produce as glossy or as smooth surface as 4S SS for three (PR, FZ and EX) of the five composites.
(Erdemir, U., Sancakli, H. S. and Yildiz, E., 2012)	Evaluate the surface roughness and microhardness of three novel resin composites containing nanoparticles after polishing with one-step (1S) and conventional multi-step polishing systems.	**Composites:** Nanohybrid - Ceram-X™, Grandio™; Nanofill - Filtek Supreme XT™ **Polishing systems:** PoGo® Sof-Lex Pop-On®	The specimens were polished under dry conditions; with light pressure; with the duration of 30s between each step. After each polishing step, the specimens were thoroughly rinsed with water for 10s to remove debris and air-dried for 5s.	The Filtek Supreme XT™ and Ceram-X™ composites showed smoother surfaces and lower microhardness than the Grandio™ resin composite regardless of the polishing system used. One and multi-step polishing procedures decreased the smoothness obtained with MS; Both systems resulted in Ra values below the threshold value of 0.3 μm, except for Grandio™.	One-step (PoGo®) and multi-step (Sof-Lex®) polishing procedures produced similar quality in terms of surface roughness and microhardness on the same resin composites evaluated. One-step polishing system appears to be as effective as multi-step systems and may be preferable for polishing.

(Peutzfeldt, Lussi and Flury, 2016)	Evaluates the effect of three different polishing systems on six direct resin composites.	**Composites:** Microhybrid - Grandia Direct™, Venus™, Enamel Plus HFO™; Nanohybrid - Venus Diamond™, Tetric EvoCeram™, Filtek Suprem XT™ **Polishing systems:** PoGo® polishers Enhance® Venus Supra®	The polishing procedure was performed always by the same trained opera- tor according to different manufacturer's instructions, with a polishing time of 20s to reproduce clinical practice. Nor pressure, rpm, water coolant presence or hand piece were mentioned in this study.	PoGo® polisher determined a significantly rougher surface, versus controls, in 5 out of 6 composites evaluated. Polishing with Venus Supra® did not result in any significant difference in surface roughness versus controls.	Venus Supra® polishing system could determine a smoother composite surface if compared to the other polishing systems tested.
(Ereifej, N. S., Oweis, Y. G. and Eliades, G., 2013)	Compare surface roughness and gloss of resin composites polished using different polishing systems	**Composites:** Microhybrid - Filtek Silorane™ (FS); Nanohybrid - IPS Empress Direct™ (IP), Clearfil Majesty Posterior™ (CM); Premise™ (PM). Submicron - Estelite Sigma™ (ES) **Polishing systems:** Opti1Step®(OS) OptiDisc® (OD) Kenda® (KD) PoGo® Metallurgical polishing (ML)	All polishing procedures were performed using a low-speed hand piece rotating at 12000 rpm with light pressure; during 30s each step. The polishing was performed under dry conditions.	The highest roughness was recorded when KD was used; The lowest roughness was recorded after ML. The highest gloss was recorded for PM/M and lowest for FS/KD.	The polishing procedure and the type of composite can have significant impacts on surface roughness and gloss of resin composites.
(Rodrigues, S. A. et al., 2015)	Evaluate the effect of polishing with different polishing systems on the surface roughness and gloss of commercial composites.	**Composites:** Microhybrid - Filtek P90™, Opallis™; Nanohybrid - Grandio™; Nanofill - Filtek Z350 XT™ **Polishing systems:** Diamond Pro® Superfix® Polidores DFL® Enhance® Sof-Lex Pop-On®	Each polishing point was used only once with a low-speed hand piece. The polishing procedure was performed by a single operator, according to the manufacturer's instruc- tions. The time varied between 15s and 40s. Specimens were rinsed and dry with water/air syringe for 6s in each step.	Multiple comparisons showed significantly higher SR for Grandio™ when polished with the Sof-Lex Pop-On® and of Filtek Z350™ and Opallis™ when polished with the Enhance®.	SR and SG were affected by the composites and polishing systems studied. A single-step polishing system did not produce equivalent surface characteristics for all composites. Although each polishing system produced similar Ra on the four composites evaluated, there were some differences in SG. The Multi-step systems produced the highest gloss on Grandio™ and Filtek P90™, but not on Filtek Z350™ and Opallis™.

(Aytac, F. et al., 2016)	Evaluate the effects of different finishing/polishing techniques on the surface roughness of nanocomposites after thermocycling aging.	**Composites:** Microhybrid - Filtek Z250™; Nanohybrid - Clearfil Majesty ES-2™, Filtek Z550™; Supra-nanofilled - Estelite Quick™ **Polishing systems:** Occlubrush® Clearfil Twist Dia® (wheel) Sof-Lex® Wheels Sof-Lex® Discs	All of the specimens were polished at 10000 rpm on a flat surface by the same operator for 45s and then rinsed for 10s and air-dried for 5s. Nor pressure, water coolant presence or hand piece were mentioned in this study. Polishing before and after aging.	Before and after thermocycling aging, Occlubrush finishing and polishing system showed higher surface roughness values in all composite resin types Clearfil Twist Dia®, Sof-Lex Spiral Finishing&Polishing® Wheels and Sof-Lex® discs showed lower and also similar surface roughness values in all composite resin types after thermocycling aging.	Composite type and finishing/polishing method signif|cantly affected the surface roughness of composites before and after thermocycling aging.
(Sahbaz *et al.*, 2016)	Examine the effect of three different posterior composites on surface texture (SR) with various finishing and polishing procedures.	**Composites:** Microhybrid - Filtek P60™, Cavex quadent posterior dense™; Supra-nanofilled - Clearfil Majesty Posterior™ **Polishing systems:** Diamond burrs Tungsten carbide burrs Sof-Lex®	Polishing procedure was applied during 15 s each, in one direction. The pressure applied was light and intermittent, together with water cooling. Performed with manufacturer's instructions, by a single researcher. A new disc was used for each sample. Nor rpm or hand piece were mentioned in this study.	No statistical significance was determined between the composite resins with the respect to SR. In the P60™ group the SR values from lowest to highest were Sof-Lex, diamond and carbide, respectively. In the Majesty™ group the SR were Sof-Lex®, carbide and diamond. In the Cavex™ group the SR values were Sof-Lex®, carbide and diamond.	For all composites, the lowest Ra values were obtained for the Sof-Lex® polishing system samples (more successful).
(Alfawaz, Y., 2017)	Evaluate the influence of finishing and polishing techniques on the surface roughness (SR) and microhardness of two composite resins with two different types of polishing systems.	**Composites:** Nanohybrid - Ceram-X™; Nanofill - Filtek Z350™ **Polishing systems:** PoGo® Sof-Lex®	The specimens were polished under dry conditions with light hand pressure, for 30s each step, at 15000 rpm, using a slow-speed handpiece. The disks were rinsed with water for 10s and air-dried for 5s in each polishing.	PoGo® system showed minimum SR with both composite resins. The microhardness showed relatively lower values after application of the polishing system.	The PoGo® system showed significantly smoother SR compared with the Sof-Lex® system, in both composites studied. The microhardness of the composite resin has negligible effect on the polishing system used.

(Kemaloglu, H., Karacolak, G. and Turkun, L. S., 2017)	Evaluate the effects of various finishing and polishing systems on the final surface roughness (SR) of a resin composite.	**Composites:** Nanohybrid - Tetric N-Ceram™ **Polishing systems:** Enamel Plus Shiny® Venus Supra® One-gloss® Sof-Lex® wheels Super-Snap® Enhance/PoGo® Clearf|l Twist Dia® rubber cups	It was used a slow-speed handpiece; applying 30s between each step; specimens were thoroughly rinsed with water and air-dried between each application step. Polishing after aging. rpm was mentioned in this study.	Lowest Ra - Mylar < SS® < Enhance/PoGo® Rubber cups created numerically the roughest surface among all the groups tested.	The number of application steps has no significant effect on the performance of F/P systems. Some two-step systems like PoGo®, Sof-Lex® Spiral Wheels and Clearfil Twist Dia® could create similar surfaces to a multi-step system like SS. Reduced-step polishers used after pre-polisher can be preferable to multi-step systems when used on nanohybrid resin composites. The effect of F/P systems on SR seems to be material-dependent rather than instrument- or system-dependent.
(Daud, A. et al., 2018)	Evaluate the effects of different finishing and polishing techniques on the surface roughness of microhybrid and nanofilled resin composites.	**Composites:** Microhybrid - Filtek Z250™; Nanofill - Filtek Supreme XTE™ **Polishing systems:** Tungsten carbide burr Diamond burr Sof-Lex® discs Enhance/PoGo®	Dry and wet conditions in different polishing systems; light pressure; time: 20s to 30s; rpm: 3000 to 10000.	Diamond burr with 20m caused significantly greater SR than Tungsten burr. The PoGo® produced smoother surfaces than the Sof-Lex® polishing system.	Tungsten carbide finishing burr followed by PoGo® polishing may be found to result in the smoothest surface finish.
(Lopes, I. A. D. *et al.*, 2018)	Evaluate the effect of four finishing and polishing protocols in Surface Roughness (SR) and Surface Gloss (SG) of two different nanocomposites.	**Composites:** Nanohybrid - Brilliant Everglow™; Nanofill - Filtek Supreme XT™ **Polishing systems:** Diamond burr Sof-Lex XT® Discs Sof-Lex® Diamond Polishing Spiral SwissFlex® Finishing Discs Silicon burr DIATECH® Enhance/PoGo® Diashine®	All instruments were used over the sample for a period of 30s. The polishing procedures were carried with water-free technique, with an exception of spiral tools (was used water). Nor pressure, rpm or rotational hand piece were mentioned in this study.	Protocol 4 evidences the lowest SR as opposed to the Protocol 5 (highest SR). Sequence of the protocols from lowest roughness to highest: Pro4, Pro1, Pro2, Pro3 and Pro5-C. SG - accordingly to SR, except for Protocol 3, which evidenced higher gloss value than theoretically expected.	The variable Ra and SG depends on the type of Protocol performed, on the type of resin, and combined effect of both factors. The lower the SR the higher the SG. The gloss intensity depends on the SR of the aesthetic restorative material, but it is certainly influenced by other factors.

(Ehrmann, Medioni and Brulat-bouchard, 2019)	Test the effect of 2 finishing–polishing sequences on 5 nanotech-based resin composites by comparing their final surface roughness and hardness values to those of a Mylar strip control group.	**Composites:** Nanohybrid - Tetric Evoceram™, Ceram-X Mono™; Ceram-X Duo™; Nanofill - Filtek Z500™ **Polishing systems:** Blue-and-yellow-ring Qcrosscut® 12/15 bur; White-ring Crosscut® 30 bur EVO-Light® polisher	It was used contra-angle (held steady by a T-shaped device, ensuring no pressure). After each polisher, the specimens were rinsed by a water-spray for 10s, then dried by an air-spray for 5s to eliminate. The speed was about 20000 rpm and 60000 rpm.	Highest hardness and lowest roughness for all the nanocomposites - QWB system. More effective finishing than the QB system.	The use of 2 tungsten carbide burs (instead of a single one) yielded better surfaces. hardness and Ra for the 5 nanocomposites showed material dependency when using the QB and QWB finishing sequences.
(St-Pierre, L. et al., 2019)	Compare, with a threshold value of 200 nm, the surface roughness (SR) obtained when using 12 different polishing systems on four different composite resins (microfill, nanofill, and two nanohybrids).	**Composites:** Microfilled - Durafill VS™; Nanohybrid - Grandio SO™, Venus Pearl™; Nanofill - Filtek Supreme Ultra™. **Polishing systems:** Astropol® HiLuster Plus® D.Fine® Diacomp® ET Ilustra® Sof-Lex Spiral Wheels® Sof-Lex XT® Discs Super Snap® Enhance/PoGo® Optrapol® OneGloss® ComposiPro® Brush	Specimens were polished by a single operator according to the polisher manufacturer's instructions regarding the speed, pressure, and need for water during the procedure (Table 3 of the article). Specimens were thoroughly rinsed with water between each polishing step. An electric handpiece was used to standardize the polishing speed and a chronometer was used to control the polishing time. The operator rehearsed and tested the protocol until the highest gloss was achieved for each polisher using extra specimens of Filtek Supreme Ultra that were discarded.	The final surface roughness obtained with different polishing systems was not the same for each composite resin tested. Durafill VS™ composite and the D-Fine®, Optrapol®, and HiLuster Plus® polishers produced the lowest surface roughness. For Filtek Supreme Ultra, Super-Snap™ achieved the smoothest surface, but Astropol®, HiLuster Plus®, D-Fine®, Diacomp®, and OptraPol® also obtained mean surface roughness value less than 200 nm. For Grandio SO™ and Venus Pearl™, the lowest surface roughness was obtained when using Super-Snap®, OptraPol®, and Astropol® adding ET Illustra® for Grandio SO and Sof-Lex® discs for Venus Pearl. OneGloss® and ComposiPro® Brush, two simplified one-step polishing systems, were unable to reach an acceptable surface roughness and left roughness significantly above the threshold for all the composite resins tested.	There is a interaction between the polishing systems and the composite resins. A given polishing system does not perform equally with all composite resins. Except for Optrapol®, multi-step polishing systems performed generally better than one-step systems. Durafill VS™, a microfill composite resin, may be polished more predictably with different polishers.

(Nithya, K. et al., 2020)	Evaluate the effect of three different polishing systems on the microhardness, surface roughness and gloss of resin composites.	**Composites:** Nanohybrid - Grandio™; Nanohybrid flowable - Shofu Beautifil™ Flow, RestoFill HV N-FLO™; Nanofill - Filtek Z-350 XT™. **Polishing systems:** PoGo® Sof-Lex Spiral® Sof-Lex Pop-On®	Associated F/P procedures were performed according to manufacturer's instructions using three polishing systems by the same operator to avoid bias. Nor time, pressure, rpm, water coolant presence or hand piece were mentioned in this study.	The Sof-Lex Spiral® group exhibited higher mean microhardness, less surface roughness and higher gloss. Filtek Z-250™ exhibited higher mean microhardness than Grandio™ and Beautifil™ and Filtek Z-350 XT™ exhibited more microhardness than Beautifil™. Filtek Z- 350 XT™ exhibited lower mean surface roughness than Filtek Z-250. Filtek Z-250™ polished with Sof-Lex® Spiral proved to have higher gloss (34.89 gloss units (GU)) than Grandio™ and RestoFill HV N-FLO™.	Polishing with the Sof-Lex Spiral® system exhibited more microhardness, less surface roughness, and higher gloss. Filtek Z-250™ and Filtek Z-350 XT™ showed higher microhardness values. The maximum smoothness and glossiness were achieved with Filtek Z-350 XT™ and Filtek Z-250™ composites, respectively.
(Soliman, Y. A. et al., 2020)	Study the surface roughness of different nanohybrid composites with different monomer compositions after finishing and polishing with different polishing systems.	**Composites:** Nanohybrid - N'Durance™, Venus diamond™, Harmonize™ Universal **Polishing systems:** Carbide finishing bur Jiffy® natural universal wheels Sof-Lex® Spiral Wheels HiLuster Plus® Enhance®	All instruments were used in a circular and continuous path over the sample for a period of 30s. The polishing procedures were carried with water-free technique. Nor pressure, rpm or rotational hand piece were mentioned in this study.	The lowest Ra values were found in the harmonize composite group that was polished with Jiffy®. The order of polishing systems, from lowest to highest surface roughness, was as follows: Jiffy®<Enhance®<Sof-Lex® wheels< HiLuster®. The group in which Sof-Lex® wheels showed the highest surface Ra in all composites except for Venus diamond which showed the highest surface Ra with HiLuster® polishing system.	The surface roughness is affected by both the composite restoration composition and polishing system used. Different monomer compositions may have direct effect on the final surface polish of the restorative materials. Jiffy® and Enhance® produce acceptable surface polish.

Chart 3. – Polishing Single-Step (1S) devices commercially available and technical details such as, manufacturer, product name/polishing system, approximate average particle size, safety data sheet (SDS), Directions for use (DFU) and link to brochure.

Manufacturer	**Product Name/Polishing System** (Ref. number)	**Approximate Average Particle Size**	**SDS and DFU**	**Link to Brochure**
Brasseler, Savannah, GA, USA	**Composipro®**	NF	Brasseler USA Dental Instrumentation. [In line]. Available at <http://media.brasselerusa.com/userfiles/IFU%2CManuals%2CBrochures/IFU-0008%20Brasseler%20USA%20Polishers%20%26%20Abrasives%20IFU%20REV%20C.pdf > [Accessed in 12/09/2020].	http://brasselerusadental.com/wp-content/files/B-2194b-ComposiPro-One-Step-PR.pdf [Accessed in 12/09/2020].
Dentsply, Caulk, Milford, DE, USA	**Enhance®**	30 µm - Aluminum oxide and silicon dioxide.	Dentsply Sirona [In line]. Available at <https://assets.dentsplysirona.com/flagship/en/explore/restorative/enhance/524357%20Enhance%20mini%20-%20multi_WEB%20final.pdf> [Accessed in 01/09/2020].	https://assets.dentsplysirona.com/flagship/en/explore/restorative/enhance/dsp_903_Enhance%20Sell%20Sheet_A4_v10.pdf [Accessed in 01/09/2020]
Dentsply, Caulk, Milford, DE, USA	**PoGo®**	7 µm - Polymerized urethane dimethacrylate resin, fine diamond powder, silicon oxide.	Dentsply Sirona [In line]. Available at <http://www.dentsply.com.br/bulas/diretory/E/Enhance-Pogo.pdf> [Accessed in 01/09/2020].	https://www.pattersondental.com/Supplies/ItemDetail/071801760 [Accessed in 01/09/2020]
Ivoclar Vivadent, Schaan, Liechtenstein	**Optrapol®** (PL1811)	12 µm - Diamond	Ivoclar Vivadent. [In line]. Available at <https://www.ivoclarvivadent.ca/medias/sys_master/celum-connect2-assets/celum-connect2-assets/hfc/hbe/10112879755294/OptraPol.pdf> [Accessed in 12/09/2020].	https://www.ivoclarvivadent.ca/medias/sys_master/celum-connect2-assets/celum-connect2-assets/hea/h30/10213207801886/OptraPol-Next-Generation.pdf; https://www.ivoclarvivadent.ca/medias/sys_master/celum-connect2-assets/celum-connect2-assets/hc1/h5d/10213207015454/OptraLine1.pdf (page 6) [Accessed in 12/09/2020].

Kenda AG, Vauz, Liechtenstein	**Rubber cup®**	Ultra-fine	Kenda Dental Polishers. [In line]. Available at <http://www.kenda-dental.com/portals/0/conteco/english/k-4_maximus.pdf> [Accessed in 10/02/2020].	http://www.kenda-dental.com/DesktopModules/ToSic_KendaProductCatalog/FileStream.aspx?File=/Kenda/Specifications/Maximus/EN.pdf; http://www.kenda-dental.com/portals/0/content/english/k-4_maximus.pdf [Accessed in 10/02/2020].
Kerr Corp, Orange, CA, USA	**Occlubrush®** (2545189)	**4**.0±0.5 µm	Kerr Corp. [In line]. Available at <https://www.kerrdental.com/en-eu/dental-restoration-products/occlubrush-finishing-and-polishing#docs> [Accessed in 02/09/2020].	https://www.kerrdental.com/en-eu/dental-restoration-products/occlubrush-finishing-and-polishing [Accessed in 02/09/2020].
Kerr Corp, Orange, CA, USA	**Opti 1 Step®** (8001, 8002, 8003)	NF	Kerr Corp. [In line]. Available at <https://www.kerrdental.com/en-eu/dental-restoration-products/occlubrush-finishing-and-polishing#docs> [Accessed in 02/09/2020].	https://www.kerrdental.coc/en-eu/dental-restoration-products/opti1step--polisher-finishing-and-polishing [Accessed in 02/09/2020].
Shofu Dental Corporation, San Marcos, CA, USA	**One-Gloss®** (0112918)	80 µm – aluminum oxide	Shofu INC. [In line]. Available at <https://www.primedentalsprime.com/files/shofu-one-gloss-sds.pdf> [Accessed in 10/02/2020].	https://www.shofu.de/wp-content/uploads/2019/02/OneGloss-M-BRO-UK-2018-09.pdf; https://www.shofu.de/wp-content/uploads/2018/06/OneGloss-OneGloss-PS-Info-UK.pdf [Accessed in 10/02/2020].

Chart 4. – Polishing Multi-Step Devices commercially available and technical details such as, manufacturer, product name/polishing system, approximate average particle size, safety data sheet (SDS), directions for use (DFU) and link to brochure.

Manufacturer	**Product Name/Polishing System** (Ref. number)	**Approximate Average Particle Size**	**SDS and DFU**	**Link to Brochure**
Brasseler Savannah, GA, USA	**Diacomp®** **Green Medium** **Gray Fine** (KR6FF KR8MZ)	40-60 µm 1-3 µm	Brasseler USA Dental Instrumentation. [In line]. Available at <http://39a6b12ilb7y46yglh3knb1p-wpengine.netdna-ssl.com/wp-content/files/DentalPolishers-SDSExemptionLTR-060316%28002%29.pdf> [Accessed in 12/09/2020].	http://brasselerusadental.com/wp-content/files/Diacomp_Comp%20Polishing.pdf [Accessed in 12/09/2020].
Brasseler Savannah, GA, USA	**ET Illustra®** **Pre-Polish - Dark Purple** **High Gloss Shine - Light Purple** (KB7EM)	NF	NF	http://39a6b12ilb7y46yglh3knb1p-wpengine.netdna-ssl.com/wp-content/uploads/sites/9/2015/03/B-2786-ET-Illustra.pdf [Accessed in 12/09/2020].
Clinician's Choice Dental Products Inc., New Milford, CT, USA	**D◆FINE Double Diamond® Polishers** **Primary Polisher - Purple**	45 µm Diamond abrasive	Clinician's Choice Dental Products Inc. [In line]. Available at <https://clinicianschoice-ifu.com/IFU_doublediamond.pdf> [Accessed in 12/09/2020].	https://optident.co.uk/app/uploads/2016/03/Clinicians-Choice-catalogue.pdf (page 26); https://www.clinicianschoice.com/product/d-fine-double-diamond-polishing-system/ [Accessed in 12/09/2020].
	Final High Shine Polisher - Orange	5 µm Diamond abrasive	Clinician's Choice Dental Products Inc. [In line]. Available at <https://clinicianschoice-ifu.com/IFU_doublediamond.pdf> [Accessed in 12/09/2020].	https://optident.co.uk/app/uploads/2016/03/Clinicians-Choice-catalogue.pdf (page 26); https://www.clinicianschoice.com/product/d-fine-double-diamond-polishing-system/ [Accessed in 12/09/2020].
COLTENE Group, Glattbrugg, Zurich, Switzerland, CH	**DIATECH *ShapeGuard* ®-Composite Polishing Plus Kit** **Spiral pre-polishing silicon bur (rose)**	NF	COLTENE Group. [In line]. Available at <https://global.coltene.com/pim/DOC/IFU/docifu30003981-02-20-recommendations-for-safety-and-hygiene-silicone-polisherssallaindv1.pdf> [Accessed in 12/09/2020].	https://global.coltene.com/pim/DOC/BRO/docbro60019970-02-17-shapeguard-en-desallaindv1.pdf [Accessed in 12/09/2020].
	Spiral polishing silicon bur (blue)	NF	COLTENE Group. [In line]. Available at <https://global.coltene.com/pim/DOC/IFU/docifu30003981-02-20-recommendations-for-safety-and-hygiene-silicone-polisherssallaindv1.pdf> [Accessed in 12/09/2020].	https://global.coltene.com/pim/DOC/BRO/docbro60019970-02-17-shapeguard-en-desallaindv1.pdf [Accessed in 12/09/2020].

COLTENE Group, Glattbrugg, Zurich, Switzerland, CH	**SwissFlex® Discs Finishing Disc (Blue) - Coarse**	50 µm	**NF**	https://nam.coltene.com/pim/DOC/FLY/docfly30494b-alpen-swissflex-sssenaindv1.pdf [Accessed in 12/09/2020].
	SwissFlex® Polishing Disc (Red) - Medium	30 µm	**NF**	https://nam.coltene.com/pim/DOC/FLY/docfly30494b-alpen-swissflex-sssenaindv1.pdf [Accessed in 12/09/2020].
	SwissFlex® High Luster Disc (Red/White) - Fine	5 µm	**NF**	https://nam.coltene.com/pim/DOC/FLY/docfly30494b-alpen-swissflex-sssenaindv1.pdf [Accessed in 12/09/2020].
Dentsply, Caulk, Milford, DE, USA	**Enhance ®&** (120609)	45 µm - Aluminum oxide and silicon dioxide.	Dentsply Sirona [In line]. Available at <https://www.dentsplyestore.com.au/secure/downloadfile.asp?fileid=1002299> [Accessed in 01/09/2020].	https://multimedia.3m.com/mws/media/1123831O/sof-lex-diamond-polishing-system-vs-enhance-pogo.pdf [Accessed in 01/09/2020]
	& PoGo® (120609)	7 µm - Polymerized urethane dimethacrylate resin, fine diamond powder, silicon oxide.	Dentsply Sirona [In line]. Available at <https://www.dentsplyestore.com.au/secure/downloadfile.asp?fileid=1002299> [Accessed in 01/09/2020].	https://multimedia.3m.com/mws/media/1123831O/sof-lex-diamond-polishing-system-vs-enhance-pogo.pdf [Accessed in 01/09/2020]
Dentsply Caulk, Milford, DE, USA	**Enhance Flex NST-EF® (aluminum oxide and diamond-silica)** (090323)	40-100µm (aluminum oxide)	**NF**	**NF**
	Enhance Flex NST-EF® (diamond-silica) (090225)	40-60µm (1µm diamond particles imbedded in a matrix of nano-scale silica)	**NF**	**NF**
FGM Produtos Odontológicos, Joinville, SC, Brazil	**Diamond Pro® Dark Blue** (041111)	180 µm	FGM Dental Group. [In line]. Available at <https://www.fgm.ind.br/produtos/polimento-dental-discos-lixa-diamond-pro/#toggle-id-36> [Accessed in 02/09/2020].	https://www.fgm.ind.br/produtos/polimento-dental-discos-lixa-diamond-pro/#toggle-id-36 [Accessed in 02/09/2020].
	Diamond Pro® Medium Blue (041111)	100 µm	FGM Dental Group. [In line]. Available at <https://www.fgm.ind.br/produtos/polimento-dental-discos-lixa-diamond-pro/#toggle-id-36> [Accessed in 02/09/2020].	https://www.fgm.ind.br/produtos/polimento-dental-discos-lixa-diamond-pro/#toggle-id-36 [Accessed in 02/09/2020].
	Diamond Pro® Light Blue (041111)	25 µm	FGM Dental Group. [In line]. Available at <https://www.fgm.ind.br/produtos/polimento-dental-discos-lixa-diamond-pro/#toggle-id-36> [Accessed in 02/09/2020].	https://www.fgm.ind.br/produtos/polimento-dental-discos-lixa-diamond-pro/#toggle-id-36 [Accessed in 02/09/2020].
	Diamond Pro® White (041111)	15 µm	FGM Dental Group. [In line]. Available at <https://www.fgm.ind.br/produtos/polimento-dental-discos-lixa-diamond-pro/#toggle-id-36> [Accessed in 02/09/2020].	https://www.fgm.ind.br/produtos/polimento-dental-discos-lixa-diamond-pro/#toggle-id-36 [Accessed in 02/09/2020].

Heraeus Kulzer Gruner, Hanau, Germany	**Venus Supra® Pre-Polisher**	40 µm	Kulzer Mitsui Chemicals Group. [In line]. Available at <https://www.kulzer.com/en/int/dentist/products_from_a_to_z/venus_2/venus_supra.aspx> [Accessed in 02/09/2020]	https://www.kulzek.com/en/int/dentide/products_from_a_to_z/venus_2/vvenu_supra.aspx [Accessed in 02/09/2020]
	Venus Supra® High Gloss Polishers	4-8 µm	Kulzer Mitsui Chemicals Group. [In line]. Available at <https://www.kulzer.com/en/int/dentist/products_from_a_to_z/venus_2/venus_supra.aspx> [Accessed in 02/09/2020]	https://www.kulzek.com/en/int/dentide/products_from_a_to_z/venus_2/vvenu_supra.aspx [Accessed in 02/09/2020]
Ivoclar Vivadent, Schaan, Liechtenstein	**Astropol ®F,** **Astropol ®P,** **Astropol ®HP** (J16078, J16079, J15646 / RL0751)	36,5µm 12.8µm - silicone rubber, silicon carbide particles. 3.5µm - silicone rubber, diamond particles, aluminium oxide, titanium oxide and iron oxide.	Ivoclar Vivadent. [In line]. Available at <http://downloads.ivoclarvivivocl.com/zoolu-website/media/document/33176/Astropol> and <http://downloads.ivoclarvivadent.com/zoolu-website/media/document/1285/Astropol> [Accessed in 01/09/2020].	https://www.ivoclarvivadeiv.com/en/p/all/products/cliclini-accessories-instruments/polishing-systems/astropol [Accessed in 01/09/2020]
Kenda AG, Vauz, Liechtenstein	**Kenda C.G.I.® Coarse (White)**	NF	Kenda Dental Polishers. [In line]. Available at <http://www.kenda-dental.com/Portals/0/ConteCo/english/K-15_CGI.pdf>; <http://www.kenda-dental.com/en/products/lablaborat-use#> [Accessed in 01/09/2020].	http://www.kenda-dental.com/en/products/lablaborat-use# [Accessed in 01/09/2020].
	Kenda C.G.I.® Medium (Green)	NF	Kenda Dental Polishers. [In line]. Available at <http://www.kenda-dental.com/Portals/0/ConteCo/english/K-15_CGI.pdf>; <http://www.kenda-dental.com/en/products/lablaborat-use#> [Accessed in 01/09/2020].	http://www.kenda-dental.com/en/products/lablaborat-use# [Accessed in 01/09/2020].
	Kenda C.G.I.® Ultrafine (Pink)	NF	Kenda Dental Polishers. [In line]. Available at <http://www.kenda-dental.com/Portals/0/ConteCo/english/K-15_CGI.pdf>; <http://www.kenda-dental.com/en/products/lablaborat-use#> [Accessed in 01/09/2020].	http://www.kenda-dental.com/en/products/lablaborat-use# [Accessed in 01/09/2020].
Kerr Corp., Orange, CA, USA	**HiLuster Plus® Aluminum oxide** **HiLuster Plus® Diamond** (5462546)	10 µm 5 µm	Kerr Dental. [In line]. Available at <https://www.kerrdental.com/en-eu/dental-restoration-products/hilusterplus-polishing-system-	https://www.dentina.pt/image.ashx?i=828913.pdf&fn=KERR.pdf; page 96; [Accessed in 12/09/2020].

			finishing-and-polishing#docs> [Accessed in 12/09/2020].	
Kerr Corp., Orange, CA, USA	**OptiDisc® Coarse/medium (Medium Orange)**	40 µm	Kerr Dental. [In line]. Available at <https://www.yumpu.com/en/document/read/23814546/06-finishing-and-polishing-kerr> [Accessed in 02/09/2020].	https://www.kerrdental.coc/en-eu/dental-restoration-products/opti1step--polisher-finishing-and-polishing [Accessed in 02/09/2020].
	OptiDisc® Fine (Light Orange)	20 µm	Kerr Dental. [In line]. Available at <https://www.yumpu.com/en/document/read/23814546/06-finishing-and-polishing-kerr> [Accessed in 02/09/2020].	https://www.kerrdental.coc/en-eu/dental-restoration-products/opti1step--polisher-finishing-and-polishing [Accessed in 02/09/2020].
	OptiDisc® Extra-fine (Yellow)	10 µm	Kerr Dental. [In line]. Available at <https://www.yumpu.com/en/document/read/23814546/06-finishing-and-polishing-kerr> [Accessed in 02/09/2020].	https://www.kerrdental.coc/en-eu/dental-restoration-products/opti1step--polisher-finishing-and-polishing [Accessed in 02/09/2020].
Komet Dental, Lemgo, Germany, DE	**Q-crosscut® 12/15-fluted Finishing bur - Blue-and-yellow ring** (H48LQ 314.012)	15 blades	NF	https://www.komet.com.br/produto/broca-carbide-komet-serie-q-para-acabamento-e-pre-polimento-de-resina-foto-mode/537038-958873 [Accessed in 12/09/2020].
	Crosscut® 30-fluted Polishing bur - White ring H48LUF 314.012	30 blades	Komet Dental. [In line]. Available at <https://www.kometdental.de/en/Info-Center/Instructions%20for%20use/SyncFolder/311663> [Accessed in 12/09/2020].	https://www.kometdental.de/~/media/Komet Dental/Ordering%20Guides/SyncFolder/419067_pdf.pdf?92085715-e6eb-4117-8cb3-8f55d170f717 [Accessed in 12/09/2020].
	EVO-Light® polisher (Komet) Ultrafine (9523UF.204.030)	8 µm	Komet Dental. [In line]. Available at <https://www.kometdental.de/en/ProductCategories/praxis/polierer/composite.aspx > [Accessed in 12/09/2020].	https://www.kometdental.de/~/media/Komet Dental/Product%20Info/SyncFolder/410429_pdf.pdf?e7c231a6-4a1d-4639-93a8-b3592514212d [Accessed in 12/09/2020].
Kuraray Europe, GmbH, Hattersheim/Germany, DE	**CLEARFIL Twist DIA® Medium** (241549)	NF	Kuraray. [In line]. Available at <https://www.kuraraynokurara.eu/pub/media/pdfp/FB176_09_EVE_PrepPrepara_and_ReprocessiRe_Instructions_PolishePo_EN.pdf>;<https://www.kuraraynoritake.ee/pub/media/pdfs/FB171_03_EVE_Application_and_Safety_PrecautionP_Polishers_EN_1.pdf> [Accessed in 02/09/2020].	https://www.kuraraynoritake.eu/pub/media/pdfs/CLEARFIL_Twist_DIA_Flyer.pdf [Accessed in 02/09/2020].
	CLEARFIL Twist DIA® Fine (241549)	NF	Kuraray. [In line]. Available at <https://www.kuraraynokurara.eu/pub/media/pdfp/FB176_09_EVE_PrepPrepara_and_ReprocessiRe_Instructions_PolishePo_EN.pdf>;<https://www.kuraraynoritake.ee/pub/media/pdfs/FB171_03_EVE_Applicati	https://www.kuraraynoritake.eu/pub/media/pdfs/CLEARFIL_Twist_DIA_Flyer.pdf [Accessed in 02/09/2020].

			on_and_Safety_PrecautionP_Polishers_EN_1.pdf> [Accessed in 02/09/2020].	
Shofu Dental Corporation, San Marcos, CA, USA	**Super-Snap® Black (silicon carbide)** (1109721)	60 µm	Shofu INC. [In line]. Available at <https://www.shofu.com/wp-content/uploads/Super-Snap-SDS-US-Version-5.pdf> and <https://www.shofu.com/wp-content/uploads/Super-Snap-IFU-US-300071410-04.pdf> [Accessed in 01/09/2020].	https://www.shofu.com/en/product/super-snap-singles/ [Accessed in 01/09/2020]
	Super-Snap® Violet (silicon carbide) (1109721)	30 µm	Shofu INC. [In line]. Available at <https://www.shofu.com/wp-content/uploads/Super-Snap-SDS-US-Version-5.pdf> and <https://www.shofu.com/wp-content/uploads/Super-Snap-IFU-US-300071410-04.pdf> [Accessed in 01/09/2020].	https://www.shofu.com/en/product/super-snap-singles/ [Accessed in 01/09/2020]
	Super-Snap® Green (aluminum oxide) (1109721)	20 µm	Shofu INC. [In line]. Available at <https://www.shofu.com/wp-content/uploads/Super-Snap-SDS-US-Version-5.pdf> and <https://www.shofu.com/wp-content/uploads/Super-Snap-IFU-US-300071410-04.pdf> [Accessed in 01/09/2020].	https://www.shofu.com/en/product/super-snap-singles/ [Accessed in 01/09/2020]
	Super-Snap® Red (aluminum oxide) (1109721)	7 µm	Shofu INC. [In line]. Available at <https://www.shofu.com/wp-content/uploads/Super-Snap-SDS-US-Version-5.pdf> and <https://www.shofu.com/wp-content/uploads/Super-Snap-IFU-US-300071410-04.pdf> [Accessed in 01/09/2020].	https://www.shofu.com/en/product/super-snap-singles/ [Accessed in 01/09/2020]
TDV Dental Ltda., Pomerode, SC, Brazil	**Superfix® Dark Green** (0812/1011)	200 µm	TDV Grupo Septodont. [In line]. Available at <http://tdv.com.br/wp-content/uploads/2018/08/Bula-Superfix.pdf> [Accessed in 02/09/2020].	http://tdv.com.br/produtos/acabamento-e-polimento/superfix/ [Accessed in 01/09/2020].
	Superfix® Light Green (0812/1011)	100 µm	TDV Grupo Septodont. [In line]. Available at <http://tdv.com.br/wp-content/uploads/2018/08/Bula-Superfix.pdf> [Accessed in 02/09/2020].	http://tdv.com.br/produtos/acabamento-e-polimento/superfix/ [Accessed in 01/09/2020].
	Superfix® Yellow (0812/1011)	30 µm	TDV Grupo Septodont. [In line]. Available at <http://tdv.com.br/wp-content/uploads/2018/08/Bula-Superfix.pdf> [Accessed in 02/09/2020].	http://tdv.com.br/produtos/acabamento-e-polimento/superfix/ [Accessed in 01/09/2020].
	Superfix® White (0812/1011)	20 µm	TDV Grupo Septodont. [In line]. Available at <http://tdv.com.br/wp-content/uploads/2018/08/Bula-Superfix.pdf> [Accessed in 02/09/2020].	http://tdv.com.br/produtos/acabamento-e-polimento/superfix/ [Accessed in 01/09/2020].
Ultradent, South Jordan, UT, USA	**Jiffy® natural universal wheels Medium Wheel - Yellow**	NF	Ultradent Products Inc. [In line]. Available at <https://downloads.ctfassets.net/wfptrcrbtkd0/a5e58226-2f0a-4c2c-856d-9cfd38581575/00904d39ac5fdcbe66be512031e1e355/Jiffy-Procedures.pdf> [Accessed in 12/09/2020].	https://www.ultradent.com/products/categories/finish/ceramic-finishing/jiffy-natural-universal; https://intl.ultradent.com/SiteCollectionImages/Multi-Media-

				Tab/Brochures/Finish/Documents/Jiffy-Natural-Universal-Sales-Sheet.pdf [Accessed in 12/09/2020].
	Fine Wheel - White	NF	Ultradent Products Inc. [In line]. Available at <https://downloads.ctfassets.net/wfptrcrbtkd0/a5e58226-2f0a-4c2c-856d-9cfd38581575/00904d39ac5fdcbe66be512031e1e355/Jiffy-Procedures.pdf> [Accessed in 12/09/2020].	https://www.ultradent.com/products/categories/finish/ceramic-finishing/jiffy-natural-universal; https://intl.ultradent.com/SiteCollectionImages/Multi-Media-Tab/Brochures/Finish/Documents/Jiffy-Natural-Universal-Sales-Sheet.pdf [Accessed in 12/09/2020].
3M ESPE Dental Products, St Paul, MN, USA	**Sof-Lex® Red** (2385P)	60µm (aluminum oxide)	3M ESPE Sof-Lex. [In line]. Available at <https://media.dentalcompden.com/m/25/Downloads/Sof-Lex%20Contouring%20ana%20Polishing%20Discs%20MSDS.pdf> [Accessed in 01/09/2020].	https://msdsdigital.com/3m-espe-sof-lex-finishing-and-polishing-system-kit-msds [Accessed in 01/09/2020]
	Sof-Lex® Medium Orange (2385P)	40µm (aluminum oxide)	3M ESPE Sof-Lex. [In line]. Available at <https://media.dentalcompden.com/m/25/Downloads/Sof-Lex%20Contouring%20ana%20Polishing%20Discs%20MSDS.pdf> [Accessed in 01/09/2020].	https://msdsdigital.com/3m-espe-sof-lex-finishing-and-polishing-system-kit-msds [Accessed in 01/09/2020]
	Sof-Lex® Light Orange (2385P)	24µm (aluminum oxide)	3M ESPE Sof-Lex. [In line]. Available at <https://media.dentalcompden.com/m/25/Downloads/Sof-Lex%20Contouring%20ana%20Polishing%20Discs%20MSDS.pdf> [Accessed in 01/09/2020].	https://msdsdigital.com/3m-espe-sof-lex-finishing-and-polishing-system-kit-msds [Accessed in 01/09/2020]
	Sof-Lex® Yellow (2385P)	8µm (aluminum oxide)	3M ESPE Sof-Lex. [In line]. Available at <https://media.dentalcompden.com/m/25/Downloads/Sof-Lex%20Contouring%20ana%20Polishing%20Discs%20MSDS.pdf> [Accessed in 01/09/2020].	https://msdsdigital.com/3m-espe-sof-lex-finishing-and-polishing-system-kit-msds [Accessed in 01/09/2020]
3M ESPE Dental Products, St Paul, MN, USA	**Sof-Lex Spiral Finishing & Polishing Wheels®, Fine (Yellow)** (N511339)	NF	3M ESPE Sof-Lex. [In line]. Available at <https://multimedia.3m.com/mws/mediawebserver?mwsId=SSSSSuUn_zu8l00xmx_Sl82Z4v70k17zHvu9lxtD7SSSSSS--> [Accessed in 02/09/2020].	https://multimedia.3m.com/mws/media/850789O/sof-lex-finishing-and-polishing-system-brochure.pdf [Accessed in 02/09/2020].
	Sof-Lex Spiral Finishing & Polishing Wheels®, SuperFine (Rose) (N514708)	NF	3M ESPE Sof-Lex. [In line]. Available at <https://multimedia.3m.com/mws/mediawebserver?mwsId=SSSSSuUn_zu8l00xmx_Sl82Z4v70k17zHvu9lxtD7SSSSSS--> [Accessed in 02/09/2020].	https://multimedia.3m.com/mws/media/850789O/sof-lex-finishing-and-polishing-system-brochure.pdf [Accessed in 02/09/2020].

NF – not found