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A comparative evaluation of efficacy of three different optical magnification modalities used for tooth preparation for veneers- an in vitro study.

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Abstract

Context: Tooth preparation for veneers is highly demanding and requires high conservation of tooth structure. Magnification devices aid in visual enhancement and improved ergonomics. Hence this study was planned for comparative evaluation of efficacy of three different magnifications modalities used for tooth preparation for veneers.

Materials and Methods: 75 ivorine upper incisors were divided into 3 groups (n=25) Group 1-Tooth preparation with naked human eye Group 2- Tooth preparation using compound loups under3x magnification; Group 3-Tooth preparation using an operating microscope under 6.0x magnification. A laboratory scanning device was used to scan the teeth both before and after the preparation phase. Computer-aided design software was used tooverlay the outlines of the teeth in all groups. A sagittalplane was constructed throughout the digital teeth images,and measurements of cut hard dental tissues were done in order to evaluate the accuracy of tooth preparation by comparing the preparation depths in all the three groups.

Results: Regardless of magnification, there is a statistical discrepancy between the actual cut of hard

dental tissues and the pre-established volume of preparation. The level of preparation in cases visible to the naked eye differs statistically significantly from cases seen under magnification.

Conclusion: Under the limitation of this in vitro study, it could be concluded that accurate preparation is achieved when using magnification as compared to naked eye.

Keywords: Magnification, Veneers, Dental Operating Microscope, Loupes.

Introduction

In conservative dentistry, enamel and dentin preparation is very technical, particularly for dental laminate veneers, where minimal invasiveness is important. The final result of the therapy is determined by a number of aspects, one of which is the accuracy and quality of the created structures.

Restorative margins are regarded in adhesive dentistry as the secret to long-lasting, successful restorations. Under the scope, precise modification of the veneer preparation outline and margin can also be achieved. [1]

According to Carr, the human eye can resolve or discriminate between two discrete lines or objects separated by 200 μm (0.2 mm) when it is not magnified. In clinical settings, the majority of dentists are unable to detect an open margin that is less than 0.2 mm. By using magnification, the clinician can see more detail than they could with just their eyes alone since it enhances the eye's ability to resolve these objects. For instance, resolution can be increased to 100 μm with 2x magnifiers, such as telescopic loupes, and to 50 μm, or 0.05 mm, with 4x loupes. [2] Throughout the 20th century, operating microscopes and magnification loupes were frequently used in clinical practice worldwide.

Compound loupes, also known as telescopic loupes, are made up of several lenses with air spaces between them. This allows for adjustments to be made to the depth of field, working distance, and magnification without adding mass or weight.[1]

The range of their magnification is 2x to 8x. For sufficient field of vision visibility when using a loupe, an additional headlight is usually necessary, especially when the loupe has a magnification of more than 3.5x.[3]. Loupes are typically less onerous in the operating field because they are head mounted, less expensive, and easier to operate.[1] When dental students use loupes to magnify objects, Leiknius and Geissberger's research demonstrates that the errors in preparation design and laboratory processing are reduced in half compared to a control group that does not utilize magnification.[4]

The operational microscope underwent numerous technical development stages,[5] but today it offers improved magnification and resolution, as well as brighter, larger, three-dimensional working images and ergonomic operator position.[1, 6] It is difficult for a physician to work at higher power magnifications because even small hand motions cause disruptions.[7]

Hence the aim of this study was to assess how optical magnification affects dental preparation accuracy in a clinical condition. The depth of preparation determines how accurate the preparation was for this investigation. The idea behind the null hypothesis was that magnification wouldn't affect how precisely teeth are prepared.

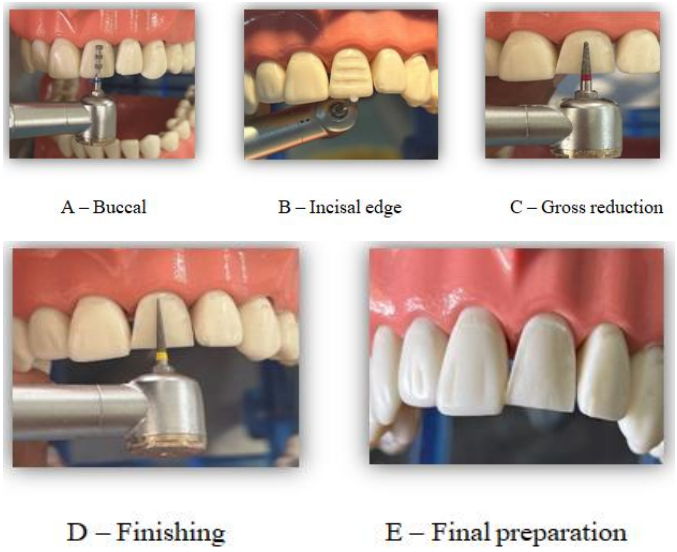
Material and Method

For the test specimens, 75 plastic upper incisors were divided into 3 groups (n= 25): 1st group - teeth prepared with a naked human eye.; 2nd group - teeth prepared using compound loupes (ZUMAX, SUZHOU) under x3.0 magnification; 3rd group - teeth prepared using operating microscope x6.0 magnification (OMS 1950, ZUMAX)

One dentist prepared all of the specimens, and the preparation design was standardized as follows to reduce the impact of technical sensitivities in the prosthesis fabrication process and to standardize the prosthesis volume and size: Shoulder marginal finish shape preparation design with incisal reduction: tissues are cut by 0.3 mm cervically, 0.5 mm in the clinical crown's middle third, and 1.0 mm incisally.

three different kinds of turbine burs were used: a cylinder bur with a beveled tip shape, a superfine diamond bur colored red, and a depth cutter with preparation depths of 0,3 and 0,5 mm (Axis Dental, Switzerland). First, the depth of preparation was marked in three planes: a depth-cutter of 0.3 mm was placed parallel to the cervical area; a depth-cutter of 0.5 mm was placed parallel to the middle third; and a cylindrical bur with a rounded tip of Ø 1,0 mm was placed perpendicular to the incisal edge.A marker was used to color the carved fissures. The buccal wall and the incisal edge were completely prepared down to the selected depth using a cylindric bur. Using a superfine diamond bur, the walls are finished and smoothed to complete the preparation.(fig. 1)

Figure 1: Ssteps in the preparation of veneers.



A – Buccal B – Incisal edge C – Gross reduction

D – Finishing E – Final preparation

The teeth were scanned with a laboratory scanning machine beforehand. Through the use of computer-aided design (CAD 3Shape Trio) software, the pre- and post-preparation tooth outlines were superimposed. The digital teeth images were generated in a sagittal plane, and measurements of the cut hard dental tissues in the cervical, middle, and incisal parts were taken. These measurements were intended to assess the accuracy of the tooth preparation using the subsequent magnification in accordance with the depth of preparation parameters that have already been determined. (fig.2)

Figure 2: Measurement of the depth of preparation.

A- Cervical B- Middle C- Incisal

Statistical analysis

Standard error, or mean±SE, was used in descriptive statistics. The Saphiro-Wilk test was used to confirm deviations from fundamental presumptions regarding the data's normality. A single sample ttest was used to compare study groups and baseline depth of preparation. The independent sample t-test was used to compare the study groups (loupes vs. naked eyes). At $p<0.05$, statistical significance was deemed acceptable. The IBM SPSS Statistics 22 software program (IBM SPSS Inc., Chicago, IL, USA) was used for all statistical calculation.

Results

The descriptive statistics show a depth of preparation for 1st group - mean values for the cervical third of 0.55±0.06mm, for the middle third 0.69±0.05 mm and for incisal edge 1.25 ± 0.04 mm; for 2nd group - mean values for the cervical third of 0.44±0.05mm, for the middle third 0.55± 0.05 mm and for the incisal edge

1.17±0.06mm; for 3rd group - mean values for the cervical third of 0.42±0.05mm, for the middle third 0.52± 0.05 mm and for the incisal edge 1.14±0.05 mm (table 1).

Table 1: Descriptive statistics.

	Mean ± Standard error	Standard deviation	t value	p value
	1st group – naked eye			
Cervical third – 0.3mm	0.55± 0.06	0.11	11.880	<0.001*
Middle third – 0.5mm	0.69± 0.05	0.11	6.971	<0.001*
Incisal third – 1mm	1.25± 0.04	0.13	9,126	<0.001*
	2nd group – compound loupes			
Cervical third – 0.3mm	0.44± 0.05	0.11	6.902	<0.001*
Middle third – 0.5mm	0.55 ± 0.05	0.09	2.431	0.023*
Incisal third – 1mm	1.17± 0.06	0.13	4.123	<0.001*
	3rd group – operating microscope			
Cervical third – 0.3mm	0.42± 0.05	0.11	6.554	<0.001*
Middle third – 0.5mm	0.52± 0.05	0.10	1.638	0.115
Incisal third – 1mm	1.14± 0.05	0.10	5.574	<0.001*

One sample t test; * indicates significant difference at p≤0.05

One sample t-test proved the statistically significant difference between mean values of preparation for all groups and areas versus the baseline depths of preparation (p< 0.05). The only exception is the preparation in the middle third in 3rd group - there was no statistically significant difference between the pre established 0.5 mm and the actual depth.

Table 2: Comparison of between three groups

	Naked eye vs Compound loupes		Naked eye vs Operating microscope		Compound loupes vs Operating microscope	
	t value	p value	t value	p value	t value	p value
Cervical third – 0.3mm	3.627	0.001*	3.828	<0.001*	0.214	0.831
Middle third – 0.5mm	3.811	<0.001*	4.173	<0.001*	0.487	0.628
Incisal third – 1mm	3.598	0.001*	3.617	0.001*	-0.301	0.765

Independent t test; * indicates significant difference at p≤0.05

There was statistically significant difference in mean value in incisal third - naked eye vs loupes and naked eye vs operating microscope; in middle third - naked eye vs loupes and naked eye vs operating microscope; and cervical third - naked eye vs loupes and naked eye vs operating microscope; however, there was no statistically significant difference in mean values between compound loups and operating microscope (p>0.05). (Table 2)

Discussion

The statistical analysis demonstrates that the level of preparation in every area that was looked at was much higher than the predetermined parameters. So unnecessary tissue in the teeth was cut. The technical protocol of preparation provides an explanation: following depth cuts, a finishing bur and a cylindric bur were used to polish the surface.

This fact is questionable given the modern trend toward minimally invasive procedures. In order to create a superior adhesive bond between the veneer and the dentinal surface, the majority of experts insist on minimum invasive preparation. [8,9]

Le Sage et al. state that at least 50% of the total enamel and at least 50% of the marginal enamel must remain in order for veneers to be successfully fixed. In every clinical situation where it is feasible, dentin exposure should be prevented.[10]

The depth of enamel 1 mm above the cemento-enamel junction is found to range between 0,17 mm and 0,52 mm in a study conducted by Ferrari et al. [11] Our measurements show that visible dentin will be present in nearly all cases, regardless of magnification. It can weaken the bonding power of the adhesive. There was significantly more enamel in the middle and incisal third, and dentinal exposure was less common when constructing teeth that are between 0.5 and 0.7 mm.

A statistical analysis demonstrates a noteworthy distinction in preparation precision between the first, second, and third groups. This was consistent with the findings of numerous scholars in the field. Cavity preparations perform better under magnifying loupes than without them, according to an in vitro trial [12] that compared the preparation of Class II with and without loupes. This difference was statistically significant based on kappa values (0.64 with loupes and 0.76 without loupes) and Chi-square value (8.01).About 80% of cavity preparations were rated as "satisfactory" by the loupes when assessing the quality of tooth preparation, compared to 20% that were rated as "nonsatisfactory." This may result from the use of magnification, which reduces eyestrain by enhancing detail of the oral cavity and improving visibility of the operating field without the need to be closer to the patient.

Research of a similar nature by Farook et al., Maggio et al., and Buhrley et al. demonstrated that using magnifications was always preferable. Not using a microscope or loupes not only affect the practitioner's musculoskeletal health but also aid in raising the standard of care.[13, 14] The use of magnifying loupes enhances the quality of the preparation.Operator fatigue is decreased and treatment times are shortened when great precision and enhanced control are possessed. To guarantee that professionals can fully benefit from these magnification devices, technical expertise and training are needed.[15]

Conclusion

Preparation for laminate veneers when magnification is used is much more precise according to depth of preparation of hard dental tissues. Compound loups and

operating microscope cause less invasive preparation design.

References

1. Hegde R, Hegde V. Magnification- enhanced contemporary dentistry: Getting started. J Interdiscip Dentistry. 2016; 6(2):91-100.
2. Carr GB. Magnification and illumination in endodontics. In: Hardin FJ, editor. Clark's clinical dentistry, 1998; vol. 4. p. 1–14.
3. van As GA. The use of extreme magnification in fixed prosthodontics. Dent Today. 2003 Jun; 22(6):93-9.
4. Leknius C, Geissberger M. The effect of magnification on the performance of fixed prosthodontic procedures. J Calif Dent Assoc. 1995 Dec;23(12):66-70.
5. Schultheiss D, Denil J. History of the microscope and development of microsurgery: a revolution for reproductive tract surgery. Andrologia. 2002 Sep;34(4):234-41.
6. Mamoun JS. The maxillary molar endodontic access opening: A microscope- based approach. Eur J Dent. 2016 Jul- Sep;10(3):439-446.
7. Mittal S, Kumar T, Sharma J. An innovative approach in microscopic endodontics. J Conserv Dent. 2014 May;17(3):297-8.
8. LeSage BP. Minimally invasive dentistry: paradigm shifts in preparation design. Pract Proced Aesthet Dent. 2009 Mar-Apr;21(2):97-101.
9. Magne P, Douglas WH. Porcelain veneers: dentin bonding optimization and biomimetic recovery of the crown. Int J Prosthodont. 1999;12(2):111-21.
10. LeSage B, Wells D. Myths vs. realities: two viewpoints on prepared veneers and prep- less veneers. J Cosm Dent. 2011 Summer;27(2):67-72.
11. Ferrari M, Patroni S, Balleri P. Measurement of enamel thickness in relation to reduction for etched laminate veneers. Int J Periodontics Restorative Dent. 1992; 12(5):407-13.
12. Narula K, Kundabala M, Shetty N, Shenoy R. Evaluation of Tooth Preparations for Class II Cavities Using Magnification Loupes Among Dental Interns and Final Year BDS Students in Preclinical Laboratory. JConserv Dent. 2015 Jul-Aug;18(4):284-7.
13. Farook SA, Stokes RJ, Davis AKJ, Sneddon K, Collyer J. Use of Dental Loupes Among Dental Trainers and Trainees in the UK. J Investig Clin Dent. 2013 May;4(2):120-3.
14. Branson BG, Abnos RM, Simmer- Beck ML, King GW, Siddicky SF. Using Motion Capture Technology to Measure the Effects of Magnification Loupes on Dental Operator Posture: A Pilot Study. Work. 2018; 59(1):131-9.
15. Wajngarten D, Petromilli P. Expanding the Operating Field in Endodontics: From magnification loupes to microscope. Dent oral biology and craniofacial research. 2018 Mar;1(1):2-4.