

Magnification and Illumination - Augmenting Routine Dentistry with Dental Loupes

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Abstract

Clinicians when operating without a magnification aid, tend to keep the head and neck in an unbalanced forward position which leads to muscle fatigue and pain. Use of magnification with illumination gives an improved precision in treatment and comfort to the operator. This article describes the widespread application of magnification in dental procedures and aims at encouraging clinicians to include dental loupes in the everyday dental practice armamentarium.

Keywords: Magnification; Illumination; Augmenting; Dental Loupes

Introduction

Painless and minimally invasive dentistry is what today's up-to-the-minute patient seeks. An enhanced visual acuity is the supreme priority for the modern-day dentist to achieve better working field and precision.

Syngcuk Kim mentioned, "You can only treat what you can see" [1].

Without a doubt, the operator can have improved potential of accurate diagnosis and treatment planning in more clarified and detailed magnified operating field.

Currently, Dental loupes and Dental Operating Microscope, are the devices utilized in dentistry for magnification [2].

By the early 1900s, the surgical loupes discovered in the 1870s, had evolved into a binocular loupe accompanying spectacles [3]. Operating Microscope was introduced by Dr Jako and Dr Apotheker in 1978 in dentistry [4].

Dental loupes

Magnification ranging from 2X to 6X is the normal range utilized in dentistry. Loupes were developed to correct the difficulties of reduced depth of field, proximity to the object and the eyestrain caused as a result of moving nearer to the subject [5].

Mainly, loupes are made up of two monocular microscopes, with side by side lenses, angled to focus on an object to form magnified images with stereoscopic properties that are created by the use of convergent lens systems. Dental loupes are available in two types [6]:

- Galilean loupes that are light in weight and economic. These loupes enable a large field of view with magnification in the range of 2.0 x and 5.5 x.

- Keplerian or Prismatic loupes offer a greater depth of field, a higher resolution with longer telescopes compared to the Galilean type. Prismatic loupes provide a magnification of 4.0x - 8.0x [7].

Based on the design, Dental loupes can be classified as Flip-up loupes and Through the lens (TTL) loupes. In the flip-up loupes, the telescope is present away from the eyes and the scope is positioned in front of the lens in a hinged manner. The field of vision is narrow and are heavier than TTL loupes [3].

Through the lens loupes are placed nearer to the eyes and they provide a wider field of vision and are more comfortable. It is expensive than the flip-up type and requires demounting to adjust the change in eye prescription.

Applications of magnification and illumination in dentistry

Magnification plays a pivotal role starting from diagnosis and treatment planning to finishing and polishing of restorations. Clear field of view with enhanced illumination aids in accurate and precise dentistry.

Restorative dentistry:

- Recognition of enamel/dentine fractures.
- Detection of dental caries.
- High precision on crown edges, preparation levels, veneers.
- Better finishing of restorations.
- Good marginal integrity.

Implant dentistry

- High-precision examination and treatment.
- Reliable detection of anatomical structures.

Periodontics

- Support of soft tissue management for fast healing.
- Low scarring; improved cosmetic outcomes.

Endodontics

- Detection of root canals, isthmuses.
- Visibility right to the apex.
- Localization, visualization of accessory canals.
- Locating calcified canals.

- Final examination of canal preparation.
- Removal of fractured instruments.
- Recognition, location of fractures.
- Perforation repair.
- Soft tissue management.
- Root end procedures (apicoectomy with retrograde filling).

Prosthodontics [8]

- Can be used for tooth preparation and better evaluation of finish lines.
- Final restoration in fixed prosthodontics.

Orthodontics [8]

- Enhanced magnification helps with smaller bracket systems, self-ligating system, lingual appliances etc.
- Aid in orthodontic microsurgeries and piezosurgical bone cuts.

Oral surgery [8]

- Superbly helpful in microsurgery.
- Injuries to nerve and tissues can be avoided using magnification in surgery of impacted teeth and mucogingival procedures.
- More precision causes minimum trauma to soft tissues leading to reduced discomfort and faster healing for the patient.

How to select dental loupes?

1. Choose the correct magnification and working distance in order to ensure that you work in complete ergonomic harmony with your new loupe.
2. Test the working distance (Table 1).
3. Look at an object with straight black lines.
4. Test the magnification.
5. Check the field of view.

Height	Sitting	Standing
< 170 cm (5ft 7 in)	340 mm (14 in)	420 mm (16 in)
170 - 190 cm (5ft 7 in to 6ft 4 in)	420 mm (16 in)	500 mm (20 in)
> 190 cm (6ft 4 in)	500 mm (20 in)	550 mm (22 in)

Table 1: Ensuring correct working distance.

The declination angles that are steep enables the operators to only look down and work, instead of adjusting their backs and neck in uncomfortable positions. The presence of efficient illumination enhances the field of view and accuracy for clinicians, thus rendering dental loupes as a smart ergonomic investment.

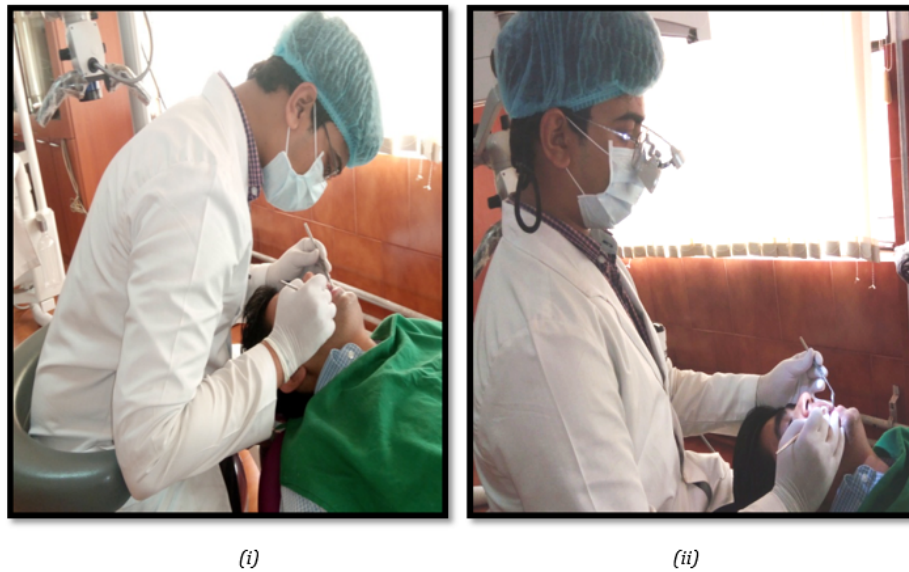


Figure 1: Posture (i) Without magnification (ii) With magnification.

Newer advances in dental loupes [11]

ZEISS EyeMag smart (Figure 2)

Flip-up medical loupes featuring a Galilean design:

- 2.5x magnification provides large fields of view for optimal visualization of the surgical area.
- Easy, intuitive operation - ready for use in seconds.
- Comfortable, ergonomic fit.
- Available with three different carriers:
 - ZEISS EyeMag Smart with titanium eyeglass frame.
 - ZEISS EyeMag Smart with sports frame.
 - ZEISS EyeMag Smart with laser protection.



Figure 2

ZEISS EyeMag Pro F and EyeMag Pro S (Figure 3)

- Flip-up medical loupes featuring a Kepler design.
- Edge-to-edge sharpness with up to 5x magnification.
- For users with high magnification demands.
- Large selection of different models available in different combinations of magnification levels and working distances.
- Available with two different carriers:

- ZEISS EyeMag Pro F with titanium eyeglass frame.
- ZEISS EyeMag Pro S with headband.



Figure 3

EyeMag Light II (Figure 4)

- Mobile LED light source.
- Brilliant illumination for outstanding image quality.



Figure 4

Dental operating microscope

The microscope provides enhanced illumination along with a great magnification ranging from 3x to 30x. Prominently contributed to improved surgical and non-surgical dental procedures.

Loupes vs dental operating microscope

Loupes	Operating Microscope
1.5x - 8x Magnification	2.5x - 20x Magnification
Need additional illumination for magnification of 4x or greater	Use excellent coaxial Fibre optic illumination, hence does not need an additional light source
Operator eye comfort is less as the eyes must converge to view the image	High comfort as it has parallel binoculars
Initially easy to use	Basic training required to use a surgical microscope
Cannot provide variable magnification	Main advantage: Provides variable magnification

Study done by Wajngarten, *et al.* (2019) on dental students concluded that both the Keplerian and Galilean magnification, at a comfortable and standardized distance, provided ideal visual acuity and least strain to the operator’s neck. Dental operating microscope produced similar results at a standardized distance of 30 - 40 cm [12].

Advantages of magnification and illumination in everyday clinical use [9]:

1. Improved precision of treatment.
2. Magnified image.
3. Enhanced ergonomics.
4. Brilliant illumination.
5. Improved comfort.

Illumination

Insufficient lighting can cause bent postures to visualize the areas of the mouth that are shadowed. Dr Lance Rucker, ergonomic expert and director of clinical simulation at the University of British Columbia recommends the operatory light to be positioned parallel to or within 15 degrees of the operator’s line of vision. Loupes with mounted headlights are also parallel to the operator’s line of sight [10].

Summary

To achieve clinical accuracy, Magnification with adequate illumination is an important asset. Magnification devices, especially dental loupes, should be a part and parcel of everyday dental armamentarium. The clinicians should develop the capability of recognizing various properties of magnification devices and learn the usage of the same. In the coming times, magnification is the biggest help in raising the levels of dentistry and enhancing the work of clinicians with improved visual acuity and comfort. Hence, it should be a part of everyday practice as a valued patient education tool and self-appraisal device by the clinicians and dental students.

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