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LOUPES IN ORTHODONTIC PRACTICE: A REVIEW

Orthodontics

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ABSTRACT

Introduction: The dental practice places an enormous emphasis on the operator's visual acuity and musculoskeletal system. While performing orthodontic procedures, the dental surgeon may incline their head and neck towards the patient's mouth to get closer and obtain a better view of the operating field, thus increasing the dentist's risk of developing musculoskeletal disorders. Loupes should be considered a standard piece of equipment for today's clinicians. Magnification benefits of loupes are visual acuity at a greater focal distance with decreased eye strain and increased treatment accuracy and effectiveness, which increases the quality of patient care. Ergonomically correct posture decreases neck, shoulder, and back strain and increases the longevity of your career. Start using loops as a student if possible. It is easier, to begin with, good posture than to break old habits. The current evidence endorses the advantages of magnification loupes in dentistry in diagnosis and treatment delivery. However, more studies should be conducted to research different procedure outcomes over the long run. Further, there is strong scientific evidence supporting the use of dental magnification loupe for postural and musculoskeletal support, but very few articles about orthodontics. **Aims and Objectives:** This review article aims to emphasize the ergonomic benefit of dental loupes in orthodontics. **Material and Methods:** The paper included 60 articles selected on dental loupes with inclusion criteria and 41 articles were excluded based on exclusion criteria. Overall, seven electronic databases in seven databases like Google Scholar, PubMed, CENTRAL, Scopus, Cochrane Library, Web of Science, Embase, beginning, and hand searching until 2021, were conducted. **Conclusion:** Dental loupes can have a positive effect on the quality of the treatment where the debonding procedure can result in less enamel damage and the bracket bonding procedure will leave composite residues which is called flash, As we deal with different types of new bracket system, which has doors to lock the wire in the bracket, its difficult to work manage the composite flowing into it through the naked eye and therefore we recommend the use of dental loupes in any orthodontic procedures

KEYWORDS

Ergonomics, musculoskeletal disorder, loupes, visual acuity

INTRODUCTION

Dentistry requires constant touch with minute biological and nonbiological structures, making it a visually demanding profession. Therefore, enhancing visual accessibility is a desired advantage. Dental professionals frequently try to move their heads closer to view their operating fields or target area to improve visibility. But this results in poor postural adjustments such as a hunched back, twisted neck, etc. One of the main causes of the high prevalence of musculoskeletal problems among dentists is thought to be these unergonomic procedures. For use in dental surgery, Apotheker and Jako created the first surgical microscope in 1978[1]. Although dentists have traditionally used their unaided eyes to perform most dental procedures, magnification loupes have been used by them as a visual aid for many years, and their design and effectiveness have continuously improved. Dental work necessitates using various upper body regions, including the head, neck, shoulders, arms, and back. According to Lietz et al systematic reviews and meta-analysis, the annualized prevalence of musculoskeletal problems among dentists was as high as 78%, with the neck and upper back being the most prevalent places to experience discomfort [2]. Additionally, incorrect and awkward postures are one of the key risk factors for musculoskeletal problems in dental hygienists and dental assistants. Methods including adopting ergonomic seating, ergonomic training, and magnification loupes have been suggested to reduce these musculoskeletal dysfunctions in dentistry. The loupes set working length and lens inclination angles claim to have postural and musculoskeletal benefits.

MATERIALS AND METHODS

The papers included 60 articles selected on dental loupes with inclusion criteria and 41 articles were excluded based on exclusion criteria. Overall, seven electronic databases in seven databases like Google Scholar, PubMed, CENTRAL, Scopus, Cochrane Library, Web of Science, Embase, beginning, and hand searching until 2021, were conducted.

Types Of Optics Used In Loupes

[1] Galilean loupes and Keplerian (prismatic) loupes

They are two categories of magnifying loupes based on how the lens systems are designed and constructed. An objective convex lens and a concave eyepiece lens are the two lenses that Galilean loupes commonly use as given in figure 1. Galilean loupes are useful as general-purpose dental loupes or beginner magnification loupes for beginning users since they provide magnifications on the lower end, ranging from 2.0 to 3.5. Keplerian loupes have a prism sandwiched in between two or more convex lenses. Although higher magnifications are possible, Keplerian loupes are often tailored to be between 3.5 and 4.5 for most dental usage despite having a larger range of magnification power. The prisms lengthen the light path, increasing magnification depth and extending working distance. Galilean loupes are smaller and lighter than Keplerian loupes, but they have a lower field of view and a shorter operating distance. Due to their simplified design, they are also less expensive[5].

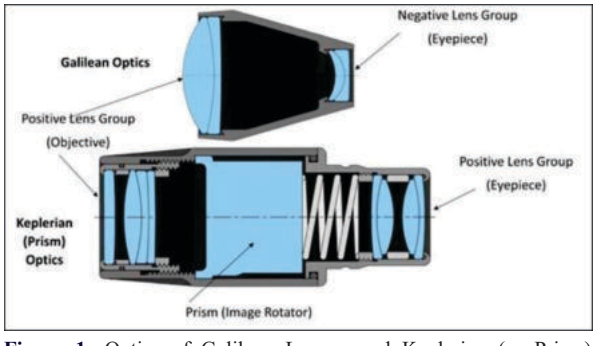

Figure 1: Optics of Galilean Loupes and Keplerian (or Prism) Loupes[22]

The most typical loupe magnification power for general dental procedures is between 2.0 and 3.5, regardless of the lens system employed. For endodontic procedures, periodontal microsurgeries,

and other purposes requiring extremely high-detail discrimination, high-powered magnifications of 4.0 and more are preferred by some skilled operators. It is advised for more seasoned users because of the reduced depth of focus and smaller field of view caused by the higher magnification power. When selecting a magnification loupe for dental use, considerations other than magnification should be made. A wide field of view enables one to observe more structures that are in the line of sight. A customizable set working distance enables an upright lower and upper back, and the steeper the inclination angle, the more upright the head and neck position. A high-quality loupe set should be created specifically for the individual to match their needs and better address their size and field of vision. To give the highest level of patient care, new procedures, tooth-colored materials, and finer equipment have all been developed. This shows that the use of visual augmentation is appropriate in clinical settings. It may not come as a surprise that there isn't much information in the literature about the advantages of magnification eyeglasses in orthodontics. However, paying close attention to details is crucial for our work. Ceramics, lingual appliances, self-ligating systems, and smaller bracket systems are still developing. Working posture is likely to be impacted by visual acuity. Between 25 and 36 cm is the working distance or the distance between the operator's eye and the patient's tooth. The operator has two options if a larger image is needed. They must either employ magnification or go closer to the thing, endangering their posture. Working distance is also impacted by presbyopia, which impairs the ability to focus clearly on close objects. Everyone will experience this disease at some point as a natural byproduct of aging. Older orthodontists may discover that this has a considerable impact on their clinical practice, and using magnification may occasionally improve working posture and increase performance[5].

[2] Ergo loupes

The Ergo loupes are TTL (through-the-lens) loupes that have a declination angle of 80 degrees as given in (figure 2) The high angle and low weight recompense for the head inclination and turn down the load on the cervical spine during long working hours. The conventional TTL magnifying glasses, ergo loupes help direct the eyes optimally. As illustrated in the diagram, the eye position when using ergo is more native. This increases the comfort of the clinician and reduces eye fatigue when undertaking long, compound procedures. The working distance measurements of ergo TTL is given in (table 1)[34]

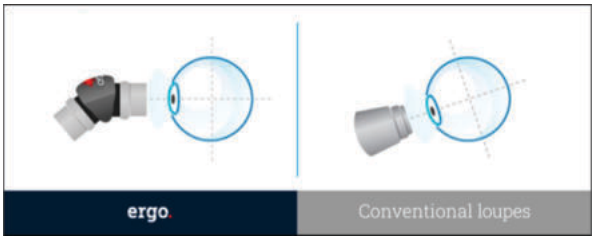

Figure 2: Ergo loupes are TTL (through-the-lens) loupes that have a declination angle of 80 degrees[23]

Table 1: Magnification and working distance measurements of ergo TTL loupes

MAGNIFICATION	WORKING DISTANCE	FIELD OF VIEW	DEPTH OF FIELD	WEIGHT *
3.0X	450mm 500mm 550mm	110mm 130mm 155mm	95mm 105mm 115mm	45gr
4.0X	450mm 500mm 550mm	85mm 95mm 105mm	80mm 90mm 100mm	45gr
5.0X	450mm 500mm 550mm	70mm 78mm 86mm	70mm 80mm 90mm	46gr
6.0X	450mm 500mm 550mm	50mm 56mm 62mm	55mm 65mm 75mm	46gr
7.5X	450mm 500mm 550mm	40mm 45mm 50mm	40mm 50mm 60mm	48gr
10X	450mm 500mm 550mm	30mm 35mm 40mm	30mm 37mm 45mm	52gr

TTL LOUPES:

TTL loupes stand for “through the lens” loupes and are also known as 'front mounted' loupes. The optical barrels (oculars/magnifiers) are mounted into the lens of the loupes, based on the user's pupillary distance and working distance measurements. Useful for people with vision impairments as well as those that need to work with minute details. TTL loupes are fixed at the steepest angle of declination possible to allow the user to achieve the most ergonomic posture possible. The Convergence Point on an FLM is adjustable for those who need to

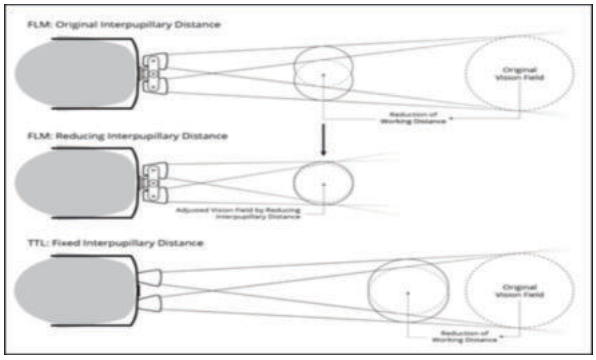

Figure 3: The Convergence Point on an FLM is adjustable for those who need to work at various working distances[24]

This mechanics is explained in figure 3. The TTL Convergence Point is fixed and will cause an overlap at a longer or shorter working distance

What to check for when purchasing magnification aid:

The resolution, field breadth, and field depth, in that order of significance, determine superior visualization.

Resolution

Being able to see small structures is a resolution. The standard of optical engineering and the usage of precise lenses determine it. Resolution is defined as the capability of the optical lens to form discernible images of objects that are at a particular distance. For dental optical loupes, higher resolution is suggested as it allows us to see the patients oral cavity in a better and finer way [4].

Field width

The field of view, basically the width of the field(target area), is the area to be focused on when using the loupes. The field of view is directly associated with the working distance of the loupe, depth of field(area that is visible clearly while working), and magnification. When a dental loupe has a wider field of view it means it has a greater depth of field and a longer working distance. While those loupes which have a narrower field of view will have a higher magnification factor[4].

Field depth

The depth of field or depth of view is the extent of focus or the depth of the area that is visible when working with the magnifying loupe. It is the measurement of how far you can lean in or how near you can lean out but still be able to see the target area with clarity. It is a rule of thumb that, if you need a deeper area of visibility, choose a loupe that has a greater depth of view[4].

Also, the size of the depth of view or depth of field has a direct association with both the working distance and the magnification factor. That is, the larger the depth of field, the longer the working distance will be, and vice versa. Likewise, the larger the depth of field is, the lower will be the magnification factor and vice versa[4].

Weight

Weight is a crucial factor to look into while getting a loupe. The usage of the loupes ranges from a few seconds to hours. It is vital to select the loupes which give you a warm and comfortable feel. It should also be weightless[4]

Flip-up or Through-the-lens.

The flip-up system's advantage is its ability to be flipped up for a non-magnified examination of the target area. They are often larger and heavier than fixed systems, and there is a higher chance of contamination (during adjustment). Additionally, the telescopes may become out of alignment with repetitive movement. Through-the-lens

(fixed system) telescopes that are tailored to the user according to the user's eyesight to enable viewing of the field while maintaining the proper distance. They frequently have no suspension system, which makes them lightweight. However, returning the telescopes to the manufacturer is typically required if the operator's eye prescription changes[4].

Working Distance of loupes:
Multiple working distances have been considered in a dental loupe fabrication. The working distance is the distance between the operator's eyes and the patient's mouth. Choosing the right working distance will give you ergonomic advantages by allowing you to work on any dental procedures comfortably and in an upright position which will prevent harmful musculoskeletal disorders regardless of whether you are sitting or standing.

To measure the working distance in your operatory you need a patient in the chair, with the mouth at or very slightly above your elbow level. While looking into the patient's mouth, and hands/arms simulating a treatment position, have someone view you from the side and measure the distance from your eye to the work surface. Do this in three treatment positions around the patient's head (for example, 12 o'clock, 10 o'clock, and 8 o'clock positions). Working distances will vary for shorter operators (14 inches or less) to very tall operators (more than 20 inches). Therefore, working distance should be tailored to the individual[21].

- For a person whose height is 5'7" or 170 cm, the standard working distances are 340 mm or 14 inches in a sitting position and 420 mm or 16 inches in a standing position
- For a person whose height is 5' 7" to 6' 4" or 170-190 cm, the standard working distances are 420 mm or 16 inches in a sitting position and 500mm or 20 inches in a standing position
- For a person whose height is over 6' 4" or 190 cm, the standard working distances are 500 mm or 20 inches in a sitting position and 550 mm or 22 inches in a standing position [20]

Frame size:
Keep in mind that the lower the manufacturer can place the scope about your pupil, the better declination angle they can generally provide for you. Large frames that sit low on the cheek will allow lower placement of the TTL scope than the stylish, small oval frame that is popular today. In general, flip—up loupes sit lower about the pupil than TTL loupes[21].

Even when ordering a large frame, some manufacturers may not mount the scope as low as needed. Buyers should always request that the TTL scope be placed as low in the large frame as possible[21].

Angle of Declination

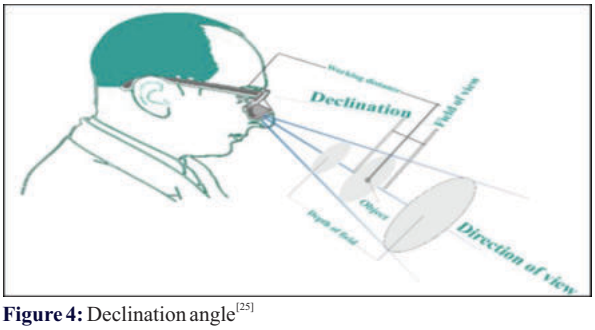

Figure 4: Declination angle[25]

The angle of declination is the angle that the eyes of the dentist with loupes inclined downward toward the patient's mouth or the target area. The angle of declination is depicted in (Fig 4). To procure an upright working position, to prevent any musculoskeletal disorders you must pick the loupe with a steep angle of declination. 20 degrees or less angle of declination is preferred as it allows minimal forward head posture.

What magnification?
The majority of dental loupes sold for routine procedures have a 2.5 magnification. Magnification in the range of 3.5 to 4.5 seems better suitable for endodontic and crown and bridge procedures. For orthodontics, no particular magnification is advised, very few articles are available on the loupes in orthodontics, though 2.5 to 3.0 appears suitable[4]. However, Baumann DF in his article strongly recommends the use of dental loupes in orthodontic debonding procedures. Dental loupes influence the quality of the debonding procedure, resulting in less enamel damage and composite residue, as well as less LAG[3] It is crucial to reiterate that better visualization does not always entail a larger image. The ideal loupes combine field depth, field width, and resolution.

Commercially Available Dental Loupes
1. Q Optics: Galilean

Figure 5: Galilean dental loupes from Q Optics.[26]

Magnification
- 2.5x - Field of View: 7-10cm / Weight: 43.0g
- 3.0x - Field of View: 5-8cm / Weight: 44.0g
- 3.5x - Field of View: 3-4cm / Weight: 47.5g

Q-Optics high-resolution loupes feature an extra dense optical system. Multiple lenses and glass types combine to create increased image clarity. Weight was not ignored, however, as these loupes still weigh an average of 25 grams less than standard optical systems (Fig 5).

2. Q Optics: Prismatic

Figure 6: prismatic loupes by Q Optics[26]

Magnification
- 3.5x - Field of View: 8-10cm / Weight: 53.0g
- 4.0x - Field of View: 7-8cm / Weight: 54.0g
- 4.5x - Field of View: 4-5cm / Weight: 58.0g

Q-Optics prismatic loupes feature a greatly expanded field of view and edge-to-edge clarity. Machined titanium unibody housing and carbon fiber shrouds provide extreme weight reduction without compromising optical performance, resulting in the most lightweight prismatic telescope available, exemplifying strength and durability (Fig 6)

3. Ergonoptix
Magnification
- Comfort Galilean loupes - 2.5x, 3.0x, and 3.5x
- Micro Gailean loupes - 2.5x and 3.0x
- TTL Gailean loupes – 2.5x, 3.0x and 3.5x

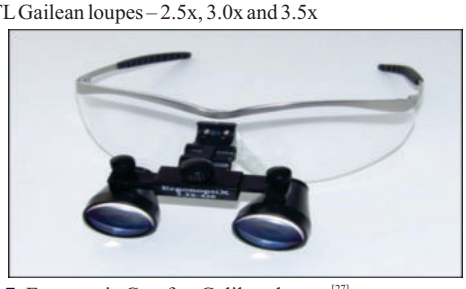

Figure 7: Ergonoptix Comfort Galilean loupes[27]

Designed for optimal ergonomic comfort, providing an extra wide field of view, with an extra deep focus range. Ergonoptix binoculars, flip-up, dental, and surgical loupes offer the maximum ease of use, combined with multi-functional capabilities for your ergonomic comfort. Available in a variety of magnification and working distances to fit each individual. Utilize a high-performance lens system that provides comfort and loupes with a wide field of view and an extra deep field, while maintaining minimal weight(Fig 7).

4. Lumadent Ergoprism

Figure 8 : TTL Ergoprism loupes by lumadent[28]

Magnification
- 2.5x - Field of View: 8.5cm / Weight: 40.0g
- 3.0x - Field of View: 7cm / Weight: 47.2g
- 3.5x - Field of View: 5.1cm / Weight: 43.4g

The ErgoPrism optical system is an outstanding piece of design. ErgoPrism oculars feature a roof pentaprism construction, which is both compact and provides outstanding magnification. The long optical length means we can achieve higher magnification than traditional Galilean Loupes and the optical-grade glass ensures you'll be seeing your working area in crystal-clear quality from edge to edge. This design also eliminates what would traditionally be the "declination angle" of Loupes. With ErgoPrism, the image is bent through the roof pentaprism in the telescope and into your eye so that you can work ergonomically without putting any stress on your body (Fig 8).

5. Ergo Loupes By Admetec

Figure 9: Ergo loupes by Admetec[29]

Magnifications: 3x, 4x, 5x, 6x, 7.5x
Weight: 45-55g

The ergo magnifying loupes by admitted enable you to work longer with maximum comfort and concentration and achieve improved results. Utilizing a unique state-of-the-art ergonomic structure, ergo deflects the optical path of the loupes 45 degrees down, enabling you to maintain a neutral head position while tending to the patient; thereby preventing aches and physical damage.

6. Orascoptic Eyezoom Loupes

Figure 10: Orascopic eye zoom loupes with titanium frame and EASE-IN-SHIELDS protector[30]

These 3-in-1 variable magnification loupes switch between magnification levels 3x, 4x, and 5x. EASE-IN-SHIELDS™ is an ideal way to protect your eyesight during hard and soft tissue laser procedures and procedures performed with a curing light. A unique and lightweight design allows the user to easily slide the shield insert in and out of the frame between procedures.

These shields are compatible with most loupe and eyewear models, so the user can use the magnification they are accustomed to without having to purchase additional products or go through a frustrating installation process[30]

Field Depth
- 4" (10.20 cm) at 3x
- 3.25" (8.30 cm) at 4x
- 2.5" (6.35 cm) at 5x

All optical systems are made with Grade A fine annealed glass lenses fused with anti-scratch and anti-reflective coatings. All carrier lenses are made with High Index polycarbonate material offering clinicians the ability to switch between multiple magnification powers to accommodate a variety of procedures that require varying degrees of detail. Use lower magnification for routine dental examinations and preparation for crown and bridge procedures. Increase magnification for more complex and exacting procedures. The ideal way to protect your eyesight during hard and soft tissue laser procedures and procedures performed with a curing light. A unique, lightweight design allows the user to easily slide the shield insert in and out of the frame between procedures (Fig 10).

7. Zeiss Eyemag Loupes

Figure 11: ZEISS EyeMag Smart, ZEISS EyeMag Pro F and ZEISS EyeMag Pro S [31]
- ZEISS EyeMag Smart: Magnification level: 2.5x
- ZEISS EyeMag Pro F Magnification level: 3.2x - 5x
- ZEISS EyeMag Pro S**:** Magnification level: 3.2x - 5x

EyeMag loupes from ZEISS generate a high-contrast stereoscopic image, thus enabling you to recognize and differentiate between minute structures. ZEISS EyeMag is the loupe system for users with higher magnification demands. It is available in a wide range of magnification levels and working distances, enabling you to select loupes tailored to your individual needs. The depth of field permits good depth orientation. It can be quickly adapted to the current treatment position. The adjustability of the eyepiece inclination allows you to work in a relaxed position and prevent back and neck problems at the same time. With the titanium frame, ZEISS EyeMag Pro loupes offer a carrier system into which prescription lenses can be easily integrated. The soft nose bridge and adjustable headband enable a perfect, comfortable fit (Fig 11).

8. Univet Loup

Figure 12: TTL loupes by Univet[32]

Magnification Galilean : 2.0 X 2.5 X 3.0 X 3.5 X 4.0 X 5.0 X

Univet Loupes are designed to offer an ergonomic declination angle, with 2.0x to 5.0x magnification, a large field of view, and optical clarity. Each set of Univet Loupes is custom fitted through a 6-tier measurement process for optimal ergonomics. Ergonomic declination angle to match the pupillary height of the clinician. The wide field of vision and optical clarity minimize optical abrasions and are supported by patented achromatic technology. Attractive Italian design.

9. Zumax loupes

The Zumax loupes have multicoated optics which minimize reflections and provide crisp, bright images. **Eighteenth Brilliance series Surgical Loupes** combines Schott Glass and Achromatic Optical Path Design to ensure high image quality. It is available in a sports frame and a titanium frame. Zumax loupes also come with a headlight attached as depicted in fig.13. Optional led illumination comes with a cordless battery pack[33].

- TTL Loupes- Available in 2x, 2.5x, 3x
- Flip-up Loupes- Available in 2.5x, 3x, 3.5x
- Prismatic Loupes- Available in 4x, 5x, 6x
- Prismatic TTL loupes- 4x, 5x, 6x

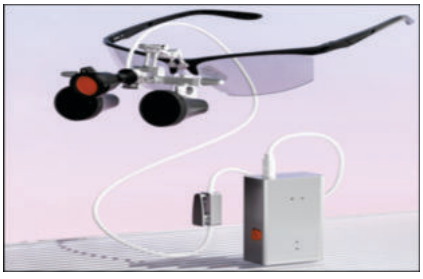

Figure 13: Brilliance Flip-Up Loupes with Softouch Surgical Headlight[33]

Advantages of loupes in orthodontics

Improved vision :

Although the orthodontist may make treatment planning decisions with normal eyesight, using magnification may increase their visual acuity for a variety of treatments. Precise bracket positioning is the need of the hour for achieving excellent treatment results. Molar buccal tube placement is another example where loupes play an important role in precise positioning. It would be easier to position the bracket accurately (especially with the new smaller systems), perform lingual orthodontics, open and close self-ligating bracket systems, and remove excess flash (especially with ceramic brackets). We usually tend to give blind forces to insert the archwire into the bracket slot without even knowing that the composite has flowed into the bracket slot in the newer self-ligating bracket systems. Orthodontic treatment could be of higher quality and take less time to improve visual acuity, and better posture. Maintaining a safe working distance from the patients throughout the orthodontic or any dental procedures is essential during the pandemic situations. Moving closer to the patient to increase eye acuity limits the operator's operating position. This posture, which is accomplished by adopting a curved spine, can induce neck and back pain as well as muscle tension. According to surveys, 70% of dentists have reported having back pain at some point. Establishing the proper working distance automatically results in the adoption of the proper working posture. This significantly lessens neck, back, and shoulder muscles and improves musculoskeletal health[4].

Disadvantages of loupes in orthodontics

Cross-infection

During orthodontic treatment, it is crucial to assess both the general occlusion and the small details. Therefore, utilizing magnifying loupes for infection control can be challenging. The most secure way of infection control is provided by fixed loupes. The telescopes don't need to be touched during the procedure because they are light enough to move around with if necessary. Flip-up designs, on the other hand, can be raised and lowered while being applied. Cross-contamination happens the moment the telescopes are touched, and it becomes very hazardous if they aren't cleaned between patients. All telescope types should be cleaned with alcohol (isopropyl alcohol 70%), and each time you raise or lower a flip-up telescope, new gloves should be put on. Some manufacturers offer sealed eyepieces that permit washing to maintain effective cross-infection control[4]. In a study, the loupes were disinfected by wiping all surfaces of the loupes with a disinfectant wipe (ExamVision, Samso) until moistened and then allowing the surface moisture to air-dry for 30 seconds[8]. Patients' peculiarities, in particular children's Many kids, may initially, find the look of enlarging loupes strange and occasionally frightful. However, most kids are more receptive and accepting of electronics than many adults are with the help of a comforting explanation! Seeing It makes sense to talk to your optometrist about using magnification, and it's crucial to give the manufacturing business permission to customize the loupes to your prescription. It is essential that the interpupillary distance is set precisely and that the angle of convergence between the two eye parts be equal if you want to avoid eyestrain and its related effects.

CONCLUSIONS

Most dental practitioners might use the dental loupes successfully, but they need a certain period to adapt to them. Different dental loupes are available in the markets at a wide range of prices, with or without a headlight. You can treat only what you can see. Dental loupes can have a positive effect on the quality of the treatment where the debonding procedure can result in less enamel damage as the bracket bonding procedure will leave fewer composite residues which is called flash. As we deal with different types of new bracket systems, which have doors to lock the wire in the bracket, it is difficult to work and manage the composite flowing into it through the naked eye and therefore we recommend the use of dental loupes in any orthodontic procedures.

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