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FEATURES SECTION

Current Products and Practice

The Bigger The Better: can magnification aid orthodontic clinical practice?

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The use of magnification in dentistry appears to be of increasing interest. This is also reflected in our own specialty, with a number of optical companies exhibiting their products at orthodontic conferences and meetings. This article reviews the principles of magnification, briefly discusses the magnification loupes that are available on the market at the present time, and highlights the advantages and disadvantages of using magnification for orthodontic treatment.

Key words: Orthodontics, magnification, loupes

Refereed paper

Introduction

The use of magnification in dentistry is not a new concept. The suggested benefits brought by enhanced vision and improved working posture are well publicized.[1–5] Although there have been many anecdotal reports describing the benefits of magnification,[2–4] there have been very few clinical studies that systematically assess this.[6,7]

Dentistry is a visually demanding profession. Indeed, visual enhancement is becoming far more acceptable and many dental schools now allow their students to use loupes on a discretionary basis. In the USA, training with dental magnification is mandatory for specialists in endodontics.[5]

New techniques, tooth-coloured materials and finer instruments all aim to provide the best standard of patient care. This suggests that visual enhancement has a place in our clinical practice. Perhaps not surprisingly, there is very little to be found in the literature regarding the benefits of magnification eyewear in orthodontics. However, attention to fine detail is paramount for our work. Smaller bracket systems, lingual appliances, self-ligating systems and ceramics continue to evolve.

Could we improve our standard of patient care with magnification? Moreover, would magnification benefit our own musculoskeletal health?

This article aims to discuss the basic principles of magnification, highlights what is available on the market at the present time, and discusses the perceived advantages and disadvantages.

Getting to grips with magnification

Visual acuity is limited by the accuracy with which the image is focused on the retina. To see clearly objects closer than 6 m, the thickness of the ocular lens needs to be altered. This is accommodation, and is facilitated by contraction or relaxation of the ciliary muscles.

In the UK, visual acuity is checked with a Snellen chart at 6 m. The numbers next to the letters indicate the distance that a person with no refractive error can read that line. Visual acuity of 6/6 is the accepted normal (i.e. that which a person with normal vision can read at 6 m). A person with 6/3 vision could read at 6 m what a standard person could only read at 3 m and a person with 6/60 vision could read only at 6 m what a standard person could read at 60 m.

Visual acuity is likely to affect working posture. The working distance (i.e. the distance between the operator's eye and the patient's tooth) varies between 25 and 36 cm. If the operator requires a larger image they have 2 choices. Either they move closer to the object, compromising their posture or they need to use magnification.

Presbyopia, an inability to focus sharply on close objects, also has an effect on working distance. This

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Figure 1 Flip-up telescope. This is the Supervu telescope with Hoggie frame manufactured by Keeler

condition is a normal consequence of ageing, affecting everybody at some stage. Older orthodontists may find that this has significant implications on their clinical practice and the use of magnification may in some cases increase performance and clinical outcome, and improve working posture.

What is available and what do you really need?

There are 3 magnification systems in dentistry. Single lens loupes, Galilean loupes and prismatic loupes. The Galilean and prismatic loupes can be either a flip-up or through-the-lens design (see Figures 1 and 2).

Single lens loupes

These provide the simplest form of magnification, and are either magnifying lenses in spectacle frames or a hinged magnifying lens, which is attached to either a spectacle frame or, more commonly, a headband. They have the advantage of being lightweight, inexpensive and easy to fit, but have limited magnification (the highest is about 3-fold), a single working vision and poor peripheral vision.

Galilean loupes

Galilean loupes or 2 power compound loupes are usually a Galilean design. They use 2 or more lenses, which offer higher magnification, improved working distance and depth of field. They can be tailor-made to the individual and have the benefit that illumination can be added. However, they are considerably more expensive than single lens loupes, and the increased magnification occasionally incurs problems with the weight and size of the loupes.

Prismatic loupes

These are 3 or 4 power compound loupes and often of Keplerian design. Similar to binoculars, they use around 5 lenses and 2 prisms to give higher levels of magnification and greater optical clarity. Again these systems can be tailor-made for the individual. However, the increased number of lenses does make them very expensive and heavier, and the higher power results in a smaller field of view.

What to look for when buying loupes

Superior visualization is governed by the following factors, in order of importance: resolution, field width and field depth.

Resolution

Resolution is the capability to visualize small structures. It is set by the quality of the optical design and the use of precision lenses.

Field width

Field width is the size of the operating area when viewed through the loupes. It is linked to the diameter of the telescope, the optical design, the distance from the lens to the eye and the magnifying power—the higher the power the smaller the field.

Field depth

This is the range of focus delivered by the loupe. Longer field depths allow more of the operating area to be viewed.

Flip-up or Through-the-lens?

The main advantage of the flip-up system (see Figure 1) is that it can be flipped up for an unmagnified assessment of the field of view. However, there is increased likelihood of contamination (during adjustment), and they are often bulkier and heavier than fixed systems. In addition, repeated movement can cause the telescopes to go out of adjustment. Through-the-lens (fixed system) telescopes (see Figure 2), customized to the individual, allow the operator to view the field, whilst adopting the correct posture. They are often lightweight as they do not have a suspension

Figure 2 Through-the-lens/fixed telescope. This is an expanded field dental telescope manufactured by Designs For Vision

mechanism. However, change of the operator eye prescription usually necessitates return of the telescopes to the manufacturer.

What magnification?

The majority of loupes marketed for general dentistry are $\times 2.5$ magnification. For endodontics and crown and bridgework, magnification in the range of $\times 3.5$ to $\times 4.5$ appears to be more appropriate. No specific magnification is recommended for orthodontics, although between $\times 2.5$ and $\times 3.0$ seems reasonable.

It is important to re-emphasize that a bigger image does not necessarily mean better visualization. The best loupes combine resolution, field width and field depth. Identifying the correct loupes for an individual should always be done in consultation with an experienced sales representative.

Loupe manufacturers

Table 1 indicates the main manufacturers of dental loupes. It shows the products currently available and highlights the individual features of each.

Advantages of magnification

Improved vision

Although normal vision is adequate to view details to make treatment planning decisions, the use of magnification may provide the orthodontist with improved visual acuity for a number of procedures. Accuracy of bracket placement (particularly with the new smaller systems), lingual orthodontics, opening and closing of self-ligating bracket systems, removal of excess flash (particularly with ceramic brackets) would all be improved. The improved visual acuity may lead to a higher quality of orthodontics and reduce operating time.

Improved posture

Achieving improved visual acuity by moving closer to the patient compromises the operator's working position. This posture, achieved by adopting a curved spine, can lead to muscle strain and cause back and neck problems. Rather alarmingly, studies have shown that 70% of dental professionals have experienced back pain.[8,9]

By establishing the correct working distance, correct working posture is automatically achieved. This effectively reduces the muscle strain in the shoulders, back, and neck and provides enhanced musculoskeletal health.

Disadvantages of magnification

Significant cost

The cost of magnification systems varies widely and can range from £25 to thousands of pounds. Generally, for a standard, Galilean, through-the-lens system with a magnification of $\times 2.5$ you can expect to pay around £1000. The larger manufacturing companies offer professional advice and help with purchasing magnification systems and it is advisable to discuss your individual requirements prior to buying.

Cross-infection

Assessment of the overall occlusion, in addition to close-up detail work, is essential during orthodontic treatment. Infection control, when using magnifying loupes, can therefore be difficult. Fixed loupes offer the safest method of infection control. As the telescopes are light enough and easy to see around if necessary, they do not need to be touched during the procedure. Flip-up designs on the other hand, may be flipped up and down during the procedure. Cross-contamination occurs as soon as the telescopes are touched and is particularly dangerous if the telescopes are not disinfected between patients. It is recommended that all types of telescope are disinfected with alcohol (isopropyl alcohol 70%), and that you should re-glove each time you raise or lower a flip-up telescope. To maintain good cross-infection control some manufacturers have sealed oculars, which allow washing.

Peculiarity to patients, particularly children

The appearance of magnifying loupes can at first seem somewhat bizarre to many children and occasionally

Table 1 Dental loupes: what's currently available

Manufacturer	Product	Galilean/Prismatic	Through-the-lens (TTL) Flip-up (FU)	Magnification	Additional features	Website
Keeler	SuperVu	Galilean	TTL or FU	×2.0, ×2.5, ×3.0	Superior depth of field Excellent clarity Lightweight alloy bar and shell Individual interpupillary adjustment	www.keeler.co.uk
	XL Advantage	Prismatic	TTL or FU	×3.5, ×4.5, ×5.5		
Designs For Vision	BDR Loupes	Galilean	TTL	×2.0	Wide field of view Lightweight (begin at 1.4 oz) Stylish frame 45 day free trial	www.designsforvision.com
	SafetyScope®	Galilean and Prismatic available	TTL	×2.5, ×3.5, ×4.5, ×6.0	Combines custom magnification with curing light (UV and blue light) protection	
	Expanded Field	Prismatic	TTL	×4.5, ×6.0	Provides 50% wider field of view than Galilean telescopes Custom manufactured to individual	
Orascoptic	Dimension-3	Galilean	TTL or FU	×2.5, ×2.6	Mid-range level loupe	www.orascoptic.com
	HiRes	Galilean	TTL or FU	Class 2*	Round or Elliptical optical shape Lightweight Wide viewing field	
	EyeMax	Prismatic	TTL or FU	Class 3 (low and high) Class 4 (high)*	Greater precision Greater field of view	
Surgitel	Ergovision FLM	Galilean Prismatic	FU FU	×2.0, ×2.5, ×3.0 ×3.4–5.2	Lightweight	www.surgitel.com
	Ergovision TTL	Galilean Prismatic	TTL TTL	×2.0, ×2.5 ×3.0 ×3.4–5.2	Modern style titanium ergo-frames	

* For all new products, Orascoptic are now placing loupes into different measurement classes, rather than using actual figures for magnification.

frightening. However, with the benefit of a reassuring explanation, most children are more amenable and accepting of gadgets than many adults!

Visual acuity

It is sensible to discuss the use of magnification with your optometrist and essential to allow the manufacturing company to tailor make the loupes to your prescription. To prevent eyestrain and its associated consequences, it is imperative that the interpupillary distance is set accurately and that the angle of convergence between the 2 eye pieces is equal.

Conclusions

As orthodontic technology advances, we must consider what kind of visual acuity we need to perform high quality orthodontics. It is important that the benefits of magnification are recognized, and that consideration is given to its use in order that orthodontic clinical practice and patient care continues to improve.

Useful websites

www.eagleoptical.com: A useful website which lists factors to consider when buying loupes and gives information on their range of products.

www.orascoptic.com: Provides informative guide to purchasing dental loupes. They recommend Orascoptic loupes ($\times 2.5$ magnification) and the new HiRes for orthodontists.

www.designsforvision.com: Provides basic details of dental telescopes and offers a 45 day free trial.

www.videns.co.uk: In detail account of their loupe systems and outlines principles of magnification loupes.

www.surgitel.com: Provides in detail accounts of products available and explanation of technical and magnification terminology.

www.keeler.co.uk: Details of wide range of dental loupes.

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