

# Pathways of vision for the dental surgery

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It is the purpose of this article to dispel “the old wives’ tales”, myths, mis-information and sales pitch and to offer the dentist the benefit of experience gathered over 45 years of providing prescription eyeglasses, loupes and head-lights to the dental and surgical disciplines.

Aspects of the use of corrective lenses, eye protection, LED illumination, operating loupes, the space between and the relative positioning of the dentist and the patient will be addressed.

The eye is a light sensitive organ and responds to all colours of the visible spectrum. Extreme levels of white light, the combination of all colours of the spectrum, or exposure to extreme levels of any one wavelength may have a deleterious effect upon visual performance. Exposure to some light waves outside the visible spectrum, such as ultra violet, infrared and laser can result in temporary discomfort, permanent damage to the eye and/or possible irreversible blindness. Additionally, pathogenic invasion, chemical insult, ballistic or blunt force trauma may also contribute or result in temporary or permanent eye damage. These are a real danger and pose significant threats in the dental environment. In an attempt to minimise these threats and/or improve visual acuity, self examination and evaluation of one’s visual performance is commonly administered. This is a risky and in the long term an ineffective practice that could result in severe and irreversible visual impairment.

If professionally diagnosed and monitored, the majority of all blindness could be prevented. Accordingly, dentists should present to an ophthalmologist or optometrist for bi-annual eye examinations. If it is assessed that spectacles are required, the user should be educated as to how to integrate his/her prescribed spectacles into the dental environment and combine them with other head-borne devices such as operating loupes.

## Corrective eyeglasses

For the successful practice of dentistry, a minimum visual acuity of 20/20 is desirable. This will provide the ability to see near and far objects with an acceptable degree of precision. Conditions that may negatively affect visual performance include myopia, hyperopia, astigmatism and presbyopia.

- Myopia is a short sightedness condition (long eyes) and is usually corrected with lenses of negative spherical power. See Diagram 5.
- Hyperopia is a long sightedness condition (short eyes) and is usually corrected with lenses of positive spherical power. See Diagram 2.
- Astigmatism is a condition whereby the cornea is usually irregularly shaped and may be corrected with lenses of positive or negative power of toroidal form. See Diagrams 3 and 4.

The symptoms of myopia, hyperopia and astigmatism may be experienced at any age. They are conditions affecting distance vision and may be corrected with single vision and/or contact lenses.

The most commonly experienced condition affecting the performance of vision is presbyopia, from which there is no escape. Presbyopia is a progressive condition often referred to as “older eyes” and it affects the near vision of all persons in their mid to late 40’s and is only fully corrected with the use of spectacles.

The spectacles may be single vision lenses of positive power or, alternatively, bifocal lenses, trifocal lenses or graduated multifocal lenses comprising of a combination of positive/positive and/or negative/positive lens powers. These lenses may also include a component to correct astigmatism. Bifocal, trifocals and/or graduated multifocal lenses have a “sweet spot”. This “sweet spot” is strategically located by the optician to deliver optimum performance for normal every day social use. The “sweet spot” located for social use in many cases may not be located in a position compatible with the visual environment of the dental surgery.

For example, reading glasses are usually prescribed to be used at 360 millimetres which is deemed to be the average distance at which objects are held when required to be read in the “normal environment”.

It is commonly accepted that the average distance at which the dentist will view the patient’s mouth is 420 millimetres and is a result of the dentist’s desire to address the patient with the recommended and most desirable ergonomic posture. As a result, spectacles prescribed for social reading often prove to be inadequate and unsuitable for use in the dental surgery.

It is therefore desirable for the dentist to evaluate the benefits of “surgery” glasses that could be prescribed to focus coincidentally with their normal posture and/or with their operating loupe.

### Magnification vs reading glasses

Many people wishing to deny or camouflage the onset of presbyopia choose to use magnifiers in the place of prescribed corrective spectacles for presbyopia. Note:

- Magnifying loupes do not correct the presbyopic condition.
- Reading glasses do not provide magnification.

There seems to be a degree of disinformation, confusion or ignorance between reading glasses and magnifying glasses and loupes, this seems to be a result of commercial interest becoming involved in the sale of ophthalmic paraphernalia.

This myth has been created and perpetuated as a result of some government regulations correctly prohibiting the term reading glasses to be used for “ready made” “off the shelf” reading glasses. “Ready made” are offered for sale by untrained persons in department stores, newsagents, pharmacies, etc. These products are not sold by informed opticians or optometrists. To avoid prosecution under regulations, ready made reading glasses are advertised and sold as “magnifying glasses”. This is blatantly incorrect and it confuses the purchaser, many who will be dentists. The result is that the ready-made reading glasses labelled +2.5D are chosen by the uninformed consumer who believes they have chosen a magnifier of 2.5X power (Figure 1).

I am sure that the dental profession would frown upon and deem improper the community seeking dental appliances from uninformed and “off the shelf” sources.

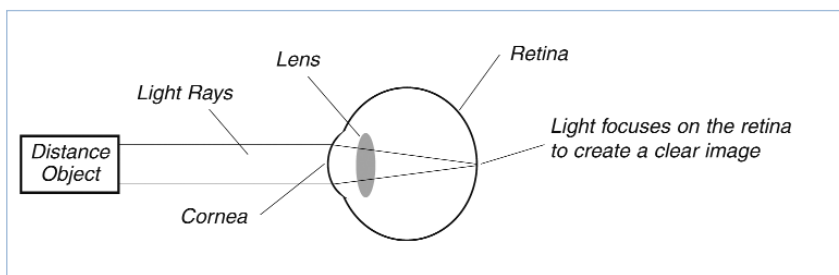


Diagram 1. Normal eye.

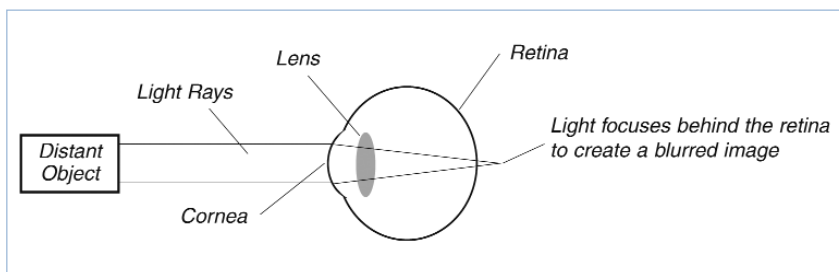


Diagram 2. Hyperopia is a long sightedness condition (short eyes) and is usually corrected with lenses of positive spherical power.

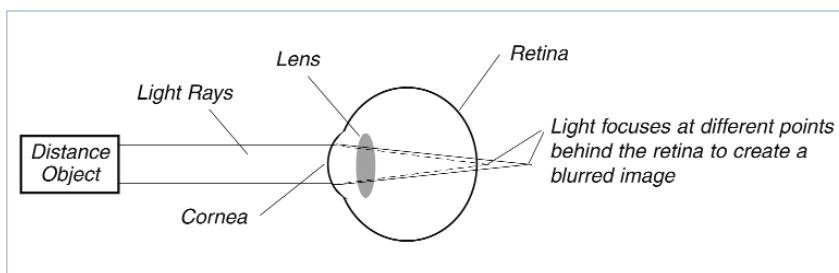


Diagram 3. Hyperopia with Astigmatism is a condition whereby the cornea is usually irregularly shaped and may be corrected with lenses of positive or negative power of toroidal form.

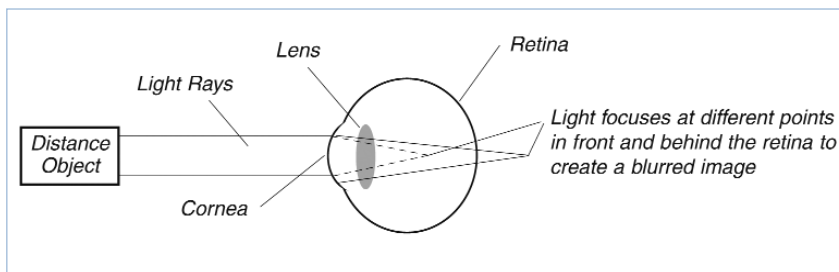


Diagram 4. Mixed Astigmatism.

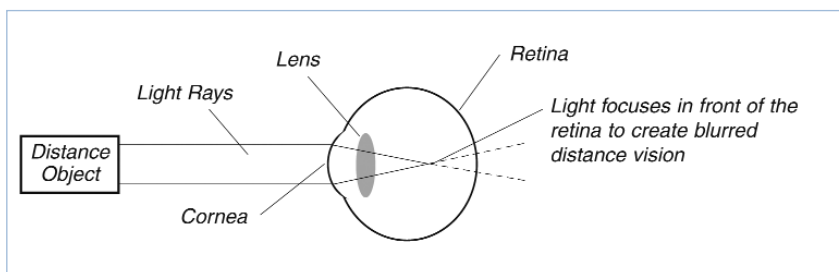


Diagram 5. Myopia is a short sightedness condition (long eyes) and is usually corrected with lenses of negative spherical power.

## Safety Glasses

The dental surgery is not an industrial site. In optical parlance, the industrial site is deemed to be a “hard environment”. Products developed for this “hard environment”, while offering protection from ballistic foreign matter and blunt force trauma, may not meet the criteria for the “soft environment” of the dental surgery.

The primary role of safety glasses for use in dentistry is to provide protection from low speed ballistic missiles, pathogenic contamination and chemical insult (Figure 2).

Safety lenses of low impact rating are often used in the surgery, however, they should conform to Occupational Health and Safety regulations.

Today’s technology provides for safety glasses of wrap-around configuration that eliminate the need for old fashioned and unsightly side shields. Wrap-around “sports type” safety glasses offer superior eye protection and aesthetic qualities.

In addition to impact resistance, eye protection for use by the dentist and surgery staff should deliver:

- Comfort for prolonged periods of wear;
- Non-fogging design;
- Fashionable aesthetics;
- Resistance to chemical and solvent degradation; and
- Compatibility with face masks.

## Fogging lenses

The “fogging up” of head-borne optical devices occurs with such frequency it requires an explanation of its cause, effect and remedies.

For the dentist and nurse wearing a mask, the fogging of the inside surfaces of the lens has unfortunately become an acceptable occurrence. This problem most commonly occurs as a result of using eye protection of an inappropriate design. The most common offenders are eye safety products whose original design rationale did not consider the use of face-masks.

The presence of lens fogging is both unnecessary and unacceptable and is usually overcome by sliding the safety glasses down the nose. At worst, this re-positioning of the safety glasses totally negates and/or substantially discounts the effectiveness of eye protection.

In an endeavour to overcoming lens fogging, many dentists resort to the so-called “non-fogging” lens. The anti-fogging lens was developed for use where



Figure 1. Note label on eyeglasses, +2.50D label and on loupe 2.5X.



Figure 2. Safety glasses.

the fogging of the lens was a result of environments where high atmospheric humidity and poor ventilation prevailed.

Non-fogging lenses are contra-indicated for use in environments where abrasives are regularly used. They are substantially “softer” than hard coated polycarbonate and will require frequent replacement as a result of loss of surface integrity and scratching. Experience has shown that the anti-fogging lens requires replacement at three times the rate of hard-coated polycarbonate.

## Why lenses fog up

Fogging that occurs on the inside surface is generally a result of a fundamentally bad design, poor individual fitting or use of a product not designed for the task for which it is used.

Fogging of the front surface of the lens is normally due to environmental factors. In most cases, this can be controlled by adjustment of the air conditioner, climate control or exhaust systems. In very few environments, for example laundries, commercial kitchens and deep underground mining, non-fogging lenses may be indicated. It is in these

environments where high humidity and/or poor ventilation may be present and may be beyond the capacity of atmospheric control systems.

Safety spectacles with a correctly designed bridge fitting (minus projection) will promote airflow to the rear surface of the lens that is prone to fogging.

## Cleaning and sterilizing loupes, spectacles and safety glasses

The recommended method of cleaning safety glasses is to rinse thoroughly with copious quantities of running water or with a “blast” of air to remove any deposits of abrasive substances on the lens surface. The lenses should then be wiped dry with a facial tissue or preferably dry with an air gun.

Disinfection for surgery or operating theatre can be effectively executed by wiping the safety glasses thoroughly with an isopropyl alcohol (pre-injection) pad. DO NOT spray, immerse or flood with cleaning or sterilising chemicals as many such agents are alcohol based and when used indiscriminately will severely degrade, corrode or destroy polycarbonate lenses, loupes and safety glasses.

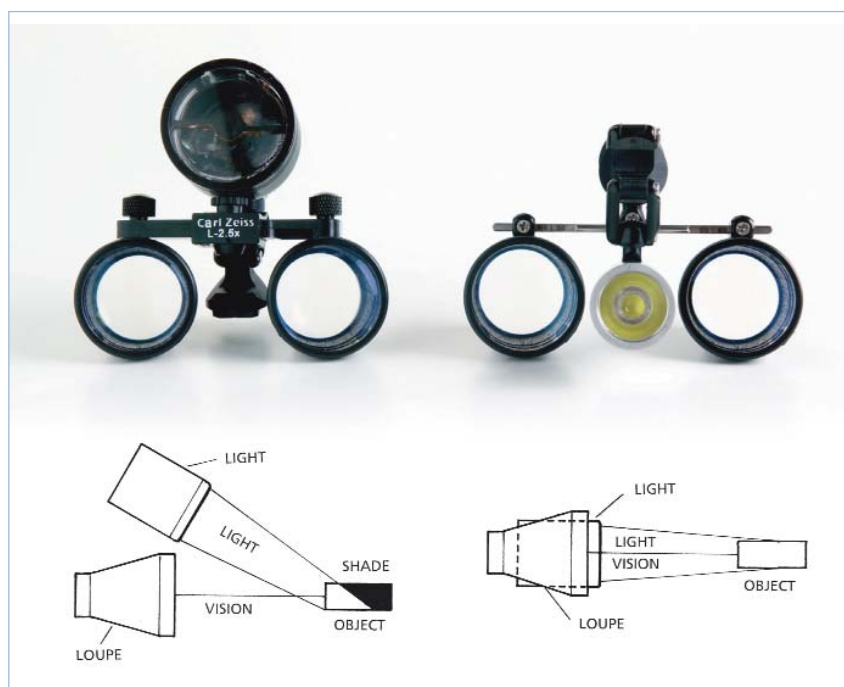


Figure 3. In the set-up on the left, the LED light is located above the plane of the loupe. This CANNOT efficiently or effectively illuminate the cavity whilst viewing through the loupe; on the right, the co-axial/co-incident location of the LED light will provide TOTAL illumination of the cavity - wherever you look, the light will be there.

Experience has shown that the indiscriminate and thoughtless use of “optician’s” cleaning cloths will contribute to the degradation of the integrity of lenses. Furthermore, as these cloths are infrequently washed and never sterilized, they may be the source of bio-contamination.

Disposable facial tissues should be used to “pat off” any excess moisture or abrasive detritus from lenses. As it is reasonable to assume that abrasive matter would contaminate the tissue, it must be disposed of and not re-used. This rationale must also be applied to all cleaning cloths.

### A fast, efficient method to “anti-fog” lenses

1. Select a DRY bar of a bactericidal soap such as Gamophen;
2. Smear the DRY soap onto both surfaces of the lenses that are free of moisture and abrasive matter.
3. Using a clean DRY facial tissue, “polish” all the “smeared” soap off the lenses.
4. Do NOT use any water!

### Test

Hold the lens close to and adjacent to the mouth and exhale (“huff”) on the lens. Fogging will NOT occur. For the true sceptics - hold the lenses over a hot cup of tea or coffee!

### LED Headlights

The eye is a light sensitive organ, therefore in the absence of light the eye cannot function. Poor illumination will result in stressful or diminished visual performance. Conversely, good illumination will result in the eye delivering a crisp and clear cerebral image.

If auxiliary head-borne illumination is to be used, it is essential for the plane of illumination to be delivered on a co-incident plane with the plane of the dentist’s vision. All illumination should be presented co-incidently with the dentist’s unaided eye, corrective spectacles or with operating loupes.

There seems to be a deal of confusion or indiscriminate and ignorant use of the term co-axial. True co-axial presentation can provide for vision to be accessed through the source of the illumination, whereas, co-incident presentation will provide for a

separate source of illumination to the access for vision. However, with co-incident presentation, both will be delivered on the same plane (Figure 3).

Auxiliary headlights are not designed to replace the overhead surgery light. The head-borne LED light will not produce the level of illumination provided by the overhead light and should be considered only to be an adjunct to the overhead light. When integrated with the loupe on a co-incident plane, the LED headlight will provide full illumination to the entire target area, in particular when the target is a small diameter deep cavity.

LED auxiliary head-borne illumination has become the head-borne illuminator of first choice as it provides the dentist with freedom and mobility.

Although the current generation LEDs provide an adequate degree of illumination for the purpose of the general practice of dentistry, the LED cannot deliver the level of illumination delivered by either the overhead light or fibre optics head lights. However, experience has shown that all LEDs designed for dental use are adequate for the purpose for which they are designed.

Many dentists who only seek the “brightest” of LED light often do so as they actually have an underlying and undetected requirement for corrective spectacles. It is common to seek additional light to compensate for poor visual performance, however, a brighter light will only temporarily mask the problem. All matters relating to visual performance should be addressed only after consultation with an optometrist or ophthalmologist and this will provide a permanent solution.

There appears to be a “competition” between many purveyors of LEDs to make claims to the “brightest, most powerful” LED.

Such claims may be made to disguise the shortcomings of other aspects of the design of the LED on offer.

Of prime importance in selecting a LED for dentistry is the co-axial/co-incident presentation of xxxxxx [what?]

### Magnification with loupes

It is not possible to combine magnification and a controlled reading distance with a simple single lens e.g. spectacles prescribed or ready made glasses.

Magnification with a controlled working distance can only be achieved with a lens

system such as a Galilean telescope. Basically, a simple Galilean telescope is comprised of two lenses, one of positive power and one of negative power. The relative powers of the lenses and the separation between the lenses will define both the magnification and the working distance.

The Galilean loupe offers a simple and effective form of magnification whilst being flexible and forgiving in its application.

Galilean type loupes with a 2.5X magnification are universally recognised as the loupe of first choice for general practice in dentistry.

The choice of working distance is determined by the dentist's recognition and acceptance of prescribed ergonomic posture guidelines. Most dentists conduct the majority of procedures whilst seated with the patient in the supine position with the result that the average working distance from the dentist's eyes to the patient's mouth is forty two centimetres. Of course, this is not a hard and fast rule. Diminutive practitioners prefer a shorter working distance whilst taller practitioners with a longer reach may choose a longer working distance. Experience shows that if the dentist's pre-determined working distance is not available, it is preferable to select a longer rather than shorter working distance as the longer working distance will contribute to an ergonomically desirable posture.

Many loupe salespersons, whilst fully conversant and informed of their own product, possess little or no ophthalmic knowledge or background. It is, therefore, desirable for the loupe salesperson to seek the services of an informed optician and/or optometrist.

The astute and thoughtful providers of loupes employ registered opticians as their loupe consultants and should be sought out by the prospective purchaser. The service provided by companies employing opticians provide a "one shop stop" and can ensure a desired initial result with an understanding of the requirements of the ageing eye and the dentist's changing visual environment. Opticians are qualified and equipped to provide ongoing product and consultancy to secure long term excellence for the requirements for vision and illumination for the dentist.

Dentists should be made aware that magnifying loupes do not correct vision and reading glasses do not provide magni-



Figure 4. Galilean loupes (left) and Prismatic loupes (right).

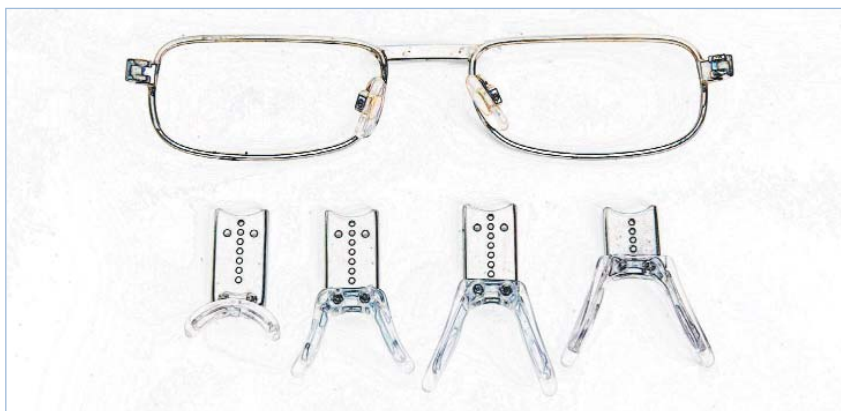


Figure 5.

fication and that their individual roles must be clearly understood and never confused. Understanding and accepting this basic premise will greatly contribute to the economical, practical and successful use of individual or the collective use of integrated ophthalmic appliances.

Prior to purchasing a loupe, the dentist should consult an optometrist or an ophthalmologist for an eye examination. This examination will provide an evaluation of unaided vision performance. It is prudent to seek the services of an optometrist or ophthalmologist who is conversant with the dentist's working environment.

Experience has shown that even the smallest of prescriptions should be incorporated into the spectacles that are to be integrated with any magnifying device. Although many small prescriptions do not perceptibly improve vision, they can assist in significantly reducing eyestrain for procedures of long duration particularly if an operating loupe is to be used.

### Magnification

Universally the consensus is that the most commonly used operating loupe used by the dentist in general practice

is the Galilean loupe with the following characteristics:

- Magnification 2.5X;
- Working distance 42 centimetres;
- Minimum field of vision 100 millimetres;
- Depth of field 25 millimetres;
- Total weight between 35 and 50 grams;
- Flip Up/Flip Down capability; and
- Stable positioning in front of the eye.

### Types of loupes

Magnifying loupes are of two basic designs: Galilean and Prismatic (Figure 4).

#### Galilean loupe

The Galilean is generally lightweight, of simple construction, relatively inexpensive and only available in lower magnifications.

Almost all loupe manufacturers produce Galilean type loupes in a range of powers, starting at 2X through to 3.0X in increments of 0.5X. Claims are made for a 3.5X Galilean loupe, however, these claims should be closely examined and a request should be made to supply documentation to support such claims. All well known brands of Galilean loupes will deliver a magnified image with an ample field of vision, depth of focus with little or

no apparent peripheral distortion and are suitable for the general practice of dentistry. As a cost efficient device, the Galilean loupe has a proven track record for general practice.

Generally the Galilean loupe will have a large objective lens. The objective lens is the large lens at the front of the loupe and is responsible for the light gathering capability of the instrument. Therefore, the larger the objective lens, the brighter the image that is presented to the eye.

The dentist is often presented with a dilemma. A loupe sales person will proffer a loupe as being the lightest weight loupe available. Close inspection will reveal that the lightness is achieved by reducing the size of the objective lens with the result being the brightness of the image presented to the eye is significantly diminished.

### Prismatic loupes

The Prismatic loupe is a highly sophisticated instrument. It is a head-borne "mini" microscope. Generally the prismatic loupe is available in a range of powers from 3.5X to 5.5X. The result is a heavier instrument (approximating 90 gm plus).

As the prismatic loupe is a more sophisticated instrument, it therefore is generally more expensive than the simple Galilean loupe. However, it provides the increased magnification and quality of image required for endodontic procedures at a cost-efficient price.

Despite the additional cost, weight, loss of field of view and depth of field, the higher magnification makes the prismatic loupe universally the first choice for endodontic use. The most commonly selected magnification is 4.0X or 4.5X.

### Through the lens vs flip-up

Both the Galilean and the Prismatic loupes are offered in two configurations.

The "Through the lens" fixed configuration and the "Flip up Flip down" configuration.

The "through the lens" manufacturers and adherents make robust claims that the "fixed position" design allows the eye-piece lens to sit closer to the eye resulting in an increased field of vision. Almost all 2.0X to 3.0X Galilean loupes offer an adequate field of vision irrespective of the distance from the eye.

The relevance of such claims with

respect to the practice of dentistry are of a personal rather than a general nature. However, such claims may have relevance in other surgical disciplines.

"Flip up flip down" designs provide the dentist with a workable and adequate field of vision whilst giving the added benefit of being able to be relocated temporarily to provide the dentist with a panoramic and non-magnified view of the target area whilst maintaining an ergonomically correct position. Additionally, the "flip up flip down" loupe can be integrated and used in conjunction with any form of eyeglass prescription including bifocal, trifocals and graduated lenses. These lenses should be protected by a separate disposable polycarbonate shield.

In the case of the loupe of the "through the lens" configuration, the host lens that holds the optics of the loupe must be replaced if the lens surface integrity is damaged or degraded. This is a very expensive exercise with the cost being substantially increased if an eyeglass prescription is incorporated.

The "through the lens" host lens is required to serve the triple role of eye protection, eyeglass prescription and foundation into which the loupe optics are mounted. Furthermore, the lens that is used to perform this triple task is of a material that is thicker and heavier than two normal polycarbonate lenses as used with the "flip-up" loupe.

### The frame

The frame should be the primary consideration when considering the purchase of any head-borne devices as it is the foundation upon which all head-borne eyeglass prescriptions, eye protection, magnifying loupes and auxiliary illumination is built.

The conventional spectacle frame, safety glasses and sports glasses are engineered, designed and manufactured of components to comply with the stresses and strains produced by lenses not exceeding 20 grams of weight. It is illogical to affix any appliance exceeding this weight to such a frame.

Since the 1960's when the practice of using spectacle frames as a mount for loupes first began, experience has shown the conventional frame will generally provide long term comfort and durability only if this weight factor is not exceeded or transgressed (Figure 5).

All Galilean loupes are available in a range of magnifying powers, and will weigh between 30 grams and 48 grams, whilst the prismatic loupe will weigh up to 95 grams.

The additional weight of corrective lenses or eye protection shields and LED lights will increase the weight by some 40 grams.

It is only reasonable to assume that the conventional spectacle frame, safety glasses and sports frames offer a less than desirable foundation upon which to mount an operating loupe and other paraphernalia. The inadequacies of these designs becomes immediately evident as they must all be "tied" onto the dentist's head with a head strap to obtain and maintain any fitting integrity. In the longer term, the poor performance of these frames will become more apparent and therefore an irritation as they all require frequent re-adjustment and replacement of broken and/or worn components. In fact, in many cases the entire frame must be replaced.

The thoughtfully designed frame to which a loupe is to be affixed will provide comfort irrespective of the weight for the duration of extended procedures. The design should also be flexible enough to facilitate the addition and integration of separate corrective lenses, eye protection and auxiliary illumination and should not require it to be "tied on". Furthermore, the well-designed frame will provide for the interchange of operating loupes of differing magnifications thereby eliminating the need to purchase a complete new frame for each magnifying loupe and/or headlight light.

### Titanium frames

Much has been claimed regarding the use of titanium as a material from which to make a spectacle frame. It is true that a spectacle frame used for the purpose for which it was designed can be fabricated from titanium-profiled materials with the same strength as the conventional materials. It is true that it is lighter.

How much? Perceptibly, it is almost undetectable. As a percentage of the overall weight of a pair of spectacles? Perhaps 10%. As a percentage of the overall weight of a frame with a loupe and/or LED attached? Less than 1%.

The additional cost of a titanium frame as a cost-efficient material is questionable.

### Laser filters

The use of lasers by dentists, in fact, all surgical disciplines, is becoming commonplace.

Lasers, whilst being very valuable tools, present some real danger to the dentist's eyes if adequate precautions are not observed.

The suppliers of all laser emitting devices provide eye protection in the form of eyeglasses or goggles. It is not only the filtering capability of the lens but also the configuration of both the frame and the wrap around high curve lenses that combine to provide the prescribed protection. Laser protective eyewear rarely makes a fashion statement.

Certified protective eyeglasses/goggles must be worn at all times by all persons when lasers are in use. The risk is the potential for eye damage that could very well result in permanent blindness. Be mindful that it is the responsibility of the individual to ensure the eyeglasses/goggles they will wear are certified for use for the wavelength of the laser to be used. The eyeglasses/goggles will carry the level of protection afforded.

Laser eye protection eyeglasses/goggles supplied by laser device manufacturers do not provide for their products to be used with operating loupes, corrective or other head-borne paraphernalia.

A new lightweight rimless attachment is now available that will provide instantaneous integration of laser filters with operating loupes and corrective lenses.

This has been achieved without compromised to either the integrity of the performance of the loupe and/or the level of laser eye protection.

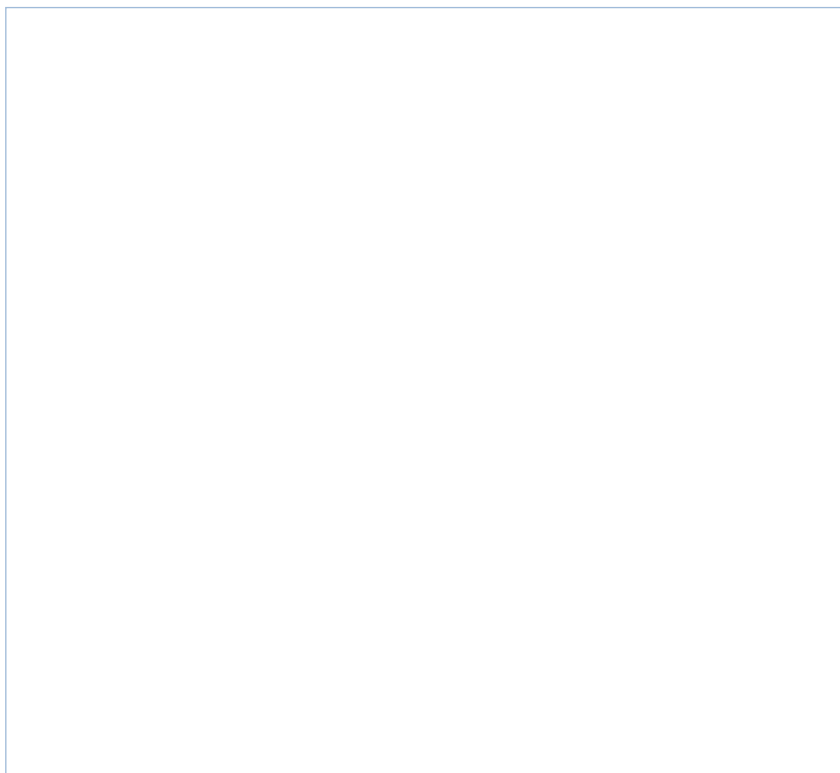


Figure 6. Filters mounted on loupes for the common wavelengths of dental lasers.

The high curve wrap-around configuration of laser lenses used in the Hogies rimless attachment are fabricated from materials that offer protection from blunt force trauma, detritus impact whilst affording maximum splash coverage.

### Disclosure

The author is the inventor of the Hogies system of loupe frames.

### About the author

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