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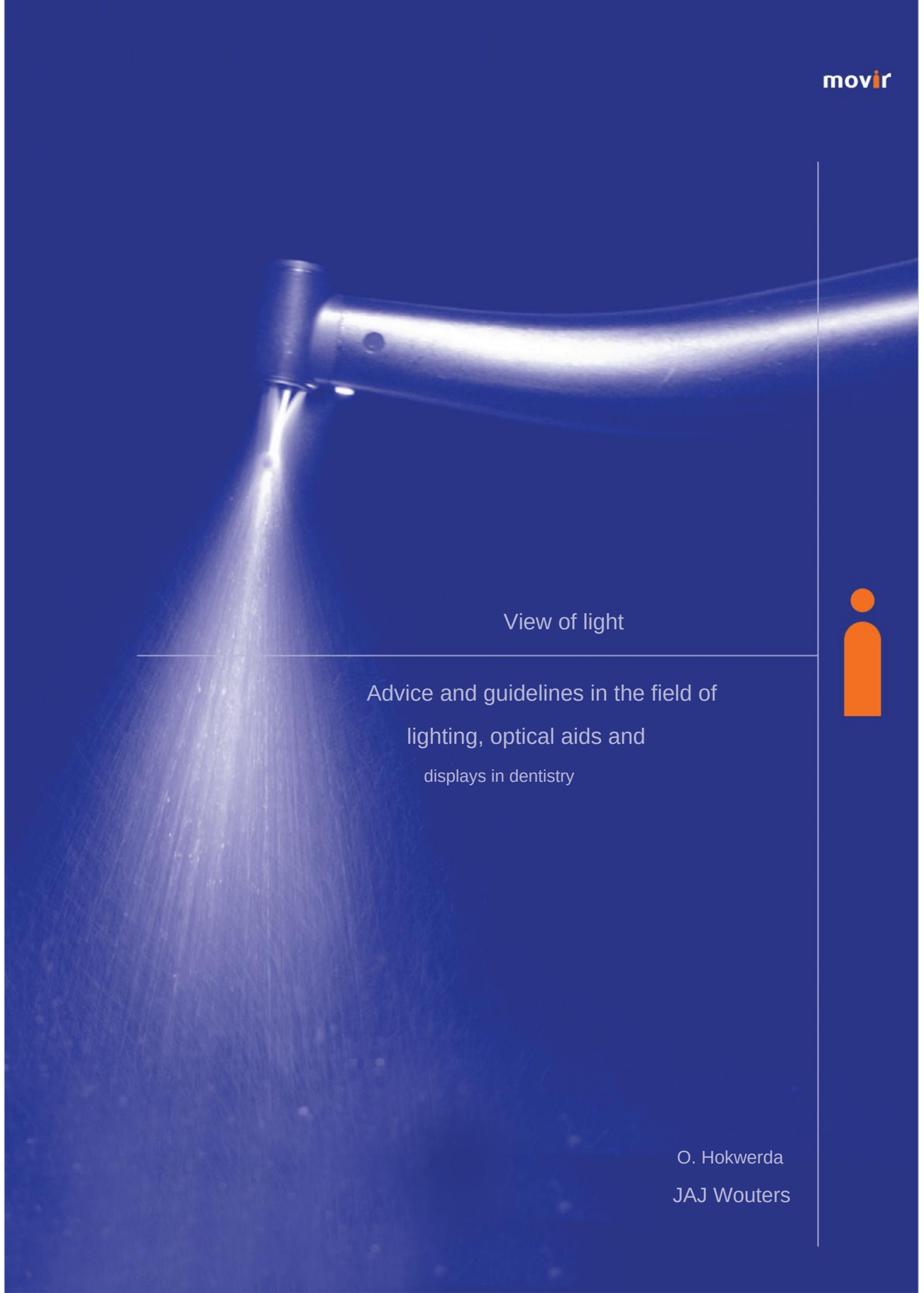

# View of light

## Advice and guidelines in the field of lighting, optical aids and displays in dentistry

O. Hokwerda

JAJ Wouters

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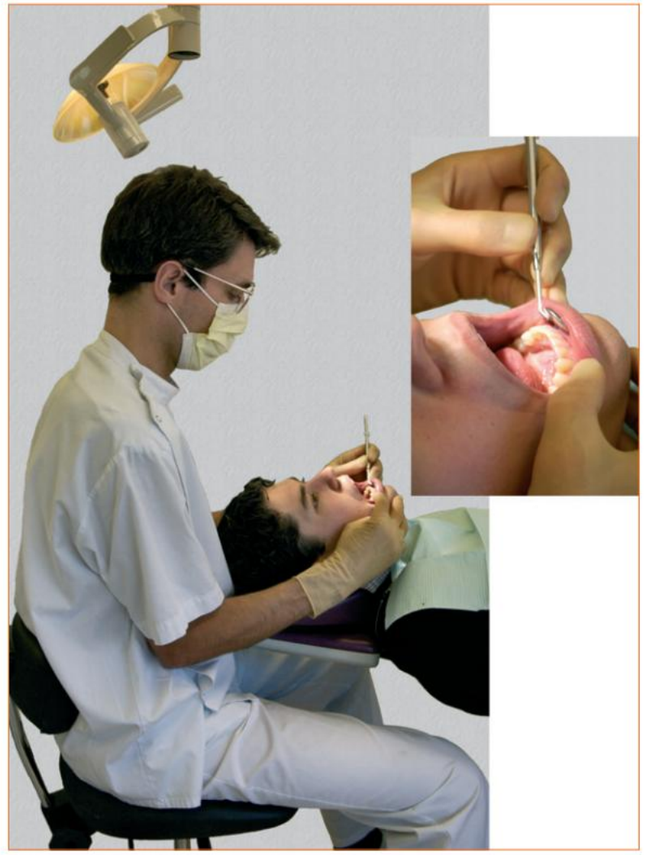
# VIEW OF LIGHT

# ADVICE AND GUIDELINES ON LIGHTING, OPTICAL TOOLS AND SCREENS IN DENTISTRY



Nieuwegein, July 2004

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## PREFACE

In the Prevention Study funded by Movir
Probe are in the second half of the nineties
1,249 dentists visited. Based on the time
Based on existing insights into lighting, light measurements were
performed. It was found in 75% of the measurements
that the method of lighting and the associated use
of colors in the treatment room
principles met. In addition, many dentists had different questions about
the effect of it
use of the many light sources in the treatment room
on visual ergonomics.

Adequate studies into the way of using different light sources in connection
with the application of
colors in the dental practice were missing. To in this one
to be able to fill the gap, Prof. Oene
Hokwerda, dental ergonomist and Joseph
Wouters, registered labor expert / ergonomist van
agency Terzet contacted Messrs
dr. FL Kooi and J. Varkevisser of TNO Technische
Human Studies in Soesterberg for the elaboration of a
research.

The costs of the TNO research and the printing costs of
this book has been taken care of by Movir. The
gentlemen Hokwerda and Wouters have this research from
guided from start to finish and put together this book.
For this, use was made of, among other things, the TNO research.
Their contribution has been selfless as a gesture to the profession.

The study 1 answers important questions
about the lighting in a dental practice, and about
possible (glasses) solutions at the (older) dentist. In
This book contains the most important guidelines and advice
to those formulated in the TNO study.

1 Guidelines and advice for the dentist's workplace at the
fields of lighting and optometry. Authors J. Varkevisser, FL Kooi,
JJ Kriekaard, 2002. TNO report no. TM-02-C029. Soesterberg:
TNO Human Engineering.



## 1 INTRODUCTION

**Why this booklet?**

**The dentist's work places high demands on it the eyesight**

The work in the dental practice is high
requirements for the dentist's eyesight and on
the eye-hand coordination. This turns on the lighting
the practice room must meet special requirements. That
also applies to the optical aids (glasses, magnifying glass and
microscope) that a dentist can use. Also for
guidelines have been formulated for the use of screens.

In this booklet you can read what you should pay attention to
customize the lighting for your practice and at
purchase of optical aids or a screen. For a better understanding
of the advice,
where necessary, the theoretical background is discussed.

The various paragraphs are provided with headings,
while in the margin keywords are indicated for
easy handling of the information.

This booklet may also be of interest to the architect
related to the color scheme, the light installer who a
correct lighting and the optician or ophthalmologist who can help a dentist
with a correct optical
tool.

**also instructions for installers, architects and opticians**

That is why you will find a special list in this booklet
which you can use for your installer if you have your
lighting and a special optometric questionnaire, which is important for
your optician, optometrist or ophthalmologist.

## 2 THE IMPORTANCE OF GOOD RELIEF

Good lighting contributes to optimal visual task performance, visual comfort, working method and attitude to work.

### Optimal visual perception

**perceiving on the border of what is visual is possible**

Often the dentist has to observe on the border of what visually possible. Light is primarily a facility to make the human environment clearly visible. Especially in the dental practice, lighting is of great importance importance of being able to observe small details.

### Visual comfort

For the visual comfort of the dentist, many things have to be done requirements are met. An important cause of eye fatigue is the frequent need to adapt strongly the eyes. Good lighting, proper use of colors, and the handling of matte instruments can counteract this. It is

**the adapter**

understood by adaptation adapting pupil dilation to different brightnesses, both inside and outside the mouth, which be observed. Like when moving the gaze from the patient's mouth to an object outside the direct field of work or vice versa. When the dentist changes of field of view and large differences in brightness perceives, the stronger is the adaptation of the eyes. In other words, large differences in light when observing lead to more eye fatigue.

### Experiencing eye strain

**coherence of factors**

Eye fatigue is a burdensome factor in the dentist's work. The problem is that this pass late, at a larger size, is observed. Men is often unaware of mutual reinforcement of fatigue due to unfavorable postures, a insufficient visual comfort and many others influence the environmental factors in the practice room.

### Influence on work posture

**relationship visual comfort and work posture**

Research 2 has shown that with an incorrect ratio of light brightnesses an increased tension of muscle groups in the shoulder occurs (musculus deltoid and musculus trapezius) and therefore fatigue can develop faster. Furthermore, a too limited placement option and/or incorrect placement of the dental lamp to a stressful work posture.

2 Bjørset, HH, Aarås, A. & Horgen, G. (1999). A comprehensive study on lighting, ergonomics and optometric interventions of workplace for VDU operators. Norway: The Norwegian Research Counsil and the Norwegian Employer Federation, Devision TBL.



## 3 BASICS

To be able to understand more of the opinions that come out the TNO research, will first be briefly discussed number of basic concepts.

### light

With regard to the concept of light, a distinction can be made between daylight and artificial light.

**daylight and artificial light**

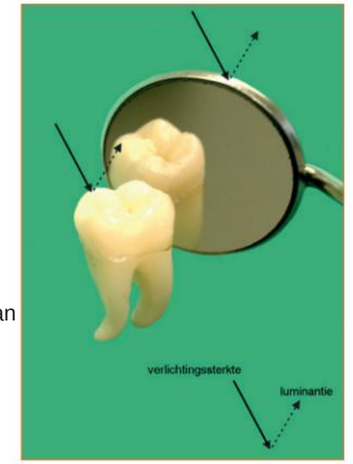
Daylight is the outside light that is present between sunrise and sunset, as well as during twilight. Artificial light is artificially generated light, ranging from light from candles and open fire to lamplight in all sorts. Although we don't notice it, the day light is not constant in color. The color changes slightly from morning to evening. Artificial light, on the other hand, has a more constant colour. However, artificial light has not always the same color as daylight.

### What do we observe?

**illuminance and luminance**

When a light source shines on an object (illuminance), this object reflects the light. In the towards the eye we perceive the brightness or luminance. The illuminance is measured in lux and the luminance is measured in candelas per square meter (cd/m2).

Every material has its own own way of light is reflected. That is for a tooth other than for example one amalgam filling or before the tongue. But also for the objects in your practice room, this is very different. So has a dark one unit has a lower reflectance than for example a light unit. In addition, the reflection color dependent on an object. White light on one yellow object means that the reflection for blue is lower than for red and green. The luminance is therefore the resultant of the incident light from the light source, and the spectral reflection of the material. What we perceive is reflected light energy. Depending on the viewing direction of the object, the luminance can sometimes differ considerably (see gloss and reflection).




*The radiation from a light source is shown here represented by an arrow pointing to the tooth and mirror. This is the striking thing light that has a certain illuminance has. The reflection, the reflected light, shown by a dotted line called luminance. Luminance (reflected light energy) is what we perceive. For correct observation, the to perceive luminances to certain meet the requirements.*

**Light and visual acuity** An image consisting of a collection of luminances is imaged on the retina. This depends on the amount of light reflected from different surfaces to the eyes. The retina can therefore locally process high and low luminances.

**relationship visual acuity and luminance**

Research shows that visual acuity decreases at low and high luminances. It appears that using too much light causes a decrease in visual acuity. The area for optimal detail and weak contrast is between 200 and 2,000 cd/m2, while visual acuity is most favorable at 1,000 cd/m2. The setting of the illuminance of the dental lamp and the strength of the lighting in the practice room must be adjusted accordingly.

**Contrast**

**small details require more contrast**

**Contrast** is important in dentistry. Contrast is about the brightness differences between details in the working field. There is therefore a dependency relationship between the ability to perceive details and the associated contrast. Small details require more contrast to be able to see these details.

Moreover, the contrast sensitivity is also age dependent.

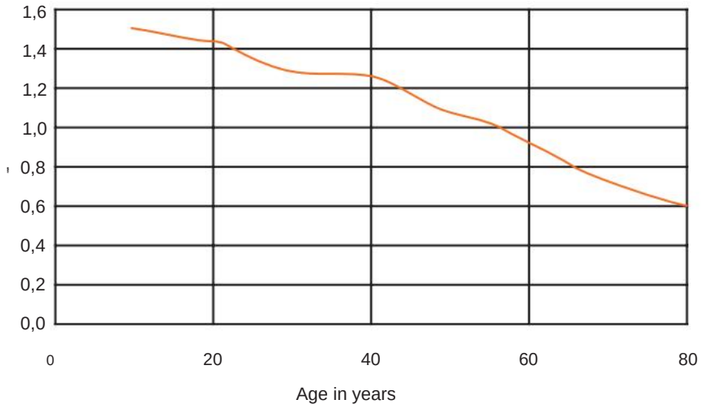
**accommodate**

**Effect of age on vision** Vision begins to decline on average from the age of 40. This mainly starts with a reduction in *accommodative ability* , so that the eyes need help to see clearly up close. This help comes in the form of reading glasses, later possibly also screen glasses and, in the case of the dentist, special work glasses. At a higher age, the following points also play a role: • there is a greater need for light • the adaptation to lower light levels takes longer • there is a decrease in contrast sensitivity and visual acuity: perception of small details becomes less possible • perception of colors becomes less good.

**eye strain**

As a result of these causes, eye fatigue occurs more quickly in old age.

That is why it is very important that the lighting is well designed and adapted to the age of the tan darts, see the chart on the next page.




(bron: Boffea, 1986)

*The table shows the influence of age on visual acuity. Because dentists perform work on the border of the perceivable, timely correction with aids is important.*

**Gloss and reflection** A matte surface reflects incident light in all directions. We call this *diffuse reflection.* The opposite is gloss and reflection, material properties in which the light or part of the light is reflected *directly* . This occurs with completely or partially smooth material surfaces.

**diffuse reflection**

These effects are most apparent when focused light hits the material. With gloss, the material becomes somewhat lighter due to the increased reflection, the color fades and the light source is visible as a diffuse spot. With mirroring, the light source is visible and the luminance that hits the eye is several times higher than through diffuse reflection.

In the case of full mirroring, the luminance striking the eye is close to that of the light source.
Convex shapes show a reflection more often, because there is always a position on the surface that reflects the light from the light source in the direction of the eye.

*These images show the difference between matte and glossy instruments. The photos were taken at a lower than usual illuminance level. When using a dental lamp, the reflection is too large to capture a good image.*

**annoying glare**
**masking glare**

When using strong light sources, such as the dentist's lamp, strong reflection is due to the use of too high illuminance is of course undesirable. Instead of a good picture of the tooth, the dentist would after all one image of the light source. Reflections are bad for the dentist because of the flare because it adversely affects vision and can lead to it to glare, which entails two disadvantages, namely “annoying glare” and “masking glare”. These concepts are explained later in this booklet discussed.


*The oral cavity of the patient is illuminated with the dental lamp. The matted the drilling tool shows some shine. Shine is also seen on the curves of the gloves and plunger. The top edge of the head of the drill tool shows mirroring, so does the handle and edge of the mirror. Reflection can also be seen on the curves of the teeth and a moist part of the lip.*

The objective of good lighting is to create an even luminance ratio in the mouth so that the objects in the mouth are optimally visible.

The research has shown that mirroring particularly occurs when using glossy round surfaces, such as instruments that are not matted and on highly curved surfaces. Also wet mirror surfaces. To prevent the mirroring of instruments, it is best to work with matted instruments.

**choose matted instruments**

**Nabeelden**

**afterimages and glare**

With too high an illuminance and with mirroring of the workplace or work surface can create glare that causes an afterimage.

Glare does not arise immediately, but builds up depending on the amount of light received the same position of the retina. The effect on the retina of glare is locally reduced sensitivity to light. If you then look at a darker surface, the image is dominated by the afterimage. The intensity of the afterimage depends on the luminance of the object and the exposure duration.

Each afterimage gradually disappears, the speed of which depends on the amount of light that the afterimage has caused and of the luminance of the plane what to look at next. The darker the plane what one looks at, the longer it takes for it afterimage has disappeared. This again emerges how important it is that the light conditions in the balance in practice.

Also the structure or texture of the surface where one is looking at affects seeing the afterimage. A textured surface masks the afterimage. That's why it is beneficial to have a structure (or an uneven wallpaper). A smooth surface of the wall is therefore less desirable.

**a textured wall masks it**
**nabeeld**

**Glare**

An excessively high luminance of the oral cavity causes moderate to annoying glare. This leads in the long run to eye fatigue. When mirroring due to too high luminances can affect the perception in the oral cavity. The light of the reflection becomes scattered in the eye of the observer causing one veil of light arises. This effect acts as a masking glare. The degree of specular reflection has one important influence on the perception of contrasts which reduces visual acuity.

Here again comes the importance of matting instruments forward to prevent annoying glare. Preventing reflections also improves low contrasts perceived.

**avoid smooth, reflective surfaces**

**Eye damage risk**

Research shows that in the daily dental practice the risk of damage to the eye is small if one the light from the lamp via reflection (via the oral cavity) and without reflections and not daily to a continuing higher than obvious load is exposed above 2000 cd/m2. To reach of the risk threshold depends on the amount of radiation and the exposure time. In the dental office serve light sources intended for illumination contain no UV and not too much IR radiation.

**Color temperature**

Color temperature is a measure of the color of the light source. Color temperature is expressed in units Kelvin (K). The color temperature of daylight like that occurs in the northern hemisphere is 5500 K and falls in the color category “cool”.

daylight is important for good color perception

White light has a high color temperature and yellow to orange light has a low color temperature (this light contains relatively little blue). At very high color temperatures the color turns slightly blue. In the dental office lighting for good color perception needed that contains all the colors (especially enough blue) and therefore approaches daylight.

**Color Rendering Index**

The color rendering index of the light source indicates in to what extent with the light of this colors true to life to be displayed. A good color rendering index is necessary for the assessment of color differences. The scale ranges from 0 (not a good display) to 100 (perfect). For dental treatment a color rendering index (Ra) is recommended for the light source of ÿ90.

importance of luminance for it perceive

**Luminance as a primary design unit** We discussed illuminance and luminance earlier. It has emerged that what it is eye actually perceives the reflection of light on it material being exposed. To assess whether a good observation is possible, should therefore primarily go to luminances are considered. Therefore it is recommended starting from the luminance in the lighting design. After all, the luminance is the amount of light that meets the eye and in which the material properties of the illuminated objects are already discounted. Short by the bend: the illuminance is the unit of measurement from the lamp manufacturer and the luminance is the unit of measurement of the ergonomist.

In daily practice, many light suppliers are accustomed to using the illuminance as a unit when designing a lighting plan. It is easy to handle and measure. We have previously recommended using luminance as a unit of measurement. To in line with the working methods of the light suppliers will this approach be translated into the use of illuminances. This can be achieved by applying an approximation by taking the ratios in illuminances between various areas in and around the mouth and the colors to be used.

*There are now computer programs in which a room can be simulated and in which the material properties, shape and color can be used as variables inserted.*

For example, one can use the ratio of 10 : 1 : 0.5 as ratio of the illumination of the oral cavity (for example, 20,000 lux for the dentist's lamp, as we commonly seen in use), the immediate vicinity of the mouth (2,000 lux) and the illuminance in the rest of the treatment room (800 to 1,000 lux).



## 4 LIGHTING IN THE DENTAL PRACTICE

ratio lighting environment, mouth and background

In a dental practice, the illuminance of the dentist's lamp, whether or not in combination with the drill head lighting, is too strong and the ambient lighting is noticeably too low. This while not in the background only illuminance that is too low but also colors that are too dark are used. Finally located often a window in the field of view that is too bright can be completely dark. In this way, under others due to frequent adaptation, a strong eye fatigue resulting in a loss of concentration, less good vision and loss of pace.

**The combination of light sources and environmental factors**

harmony between light sources

In the practice room are a series of light sources and environmental factors present that can be met as much as possible must be harmonized with each other:

- dentist lamp, chuck lighting
- ambient lighting around the mouth, background lighting
- (disturbing) additional lighting (for example uplighters and halogen spots)
- outside light influence
- mirror in the field of view
- reflective surfaces in the mouth (instruments, water film or droplets)
- curing light, intraoral camera, laser, magnifier lighting
- areas of color in the field of view (often too dark or too too light. Also influences the color comparison in restorations.)
- displays (those in a lower illuminance must be used)
- glossy surfaces with reflection (eg to join)
- white clothing.

better no white clothes

To prevent glare and glare, it becomes use of matted instruments is advised. To unfavorable luminance ratios can be avoided for example, it is better not to wear white work clothes and it is better not to wear white but light green or light blue napkins, gloves that are not too light and a light-colored rubber dam.

**use of a rubber dam can be beneficial offer**

Napkins that also cover both shoulders
covered are recommended. This is because of brightness differences in the field of view due to, for example become dark or very light clothing for the patient cancelled. By using a cofferdam that does not gloss can be quite a brightness reduction in the mouth be obtained. Don't use reflective ones suction cannulas.

**The lighting of the work area**

*The dentist lamp*
To enable the dentist to clean the mouth properly be able to work needs a certain amount of light from it stand out in the field of work. In the mouth, the reflections are often low, so that more light is needed to obtain luminances at which the dentist can adequately perceive. The amount of reflected light (the brightness of the object) is expressed in candelas per square meters (cd/m2). The recommended luminance range is 200-2,000 cd/m2. The optimal luminance is located around 1,000 cd/m2.

The dental lamp usually has an illuminance that ranges from 8,000 to 24,000-25,000 lux. This range is sufficient to achieve the intended luminances (brightnesses). can fulfill. By means of a present light controller, the illuminance of the dentist's lamp can be adjusted to the required luminance or Brightness. The optimum luminance can be easily checked by the dentist himself by setting it in such a way to state that no flattening of contrasts occurs and the details are visible to the maximum. For lamps without light control, you can achieve the optimum luminance by adjusting the distance from the dental lamp to to adjust the oral cavity in such a way that it is necessary are perceived to be well defined. This means that structures and colors of the surface are good being recognizable.

**illuminance that is too high has consequences**

An illuminance that is too high causes an undesired decrease in the contrast differences, leads to a less good perception and further contributes to glare and glare from instruments and water film or droplets.

**replace the lamp regularly**

The desired lighting intensity to be set via the light controller will differ individually depending on the height of the dentist which is the distance from the lamp to determines the field of work. But also the age, the degree of aging and pollution of the lamp as well as the extent of reflection of the light from the working field (in the front of the mouth larger than at the back) play a role in this.

A reduced light setting of 8,000 lux is suitable for use during polymerization of composites.

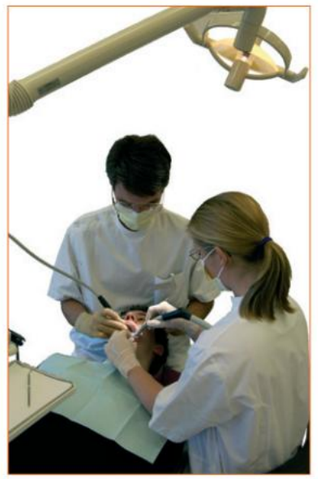
The strength of the chuck illumination is often approx 25,000 lux. Together with the dental lamp, a te high illuminance obtained, increasing brightness differences in the mouth, causing glare etc. This problem is more pronounced in work in the mouth. The illuminance of both light sources together must be such set so that the total light level does not become too high. A higher illuminance than 30,000 lux is not possible recommended because then contrasts and details disappear and glare and glare may result.

*The placement of the dental lamp*

**avoiding shadows in the working area**

For shadow-free illumination of the work area in the mouth and its surroundings should be the light beam of the dental lamp almost parallel to the direction of the dentist's gaze. In principle, it is recommended that the direction of the light beam does not deviate more than 15° to deviate from the direction of view.

The lamp is momentarily above the level of the head of the dentist placed, left or to the right of it or in front of it. And such that no visual field obstruction occurs because, for example, a drilling tool is in the light beam of the lamp placed. When working from behind the patient lamp, when using a drilling tool, for example by a right-handed dentist in the lower jaw usually on the left side of it placed head. For a good view of the drill is a as thin a drill bit as possible.

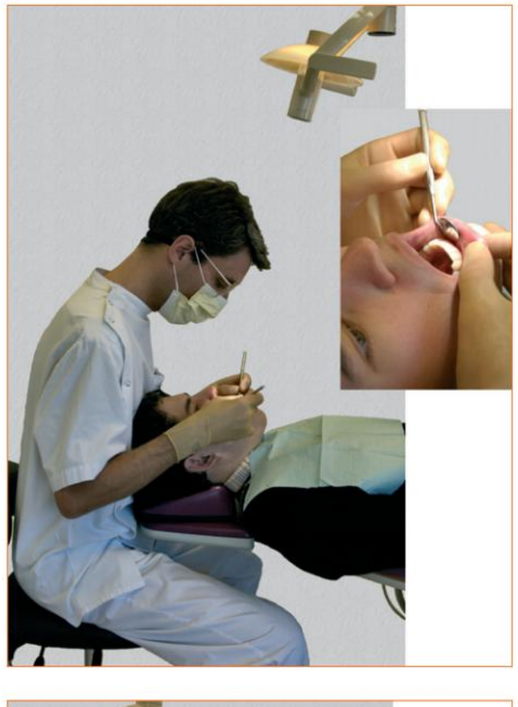


*Placing the dental lamp parallel with the direction of vision in the sitting position next to the patient. The field of work is in the plane of symmetry of the dentist, so straight in front of the chest.*

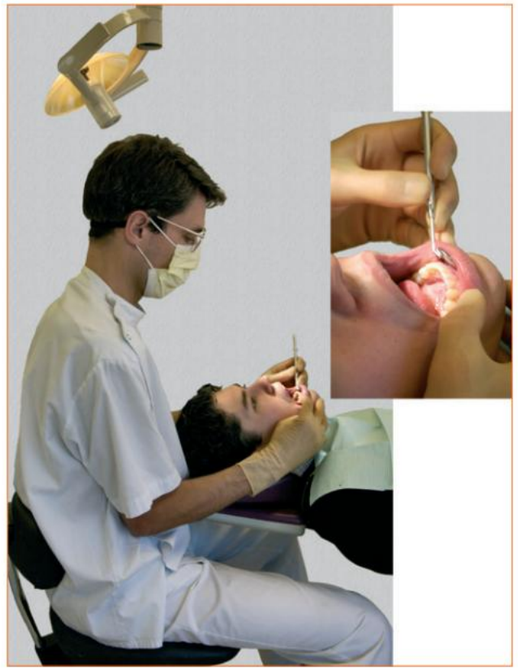
A

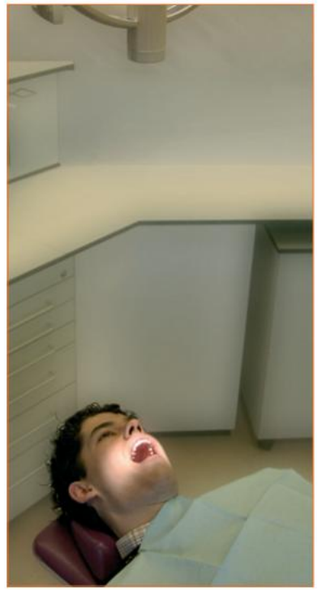
lamp arm that extends to about 45 cm beyond the back of the unextended head restraint, with the backrest positioned horizontally.

*The dentist is used to the dental lamp usually above the patient's chest places. The result is an uneven relief in the mouth (see inset) and on the preparation field which is tiring for the eyes. In addition, the mouth opening is directed too far forward placed, which forces the dentist in to sit in a bent position. In addition, when moving the hands, by the hands or the instrumentation, cast a shadow with* reduced view of the work surface. *The dentist often then adjusts the previously adopted working position in order to have a better view* resulting in an overburdening work attitude.

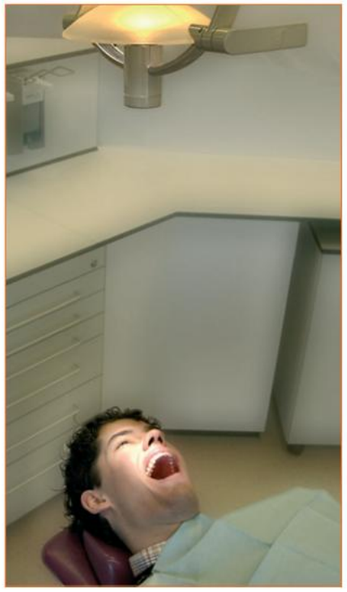


*Here the correct position of the dentist lamp is visible. The lighting beam runs almost parallel to the direction of gaze of the dentist, creating uniform illumination in the mouth (see deployment) and of the preparation field. In a relationship with the direction of the illumination beam is the head of the horizontal reclining patient sufficiently far back rotated so that the dentist is symmetrical can sit upright. Instrument manipulations in the mouth do not cast shadows on the mouth work surface.*

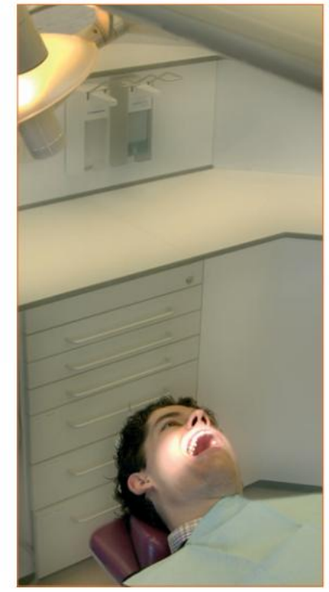




*The lighting rectangle of the dental lamp must run parallel to the mouth opening, where the upper limit is below the nose passes. The light emission upwards is then minimal so that no dazzling of eyes the patient arises.*



*In a sitting position next to the patient and placing the light beam almost parallel to the direction of vision the dentist, the rectangle comes to one lamp with 2 axes of rotation across the patient's face, causing an uncomfortable light ting on the patient's eyes.*



*With a lamp with a third axis of rotation, the lamp can be placed next to and even above the dentist's head be placed with the lighting rectangle parallel to the mouth opening, without glare cause. The lamp is then switched on an oblique position. By the way, this oblique position is also pleasant when placed next to and just above the head of the tooth doctor in treatments from behind the patient, in the 10:30-12:00 position.*

In the sitting positions to the side next to the patient chair, the lamp in the correct position, so in an angle of maximum 15° to the direction of the dentist's gaze, a three-axis lamp is required because with the commonly used two-axis lamp the light rectangle then diagonally across the face of the patient stands. This causes an excessively high light level in the patient's eyes. At the exposing the usually oblique to sideways mirror when used for indirect vision, the same problem often arises. Here, too, a three-axis lamp is required for good lighting.

**three-axis lamp**

When working from the side of the patient, in the 9 to 10 o'clock position, the lamp is on the right side of the dentist placed (mirror image for left-handers).
When working with indirect vision, preferably a KR 5 mirror used which is placed in a slanted position handled and in preparations with a spray on any distance from the work surface. Must do that the position of the head and the dental lamp are adapted to the placement of the mirror.

**General lighting and use of color**

Objective of the general lighting is the whole
to make the space of the practice room usable as
workspace. This includes light wall and ceiling colours. White, off-
white or light colors are required
to obtain the correct luminance ratios and the
to maintain the desired color reproduction. The general
lighting must be carried out in such a way that the room is evenly lit
without daylight.

**basic lighting conditions**

A ratio of 10 is assumed between the illuminance levels of the working field, the working environment around the mouth and the background in the practice room:
1:0.5. The luminance ratio of a factor of 10 between the object and its immediate visual environment should preferably not be exceeded. The luminance of the
environment of the mouth must match the luminance in the mouth opening. Based on the above
luminance ratios are assumed to be a
ambient lighting of approximately 2,000 lux. This is how it arises
not only a balanced relationship with the lighting of the dental lamp of 20,000 lux, but is also
a good starting point has been obtained for the color assessment for restorations, etc. and for performing work outside the mouth. The
illuminance of
the backlight should be approximately 800 to 1,000 lux
amounts. As described earlier, the ratio between the illuminance of the working field in the mouth,
working environment and background 10 : 1 : 0.5 assuming
a dentist's lamp with an average setting of 20,000 lux.

**color temperature and color index value**

For a good color comparison, it is preferable to use fluorescent lamps with a color temperature
of 5500 K and a color index value ÿ90. This lighting corresponds most
closely to daylight.

*Lighting in the area of the mouth (working environment)*

For ambient lighting, it is best to use luminaires with high-frequency fluorescent tubes. The luminaires, placed in the longitudinal direction of the
patient chair, should be the largest available length
to have. Prism refractor luminaires are preferred. Mirror fittings could
also be used
but these may be perceived as blinding by patients viewing them due to
the
greater brightness that these lamps have. The width
of the appearance of the fluorescent luminaires must be such

**pay attention to the lighting of the walls**

that the lighting of the luminaires over the mouth
and the treatment room is sufficiently well lit
is becoming. This also includes the walls
as much as possible to relieve without being too strong
reflection off the walls.

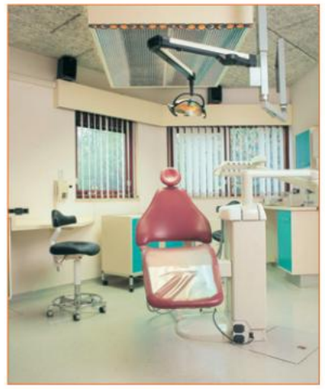
This could be the case when the luminaires are too
installed close to a wall. Using it
of a light controller for ambient lighting
are important for a particular adaptation to a
stronger outdoor lighting (but one should avoid
that the outside light disturbs the luminance ratios). Light
adjustment may also be desirable when receiving anxious patients and using
monitors (particularly when viewing digital
x-rays). A special dimmer is available for high-frequency fluorescent lamps.

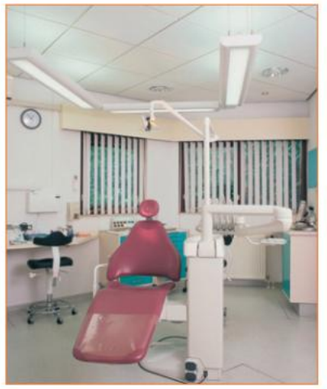
*Backlighting and color usage*

**combination of direct and indirect relief**

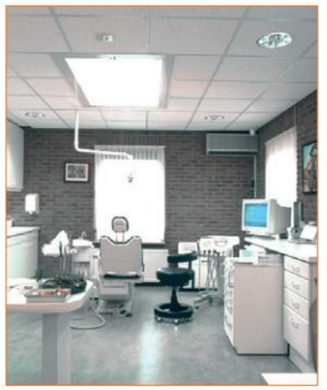
To make the entire space suitable as a workspace
a combination of direct and indirect lighting is assumed. To achieve this,
pendant luminaires are used where possible

distance of not less than 40 cm from the ceiling
must be hung because otherwise the risk
exists that the ceiling is illuminated too strongly and the
its luminance becomes too high. Furthermore, wall fixtures can be
used, but this must be done
Be careful that the grazing light along the walls does not become too bright.



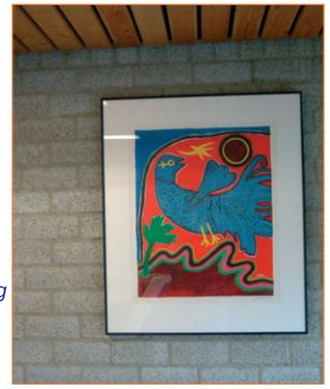


*The photos show the effect of it use of lighting with daylight fluorescent tubes, resulting in correct luminance ratios. A combination of direct and indirect lighting has been chosen. By illuminating the ceiling in this way, a calm image has been created with a even light distribution in the room.*



*These pictures show the effect of it installing lighting with daylight fluorescent tubes and daylight lamps (right photo). Because the walls are not adapted and the patient chair is opposite a window placed remains unfavorable luminance ratios. There is more light with a good color temperature but this effect is largely canceled out by the strong contrast between the luminances between the outer frame and the wall being looked at.*

*You can see the difference in these photos the effect of a wall before and after fitting the lighting with daylight fluorescent tubes and applying a light tint.*



*On the left picture, with the old situation is the reflection of the fluorescent lighting in it painting visible. Because the fluorescent lighting is mounted in the ceiling the upper part of the wall barely lit due to the boundary of the cove in which the lighting is placed.*

*On the right picture is the effect of it use of daylight fluorescent tubes in the new to see the situation. Here is the choice combination of direct and indirect relief. This gives an even light distribution in the room and on this wall.*

The ceiling and upper part of the walls of the room are also illuminated by the indirect lighting.
This makes the practice room lighter and more spacious and creates a more even illumination of the entire area
departure. Furthermore, softer and flowing shadows are created, which makes a calm impression.

*Because the space is relatively small, it became fluorescent fixture in a place close to the wall mounted giving the effect of the indirect lighting is somewhat disturbed because the wall is too bright lifted. This is visible by the small shadow forming on the wall (directly above the top edge of the painting).*

The use of white, off-white or a light shade is
necessary to maintain luminance and color rendering. The ceiling is colored white and is therefore illuminated. The walls and window coverings (such as the curtains)
are light (not white) colored because the room is different
gets boring. Dark areas on the wall (for example, a dark painting in the field of view).
better avoided because they disturb the luminance ratios. One mounted on the walls
texture or structure makes the room less boring.

Afterimages are less visible on a textured wall
then on a flat wall.

The treatment installation and other furnishing elements are also light-coloured and matte as much as possible,
so not shiny, to prevent glare and glare. The worktop of the cabinet wall is not white but
light-coloured and matte to prevent annoying reflections. To avoid this should not be shiny
become worksheets within sight of the dentist

**importance of light shades and avoidance of glossy surfaces**

used. Do not use black or glass worktops and do not use dark or shiny walls.

To avoid large differences in brightness, the floor covering is also lightly colored and provided with
not a "tickle" for splashes and daily pollution
immediately noticeable.

When one is in the treatment room for certain
If you still want to use darker colors for parts such as wall and furnishings,
the lighting level must be adjusted accordingly
be adjusted to the requirements of the dentist

to be able to maintain luminance ratios and thus
a stronger or tiring adaptation of the eyes
prevent. This apart from the influence on the color rendering index.

**a window in the field of view has large consequences**

In the field of view of the dentist it is better not to have any window. This is due to the strong differences in brightness caused by incident light, which varies greatly
can have high and very low illuminance levels.
This creates an unstable luminance ratio
which is a major source of eye fatigue.

If there is a window, it is often shielded on the inside with a non-transparent and
uncolored vertical slat curtain. That's the disadvantage
you can no longer look outside than the slats
be closed. If they are partially open, then arise
there are a number of visual objections that lead to eye fatigue.

A better solution is therefore to use a
roller blind, for example of the Pagoda type
Luxaflex. This works like rice paper because the curtain holds it
filters light. The best solution is a facility at the
outside of the window because it allows next to light
heat can also be stopped. This can be done with, for example, a “screen” or fiberglass cloth. The
view to the inside is obstructed but to the outside
viewing remains possible.

**Making a color assessment or color comparison**

Preferably a lamp or lighting with a
color temperature of 5500 K and a high color index
value (ÿ90) is used. This relief comes the most
corresponds to the daylight outside. Usually it is general
use lighting in the treatment room for this purpose.
There are quite a few snags to using the dentist's lamp for color assessment.

**color temperature and color index**

The dental lamp can theoretically be used for
a color determination when the color temperature of the
lamp is 5500 K and when the lamp has a color rendering
has an index of ÿ90. The color temperature of 5500 K
is only achieved at 24,000 – 25,000 lux but this one
illuminance is due to the loss of
contrast unsuitable for color determination. For a
high-contrast lighting, such that low contrasts
are perceptible, the illuminance must be increased
reduced. That has to be done by the lamp further away
position, because when dimming to a lower illuminance, the color
temperature decreases.

use the original bulbs

It is therefore not immediately certain whether the existing dental lamp is suitable for a color determination. Also steps changes due to the aging of halogen lamps on. This can also be the case when other than before the lamp manufactured halogen lamps are used.

Fluorescence must be taken into account of fillings in people exposed to fluorescent light (disco) stay. This can be done with blue (UV) fluorescent tubes being watched. However, these should not be on for too long due to the harmful UV radiation. There sometimes a counterfeit money detector is used.

For a less critical assessment, a color comparison can be carried out at the window. The time of the day, cloudy or clear weather or the proximity of colored areas can adversely affect the color comparison to influence.

When comparing colors, both gloss and reflection must be used will be prevented. A first comparison is performed with dry teeth. In a final comparison can the materials be moistened to prevent the color, but rather the gloss or reflection effects. The surfaces to be compared are always in kept on the same plane, so never tilted in relation to each other. The surfaces to be compared are held together.

Some aspects important for the accuracy of the assessment:

- *Assessment with directed lamp light*
  Advantage: Accuracy and better color discrimination. Possible disadvantage: the light source must correctly positioned to prevent flare and reflection to prevent. •

*Assessment at the window*
Advantage: lighting is diffused in cloudy weather, the orientation no longer matters. Disadvantage: one has cloudy weather quickly suffers from specular reflections. Colored areas in the environment adversely affect the accuracy of the color matching.

**The lighting in the hallway to the practice room**

The lighting and colors in the hallway to the practice room are preferably such that it becomes a transition formed between the lower brightness of the waiting room and the higher brightness in the practice room. On this this way there is a gradual transition to stronger lighting in the practice room for the patient.

## 5 OPTICAL TOOLS IN THE DENTAL PRACTICE

vision loss is a natural process

Vision goes on average from the age of 40 to decrease. This mainly starts with reducing it accommodative ability which aids the eyes need to see clearly up close. This help is coming in the form of reading glasses, later possibly also of one screen glasses and, in the case of the dentist, special work glasses. For the sake of enlarging it image can be used a loupe or microscope.

**Glasses**

The working distance from the working object to the eyes or spectacle lenses must correspond to the working distance in the correct working posture, sitting stretched upright with the forearms slightly raised.

relate height and working distance

The working distance is generally between 35 – 40 cm. Bee taller dentists sometimes slightly higher. With very tall dentists, problems can arise between body position and the distance of the work object – eyes. This can be corrected with glasses correction.

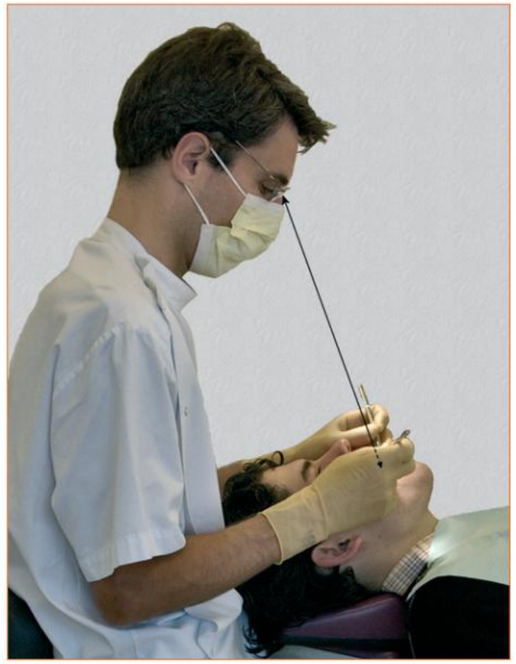
The optician must be properly instructed on this point and the individual work object distance – eyes, in one stretched upright sitting position, should be measured because he often fits dentists with spectacles that have a shorter focal distance than necessary for a good work attitude. That makes the dentist then forced to work in a bent position to to see clearly (see point 8 information for the optician/optometrist/ophthalmologist).

As with a single pair of reading or working glasses suffices, an eye correction of 35 – 60 cm is possible, this also allows viewing on the screen.
If no single vision correction is possible, the following options exist:

- bifocal glasses, with the upper part for distance and the lower part for close range. These glasses have a "hard" clear transition between the upper part for distance and the lower part for close range.

• multifocal glasses where these corrections come in gradually
overlap each other, so that the intermediate distances
can also be clearly seen. The downside is that
near part and far part are smaller in size and it is
less clear where the transitions lie. The gradual transition
also causes an image distortion
which can cause an unpleasant sensation in the eyes. A
small close part forces the dentist to work in a certain
position, which increases the risk of postural complaints,
because the image plane that provides a clear image
can be obtained is limited. Into the flexibility
distance from multifocal glasses to the working field is greater
because it can be seen sharply at any distance.
However, it should be noted that multifocal glasses
getting better.

*The working distance is measured from the correct working posture. The distance between the front of the lens and the working field in the mouth.*



The starting point is that bifocal glasses should be used where possible
is used with a large near part, greater than
usual for reading glasses. For example the long line
glasses with a near correction of 35-60 cm. In principle, this is
sufficient for close work
of the dentist so for the mouth of the patient, while
can work in a good posture. With the distance correction, the
area from 65 cm to infinity is too sharp
which is sufficient for the display.

Varifocus glasses are less suitable because they are effective
area of focus both horizontally and vertically
limited. The result is that one has to turn the head in order to
keep seeing sharply (which one does, for example
notice when reading a newspaper). Furthermore, there are
problems of not being able to see well or enough with one
varifocus glasses because the setting of the focus part
of the lens is difficult to tune to an optimal one
head posture. Here too, the glasses are technical
getting better.

**types of glasses**

Multifocal glasses qualify as the dentist
less than 1 diopter of accommodation left, the dentist outside
the practice satisfactorily recommends a multifocal
glasses used and the intermediate distance (= center area between
see near and far) to the screen and the distance
must be seen clearly. The following factors play a role in the
desire to see sharply in the transition area between near and
far: • looking from the position next to the
patient on the screen with digital X-rays or administrative

facts.
• see at some distance in the practice room of the assistant
in her work area, patient entering
watch the clock, view X photos at multiple distances
e.d..

A possible solution for the clear vision of the
bifocal glasses can be provided for this in the middle area
of a near and a middle area. The drawback of this may be that
it is not easy to see from a distance. Then one can
consider getting trifocal glasses and adjusting them
individually, with the middle part slightly higher
incurs. But smaller image planes are then created as already
indicated above.

The dentist looks quite steeply down at his work.
It is therefore recommended in the work glasses of the tan
darts the optical center, which is normally found in glasses 15°
down, can be placed an extra 15 to 25° downwards, halfway
between the 2 work areas. So that he looks straight ahead at
the screen and 30 to 45° down
in front of the mouth, so that a good view can be obtained
with less bending of the neck and spine.

**tilt of the glasses**

It is also recommended to tilt the frame up to 20°, instead of
the usual 10° tilt, so that
the dentist looks less obliquely through the glass and less
suffer from the bottom edge of the glasses. A small frame is
undesirable because the bottom edge will suffer
the frame can arise and too little space is available for a
sufficiently large close part. The frame
must be placed close to the face for a
frames that are too far from the face force
bend forward with the upper body to a good
to gain sight.

**glasses pollution affects viewing comfort**

Anti-reflective glasses are unnecessary in the dental practice because the workplace is more illuminated than the rest of the environment and anti-reflective coatings attract and retain dirt.

Glasses pollution has little influence on vision (seeing details and contrast) but it does influence viewing comfort because one is forced to look past the splashes and the pollution is not equal for both eyes.

Glass is easier to clean than plastic. Cleaning can be done with clean water and soap; disinfection can take place with alcohol (compare infection prevention guidelines).

*The important starting points for the dentist's vision correction are summarized as follows:* * The dentist's individual working posture determines the working distance from the working field to spectacle lenses. * the optician's inclination to set a shorter focus distance should be avoided. * when applying lenses, it is necessary to assume the natural postural inclination of the cervical spine (flexion up to 20-25°).

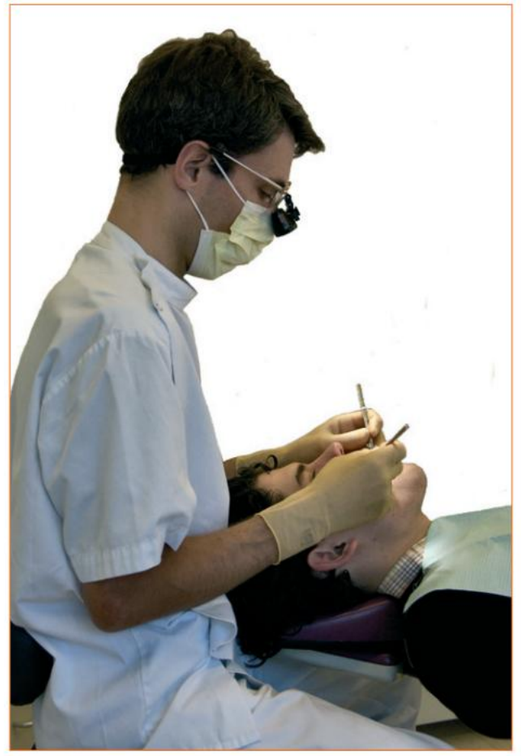
**Use loupe (magnifying glass placed in front of the eyeglass lens)**

The details that dentists want to see are on the border of what we can perceive visually or not. For a better assessment of details, there is a need for a better view that makes it possible to work more efficiently and purposefully and to improve the quality of action.

**a loupe enlarges the image**

A loupe enlarges the image which glasses hardly do and therefore improves visual acuity. The magnification can vary from 1.5 to 5 times and improves visual acuity by this factor. A microscope is required for greater magnification. The dentist can therefore use a magnifying glass or microscope to improve his visual acuity or to increase the distance to the working field without sacrificing visual acuity. A loupe can therefore offer a solution to improve posture in case of reduced vision.

*Treatment situations where loupes can be used:* • accurate observation during diagnostics • periodontal treatments • cavity and crown preparations • impressions • endodontic treatments • surgical procedures • fixing restorations.



*The use of magnifiers can lead to harmful loads as a result of making too few movements and adopting a bad, stooped working posture because the focus distance between the magnifier and the working field is often not adapted to the individually required working distance.*

*The tendency to fixate the neck can also arise from the attempt to keep the image still.*

*If the dentist wants to use a loupe, it is desirable to use a loupe that is as light as possible with a focus distance that is adapted to sitting in a symmetrical upright position. With the aim of limiting as much as possible the static load on the muscles etc., which is already unfavorable due to “sitting still”. Furthermore, it is necessary to ensure variation of the load by making movements.*

*Aspects of using loupes* With loupes, the dentist works with a fixed magnification, between 1.5 and 5 times. The greater the magnification, the smaller the field of view. As a result, more head movements are required because the image cannot be overseen due to eye movements. However, the eyes tend to avoid head movements so that the image on the retina remains stable, which means that the user tends to move the head little during magnification. This is not possible with enlargements and with every head movement the retinal image will shift, making the world appear to move. This induces a tendency to keep the head rigidly still, which leads to extra static muscle tension.

**the greater the magnification, the smaller the field of view**

The depth of field is limited, especially at larger magnifications. This requires a fixed posture, for which the tan darts fixes his head by means of the neck muscles.
Due to the very static posture of the dentist, lack of movement occurs. Depending on the weight, wearing loupes requires more muscle tension and therefore load because the weight is located at the front of the head. requires. The illuminance is often much too high, which adversely affects perception. Furthermore, the light source leads to weight gain.

**risks of a lack of exercise**

The eyes must converge for seeing. This is a
fatigue factor with a long duration of the load.
Both eyes serve exactly through the optical center of
to look closely. If this is not the case (which will often be the case
come) the optical distortions lead to fatigue. The patient's movements
can be disturbing; small results are greatly magnified. Bee

gaze changes must be strongly accommodated by the eyes as a
result of the dimensional changes
and often adapted due to light changes.

Many loupes cannot be used at the required working distance, resulting
in the dentist's head and head
upper body should bend forward. Therefore be
loupes with individually adjustable focus distance are required.
The use of magnifiers requires concentrated work and
is more strenuous. This requires a thorough organization of the work
and cooperation with an assistant
necessary.

**build movements into the process**

It is recommended, even if magnifiers are excellent from a visual
point of view and limited
weight, handle it carefully, because
due to the adopted attitude to work and the limitation of
the freedom of movement creates too great a strain on the posture. It is
therefore desirable as much as possible
incorporating movements into the process.

**Use of microscope**

A microscope is adjustable with a magnification of: • 2 – 4 times: for
orientation
• 7 times: before treatment
• 7 – 11 times: for observation of details.

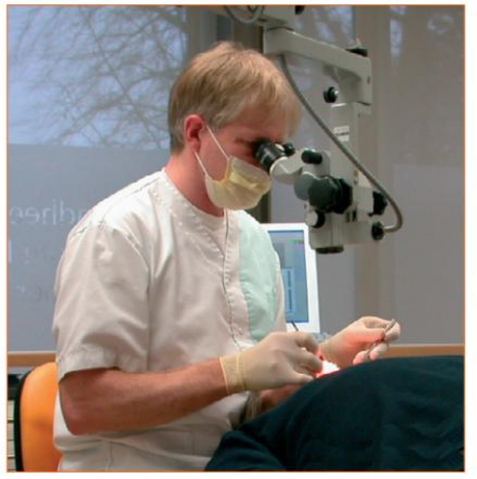
*More magnification is not effective due to:*

• shallower depth of field
• moving the patient causing the image to pass through the
magnification is quickly out of focus
• reduction of image area.

An adjustable magnification provides a gain for vision
of details. In the microscope, focusing takes place on
unending. Therefore, no convergence of the
eyes and adapt less. The focus button allows a
focusing of the image take place in relation to
correct working posture.

It is quite possible from a correct working posture
working with indirect vision. The microscope cannot turn
look at the angle" so that it remains necessary to deal with
indirect vision to work.

An adjustable binocular is required for a good head posture for the dentist.
This also makes it possible for several dentists with a different build to
work with
a good setting with the same microscope
to work.



*An important advantage of using*
*of a microscope that is the dentist through*
*an adequate setting thereof*
*becomes symmetrical to work in an upright*
*position. And so unfavorable, asymmetric and*
*bent postures can be avoided. Well will*
*should also be given attention when*
*using a microscope*
*alternation of attitude, and therefore of the*
*muscle strain, by making movements.*

The microscope has its own light source, which gives a
coaxial beam of light passing through the lens into the working field
illuminated, where it reflects and through the lens
the magnification changer is split into 2 bundles
reach our eyes through the binocular tube, so that a
three-dimensional image is created and depth information
is acquired. The light always comes along with the image
at an angle of 2°-6°. Smaller gives loss of reflection
and contrast, larger gives shadow. Recommended is the
continuously adjustable light intensity. In some cases, a polarization
filter can cause annoying reflections
avoid but low contrasts are reduced visible
to make. A yellow filter can be used with blue light sources, such as
with a curing lamp. The picture is
split to a second binocular or camera. Also
a connection is possible with a video camera where the image on a
screen can be followed.
It is also possible to capture images.

*There is the impression that with a*
*microscope a more flexible and*
*more focused efforts.*

**Using the intraoral camera**

The light source of the intra-oral camera is very bright and can cause
glare when viewed directly into the oral cavity
light source is checked whether the reflections on teeth or
instruments are observed. Therefore try to
avoid looking directly at the light source.
If the lens of an intra-oral camera fogs up, you can
cover the lens with a plastic cap, exposing the lens
cannot be moistened. Then you can enter it
dipping a liquid as done with a mirror. There
is currently a wireless intra-oral camera with which
can be manipulated more easily.

## 6 USING DISPLAY SCREENS

### IN THE DENTAL PRACTICE

Increased digital processing and consultation
data requires frequent screen use.
Long-term static loads can be added to this
performance.

Assumptions:
All screens required in a practice are met
a server united in a network so that it is available to all
functions can be used by anyone.
Screens are necessary for the dentist, assistant and
also for the patient.

These can be used in the treatment room, depending on the
users, the desired functions and the place where they are
she wants to use, be placed as follows: behind the
patient (for use by the dentist only or by
dentist and assistant), in front of the patient, on a work surface
on the dentist side of the patient chair and on the
assistant side of the chair.

**placement in front of the patient**

Positioning in front of the patient presents the following problems:

- high placement: the dentist has to go to the neck too much
  turn backwards
- low position: the patient has to do this more or less
  be brought upright
- high illuminance above the patient: gives reflections from the
  screen
- often there is a window in the background: nuisance
  of too strong ambient lighting through the
  window incident light.

We recommend screens in the treatment room
some distance from the light sources, to prevent nuisance caused
by a high light intensity. If with
If, however, a nuisance arises, especially when viewing digital X-rays,
dimming the lighting can reduce a
solution are found.

A flat LCD-TFT screen is preferred.

These can be supplied with high resolution and
light output. The number of pixels required for digital
x-ray is 1024-768. A screen with a flat surface absorbs less light from
the environment than one
convex screen. The image surface should be matte black when
switched off.

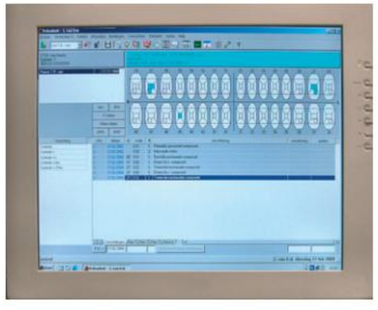
Such an image surface causes the least burden
of disturbing reflections or reflections. Take a screen with a light
colored border, preferably matte.
Black screen edges require adaptation and are
therefore not desirable. An advantage of a flat screen
is also that it takes up less space than the classic one
monitor. It also gives off less heat.

It is recommended to choose a screen size of at least 18”. By
means of a movable
arm can position the screen at the desired position and viewing distance
be drawn up.
The screen layout must be clear. The height of the symbols must allow
good legibility. For example, at a distance of 1.5 m

they are at least 9 mm.

To avoid unfavorable ambient lighting
the screen is not placed in front of a window
but perpendicular to it and at some distance from it. If that
if there is no other option, adjustable sun protection must be present
are (see above). Annoying reflections on the screen
by shining other light sources (think
uplighters and halogen spots) should be avoided.
The screen can be tilted for both a view of the screen and to
prevent reflections.

*Here you can see the difference between a light and a black screen border. A black keyboard on a light surface is also not recommended because of the strong luminance differences.*



The dentist makes a selection from the information he has
must observe for yourself. Because the eyes always have to
seeing adapt on the screen, it is
important not to consult the screen more than necessary. By
turning out he can determine certain
information, for example about the planned patients,
consult in advance and information can be entered by activating the
assistant.

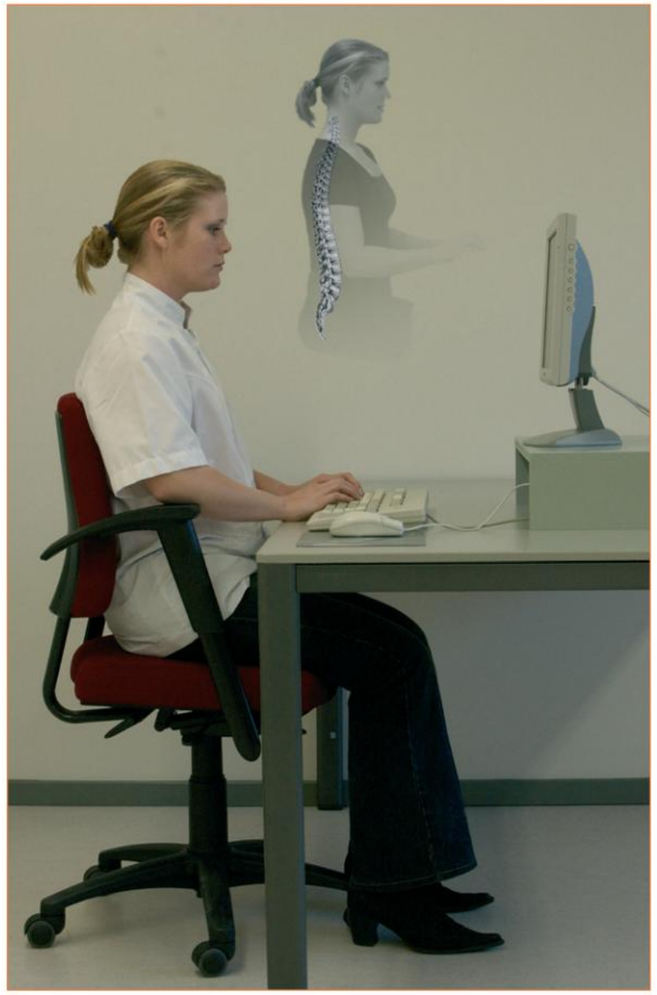
**adapt - and also accommodate and converge - when viewed on the screen**

A data structure is required to handle all via multi-input
store information obtained about a patient.
When using the keyboard, the hands lie as horizontally as possible in
line with the forearm, the
keyboard is as flat as possible and the size of the mouse
fits hand size. An alternative is one
mouse with vertically stalked handle. One must
watch out for a mouse that is too big in relation to
the hand.

The work surface height, when adjustable, ranges from 62-82 cm.
With a fixed worktop height, this is 74-76 cm.
There is sufficient space for legs and feet under the worktop to be able to sit in a relaxed position and directly in front of the screen.

When the monitor is placed on a worktop with cabinets underneath, people are forced to sit turned in front of the screen. Because such a burdensome attitude arises, it should be avoided, even if it lasts for a short time.
A height-adjustable keyboard tray for the keyboard can be obtained from a number of suppliers and can be mounted under a fixed work surface.

*The placement of the screen at this height makes it possible to work in an upright position. This results in a natural posture of the spine.*



In order to get more variation in the working posture, one can also think of entering data into the computer while standing. There are special mounting brackets for mounting the display and keyboard to the wall.



## 7 SCHEDULE LIGHTING PLAN

If you need new lighting, good communication with the installer is important to ensure that you get the right lighting. Earlier we wrote about luminance as a primary design unit. Not every installer will be able to deal with this in practice.

The following diagram contains a number of data that are important for the installer. An advice regarding the light intensity is also given here. This advice belongs to a room with light colors on the walls, floor and ceiling.

**Information for the installer.**

The dentist's task performance is complex and stressful for the eyes and the upper body, among other things. The activities in the dental practice place high demands on the dentist's eye task and eye/hand coordination. This means that the lighting must meet special requirements.

The requirements for the treatment room are listed under point A, for the rest of the practice under point B.

**A: The treatment room**

*Illumination of the mouth*
The dental lamp usually has an illuminance that can be adjusted from 8,000 to 24,000-25,000 lux.
The dental lamp must have a color temperature of 5500 K and a color index value ý90.

*General lighting and use of color* The objective of the general lighting is to make the entire space of the practice room usable as a workspace. This includes light wall and ceiling colours. White or off-white or light colors are necessary to obtain the correct luminance ratios and to achieve the desired color rendering. The general lighting must be designed in such a way that the room is evenly lit without daylight.

*Lighting in the area of the mouth (working environment)*
**Type of luminaires**

For ambient lighting, it is best to use pendant luminaires with high-frequency fluorescent tubes. The luminaires, placed in the longitudinal direction of the patient chair, must have the largest available length.

Prism refractor luminaires are preferred.

Mirror fittings could also be used
but these can be perceived as blinding by

patients looking at it, as a result of the greater
brightness that these lamps have. The width of the
the appearance of the fluorescent luminaires must be such that the
lighting from the luminaires runs over the mouth
and the treatment room is sufficiently well lit,
with as much lighting as possible on the walls
(without creating too strong a reflection from the walls, if
the luminaires are installed too close to the walls).

**The relationship between the illuminances**

A ratio of 10 : 1 : 0.5 is assumed between the illuminance
levels of the working field, the working environment around
the mouth and the background in the practice room.

Based on the above lighting conditions
assumes ambient lighting with a
illuminance of approximately 2,000 lux, for the benefit of
a balanced relationship with the light level of the
dental lamp, the color assessment for restorations and the
carrying out work outside the mouth (see lighting diagram for
the practice room).

Due to a good color comparison, preferably
assume fluorescent lamps with a color temperature of 5500 K
and a color index value ÿ90. This lighting corresponds most
closely to the daylight outside.

**Backlighting and color usage**

To make the entire space suitable as a workspace
a combination of direct and indirect lighting is assumed. To
achieve this, pendant luminaires are used where possible

distance of not less than 40 cm from the ceiling
must be hung because otherwise the risk
exists that the ceiling is illuminated too strongly and the
its luminance becomes too high. Furthermore, wall fittings can
be used, but this must be done
Be careful that the grazing light along the walls is not too high
is becoming. The indirect lighting makes ceilings and
upper part of the walls of the room also illuminated.
This makes the practice room lighter and more spacious and
creates a more even illumination of the entire room.
Furthermore, softer and smooth shadows are created,
which makes a calm impression.

The illuminance of the backlight
is approximately 800 / 1,000 lux (see lighting schedule
practice room).

**Light controller (dimmer)**

In the installation of the ambient lighting place a
light controller. Using a light controller for the
Ambient lighting can be important for adapting to stronger
outdoor lighting (although care should be taken to prevent
outdoor light from disturbing luminance ratios), when receiving

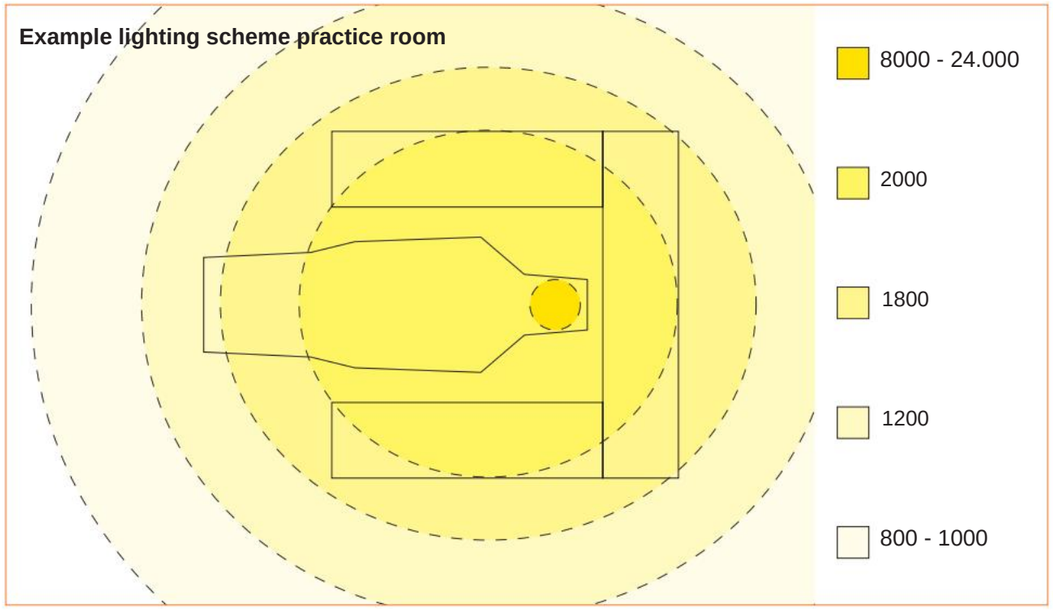
anxious
patients and the use of screens, in particular
when viewing digital radiographs.

**B: Lighting in the rest of the practice**

Lighting in the hallway to the practice room
The lighting and colors in the corridor to the practice room are
such that a transition is formed between the lower illuminance
of the waiting room
to the stronger lighting in the practice room, so that
the transition to the lighting in the practice room
for the patient is not too abrupt. Advised
to make this illuminance approximately 800 lux
using the same fluorescent tubes as in the
treatment room.

Avoid the use of strong ones throughout the practice
accent lighting or the use of halogen spotlights.

**Example lighting scheme practice room**




- an illuminance of 2,000 lux is achieved in a radius of approximately 1.5 meters around the patient's mouth
- the illuminance in the rest of the treatment room is 800 to 1,000 lux
- pendant luminaires, combination of direct and indirect light, minimum distance to the ceiling is 40 cm
- high-frequency fluorescent tubes, color temperature 5500 K, Ra ÿ90
- light controller
- luminaires placed in the longitudinal direction of the patient chair, largest available length.

## 8 INFORMATION FOR THE OPTICIAN / OPTOMETRIST / OPHTHIST

This information sheet for the optician / optometrist / ophthalmologist consists of 2 parts. In the first part you can fill in a number of details that are important for correct glasses correction. Please complete this section as accurately as possible and take it with you when you visit the optician, optometrist or ophthalmologist. The second part contains information that provides insight into the specific situation in dental practice in relation to optometry. Take both parts with you to the optometric examination.

**Optometric Questionnaire**

**Name: ..... Age : .....**

**1 Symptoms / Complaints** Do you experience 1 or more of the following complaints during or after your work? (Multiple choices possible).

Headache
Blurred vision for far
Blurred vision for near
Blurred vision at an intermediate distance Slow to adjust focus (from far to near and/or vice versa)

Sore/irritated/tired eyes
Problems with reflections and/or glare
Worse contrast
Burning / itchy / red eyes
Double vision
Nabeelden
Neck/shoulder pain
.....

If no complaints, continue with point 2

1.1 What is the main complaint?
.....

1.2 How often do you experience this main complaint < 1 x per week > 1 x per week daily

1.3 How serious do you consider this main complaint?
Not disturbing
Disturbing
Very disturbing

1.4 How long ago did this complaint start?
Since using (new) glasses
Other: ..... .....

1.5 At what time of day does this complaint start?

Immediately After a few hours / during the day
Only after extremely strenuous work
Other: ..... .....

1.6 Is there anything that fixes this complaint?
No
Yes, namely: ..... .....

**2 Do you take any medication that can affect your vision?**

No
Yes, eye drops,
name: ..... .....
number of drops per day: ..... ...
Yes, other medication,
name: ..... .....
daily dosage: ..... .....

**3 Do you wear 1 or more glasses during / outside work? (multiple choices possible)**
No, I never use prescription glasses, go to point 5 I only use safety glasses, go to point 5 Only glasses for distance (TV, driving)

Only nearby (reading etc.)
Glasses continuous for all distances
Alternating, sometimes far / near

**4 What type of glasses do you use during near patient treatments? (1 choice, the most important)** 1 power (monofocal) 2 powers (bifocal) 3 powers (trifocal) magnifying glasses (or viewer system) varying powers (multifocal / varilux), see point 4.1

4.1 if tapered lenses, type for all distances (near to far) for near to about 4 meters for near to about 1 meter

**5 Do you (occasionally) wear contact lenses at work?**
No
Yes, type and strength: ..... .....

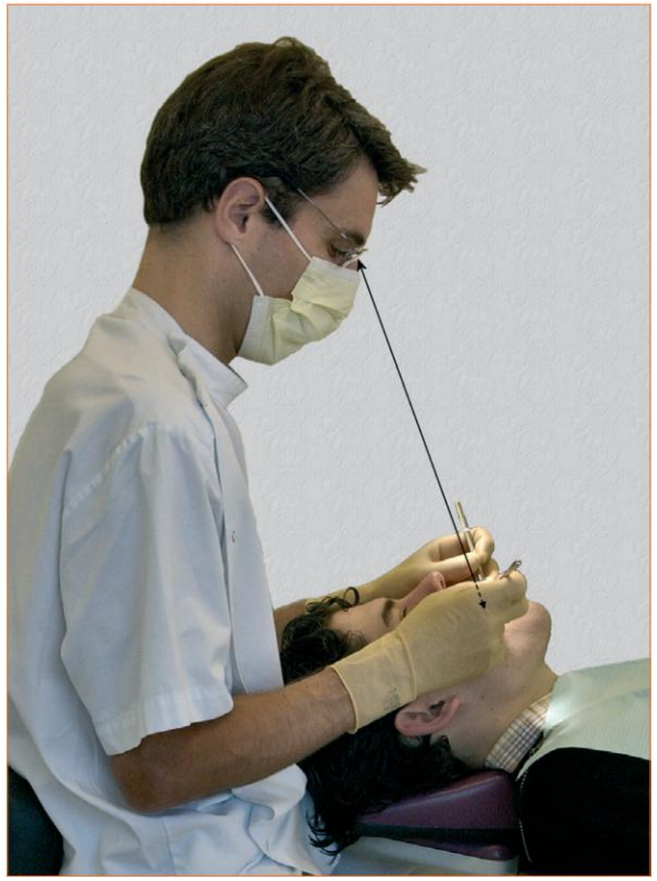
**6 What is the actual working distance measured from your eye to the treatment surface in the patient's mouth?**

Have your working distance (= viewing distance) that you are used to using carefully measured by someone else.

The distance is: ..... cm

**7 Now have the working distance measured again, but this time from an upright sitting position.**
Again, this is about the distance from your eye to the treatment surface in the patient's mouth.
The distance is: ..... cm

*The working distance is measured from the correct working posture. The distance between the front of the lens and the working field in the mouth*



**8 Do you use different glasses for working at the screen in practice?**
No
Yes, strength: ..... .....

**9 Have you ever been treated for:**
Strabismus (strabismus)
A lazy eye



**10 Are there any other conditions you suffer from (diabetes, high blood pressure, etc.)?**
Nee

And

***Please bring glasses and/ or prescription glasses with you to the optometric examination***

Glasses The working distance from the work object to the eyes or spectacle lenses must correspond to the working distance in the correct working position, ie sitting stretched upright with the forearms slightly raised as shown in the image in the questionnaire. We request that you base the optometric measurements on the measured working distance in the upright sitting position (as stated under point 7 of the questionnaire).

*Explanation:*
The working distance is normally between 35 – 40 cm. Sometimes slightly higher for longer dentists. With very tall dentists, problems can arise between body position and the distance of the work object – eyes. This must then be compensated for with a spectacle correction.

If the working distance is too small, the dentist is forced to work in a bent position in order to see clearly.

If single reading or working glasses are sufficient, an eye correction of 35 - 60 cm is possible, so that it is also possible to look at the screen with them.

If no single vision correction is possible, the following can be used:

- bifocal glasses, with the upper part for distance and the lower part for close range. These glasses have a "hard" clear transition between the upper part for distance and the lower part for close range
- multifocal glasses where these corrections are gradual overlapping into each other, so that also the in-between distances can be clearly seen. The disadvantage is that near and far part are smaller in size and it is less clear where the transitions are gradual transition also causes a picture distortion that can cause an unpleasant feeling in the eyes. A small near part forces the dentist in a certain attitude to work what the probability of postural complaints enlarged, because the image plane to obtain a clear image limited.

The flexibility in distance from progressive glasses to the working field is larger because sharp vision can be seen at any distance. The starting point is that where possible a bifocal glasses are used with a large near part, larger than usual for reading glasses. For example the long-line glasses with a near correction of 35-60 cm is acquired.

In principle, this is sufficient for the close work of the dentist so for the patient's mouth while in a good attitude can be worked. With the distance correction, the area from 65 cm to infinity can be seen sharply, which is sufficient for the display.

Varifocus glasses are therefore less suitable because the effective area of sharp vision is limited both horizontally and vertically. The result is that one with the head has to turn around in order to keep seeing sharply (which one notices, for example, when reading a newspaper).

There are also problems of insufficient or not good can see with varifocus glasses because the setting of the focus part of the lens is difficult to adjust to an optimal head position.

Multifocal glasses qualify as the dentist has less than 1 dioptre of accommodation left, the dentist outside the practice uses multifocal glasses satisfactorily and the intermediate distance (= middle area between near and far vision) to the screen (at about 1 to 1.5 m) and the distance should become sharp seen.



At the wish in the transition area between near and to see sharply from a distance, the following factors, among others, play a role:

- looking from the position next to the patient on the screen with digital X-rays or administrative data

- see at some distance in the practice room of the assistant in her work area, patient entering watch the clock, view X photos at multiple distances e.d..

A possible solution for the clear vision of the bifocal glasses can be provided for this in the middle area of a near and a middle area. The drawback of this may be that it is not easy to see from a distance.

Then one can consider trifocal glasses and these can be set individually, with the center section which rises higher. But then arise as above already indicated smaller image planes.

The dentist looks quite steeply down at his work. It is therefore recommended in the work glasses of the dentist the optical center, which is normally in glasses 15° down, can be placed 15 to 25° extra downwards, halfway between the 2 work areas. So that he right looks forward to the screen and 30 to 45° to down in front of the mouth so that with less bending of it the cervical spine a good view can be obtained.

It is also recommended to tilt the frame up to 20°, instead of the usual 10° tilt, so that the dentist looks less obliquely through the glass and less suffer from the bottom edge of the glasses.

A small frame is undesirable because it will suffer from the bottom edge of the frame can arise and too little space is available for a large close part.

The frame should be placed close to the face, because a frame that is too far from the face forces the upper body / head to bend forward to get a good view.

Anti-reflective glasses are unnecessary in the dental practice because the workplace is more illuminated than the rest of the environment and anti-reflective coatings attract and retain dirt.

Glasses pollution has little influence on vision (seeing details and contrast) but it does influence viewing comfort because one is forced to look past the splashes and the pollution is not equal for both eyes.
Glass is easier to clean than plastic, cleaning can be done with clean water and soap; disinfection can take place with alcohol (compare infection prevention guidelines).

*Partner van Professionals.*

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