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SPECIAL LIGHT

Shade selection
what a headache

Respecting
the body's
biorhythms

Seeing well :
a professional
imperative

Tension, headaches,
nervous exhaustion…
the light is to blame

Dental practice
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Edited

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Taming light

What can be more energizing than a beautiful sunny day? Nothing can be more depressing than a cloudy sky. Light exerts a crucial influence on us, surely this is taken for granted?

No it is not! Light is too often ignored in our poorly lit surgeries. Poor lighting (light quality, quantity and distribution) is a major cause of nervous exhaustion, fatigue, headaches and other health conditions…

> **“The art of lighting is to come as close as possible to the natural conditions for which our eyes are designed : natural exterior lighting”**

When badly managed, the light impairs the quality of the treatment, distorts the colour shades we select, slows down our movements imperceptibly, requires demotivating adjustments… (We don't understand this translation please advise) When underestimated, the life force that is light forces its attention on us to the extent of reducing our productivity and profitability in sporadic but enduring fashion: our body is our main working tool.

In these few pages we want to summarise what needs to be known in order to manage light and, as ever, to offer you direct operational solutions.

Have a good read

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Respecting the body's biorhythms

Our bodies are designed to live in the open air and in daylight. And by the rhythm of the seasons and therefore by hours and quality of daylight. Modern life has distanced us from these roots. So we have to try to reconstruct the conditions artificially or suffer the consequences.

Year

The body is designed to live by the rhythm of light and the rhythm of the seasons: in the summer the days are long were productivity is high in anticipation of winter. The long daylight exposure time increases the secretion of serotonins, activity hormones which condition our body to absorb this extra work and stimulate enthusiasm and vitality. Conversely, winter is a period of low yield and cultivation, the days are short and the body is conditioned to rest. But modern life reverses this seasonal rhythm by encouraging us to work hard in the winter and go on holiday and/or take siestas in the summer. It was the emergence of electricity that brought about this change. By making light cheap and easily accessible, it profoundly altered our connection to the natural rhythms, which the body has retained despite us. Which is why it is common to experience extreme weariness and even periods of depression when winter begins: starved of light, the body is depressed but our culture of productiveness pushes it to continue its efforts until the summer when it will be in good form but will be required to rest and so on for the whole of our professional life.

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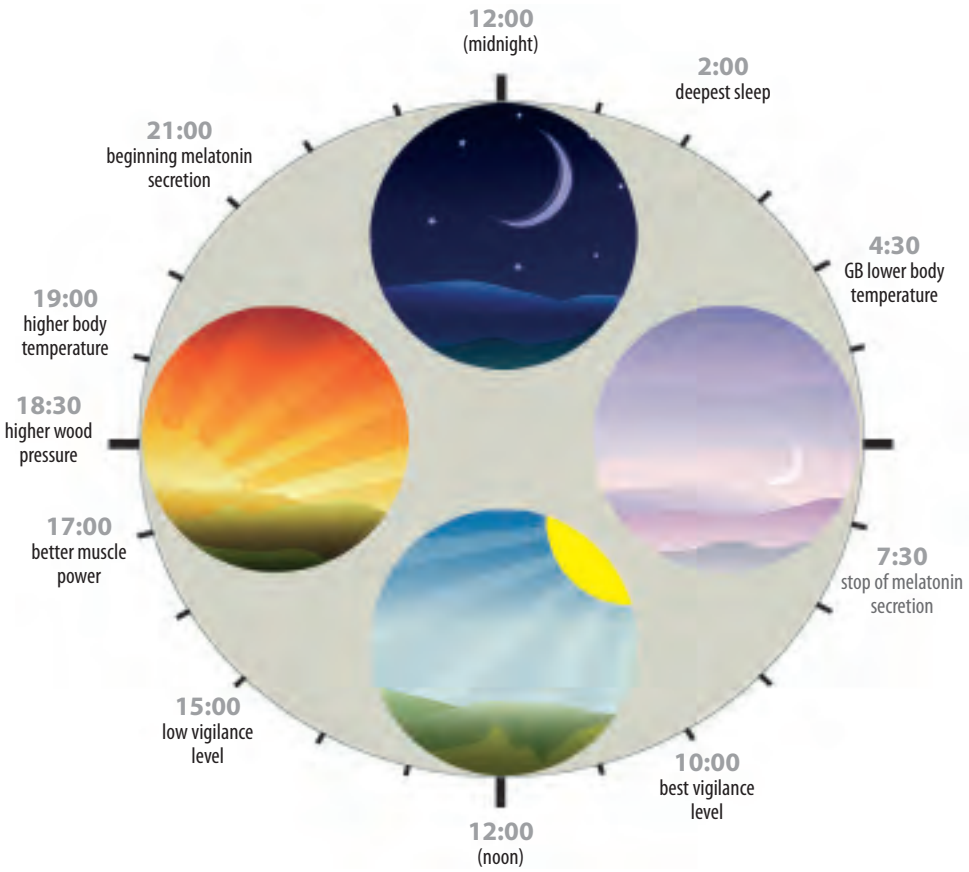
Day

The arrival of night (and the scarcity of light) caused our ancestors' brains to secrete melatonin, which prepared them for sleep. The hormone, which enables the body to rebuild its



Did you know?

Alertness and drowsiness are two aspects of the same fluctuating state with circadian variations which are divided into two sub-cycles of about 12 hours each. In other words, people placed in an environment where the spatiotemporal patterns are suppressed have a twice daily rhythm of sleep propensity.
The first and more important period of drowsiness occurs at around the usual bedtime and reaches a peak between 3 and 6 a.m. This is the time when the body's metabolism and temperature are at their lowest. Alertness is at a low and people are physically clumsy and mentally sluggish.
The second drowsiness peak occurs 12 hours later, between 2 and 4 p.m. Although less important than the first one, it is still known to everyone: it is the mid-afternoon "tiredness hit". It is wrongly associated with digesting the mid-day meal, and it is not the result of the afternoon heat. So don't be ashamed if you feel rather exhausted in the early afternoon. Most people benefit from a short rest in the afternoon period

> **"Working doesn't make us tired : there are the poor working conditions that exhaust us"**

strength during sleep, is located at the back of the eye and is only secreted in an absence of light. This is why frequent fliers put a black mask over their eyes when travelling by air: the lack of light is restorative. The brain's reflex will analyse the lack of light as a sign of preparation for sleep. At the end of a day in a poorly lit surgery the Dentist has to fight the lure of his own body chemistry. This makes him tired, which he thinks is due to the work, annoyed by his patients, who he imagines to be unbearable, and irritated by his assistant, who he tells himself is impossible… while it is actually a fight (and inevitable loss) against nature. Imagine what the end of a winter's day brings! Some people go as far as solving these problems by taking medication… and yet suitable lighting will achieve the same effect as a sunny morning: yes, the colours are brighter and the scenery is more beautiful, but it is the brain which bathes in the serotonin, adrenalin and cortisol, anti-depressant hormones with activity stimulated by light.

The less effort is made by our body to adapt to the stresses of modern life, the better it will perform. The aim of a well-designed professional lighting system is to reproduce natural lighting conditions at work.

Luminotherapy

Scandinavian companies noticed the substandard performance of their personnel throughout the interminable months of the Arctic winter. They were the first to offer free luminotherapy sessions consisting of exposure to fairly intense (artificial) daylight for several minutes a day. It took just one week to see renewed vitality and a more positive mood among the people treated. Their treatment resulted in a feeling of well being, an increase in the level of physical activity and improved body tone. These effects are particularly marked among women aged 20 to 40. Luminotherapy helps to regulate the body's internal clock. The biorhythms are reset at their optimum levels. ■

Seeing well : a professional imperative

Poor lighting is the cause of many clinical problems (poor selection of shades, access difficulty access to parts of the oral cavity…) and also personal problems (headaches, tension, stress and reduced visual acuity over time). But a few simple rules can make light your ally.

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The human eye can "see" in almost any situation. Full moon or bright sunshine, twilight, orange lighting on the motorways or blue in the nightclubs, we can still "see".

This meaning of the verb "to see" is unrelated to the concept of "good vision"; it is "good vision" which is absolutely essential for dental surgeons to carry out their skilled work in conditions of visual comfort and safety best suited to achieving results of satisfactory quality throughout the day and throughout their working life.

We spend most of our time on a chair under artificial light. An average of 2,000 hours per year or 80,000 hours in our working life. It is obviously important to have an external opening, but the light from the sun contributes little - and only irregularly - to the lighting in the treatment room and even less to the lighting in the working area. So what do we find?

That dentists generally do little to look after their main working "tool": their eyes. When it comes to fitting out the surgery, lighting is often neglected. The architect's preoccupation with decoration or considerations of movement of people and choice of furniture often take precedence over the constraints of lighting in the treatment room, if it is not already sacrificed due to "budget overruns".

And yet there are only two reasons for poor vision: an uncorrected eye defect and/or poor lighting…

Inadequate lighting = loss of visual acuity

The visual function encompasses posture behaviours (head and body orientation, eye/task distance), finer actions associated with the oculomotor muscles and proper lighting. Visual acuity loss is the most obvious consequence of poor surgery of lighting.

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Dr Maguy Lévy
dental surgeon in Paris

Visual acuity is the ability to discern fine detail and is necessary for dental surgeons in particular. Age-related physiological deterioration is associated with structural changes, including changes in the optical performance of the eye and loss of receptors and other nerve elements involved in the visual system. Rate of perception, state of alertness, emotionality and hypoxia are also individual variation factors. In fact, however, visual acuity also depends greatly on the luminous intensity, contrast, adaptability of the retina and the eye movements. Visual acuity declines by about 25 % between the ages of 20 and 60, which

can cause phenomena such as accommodation of adaptation rate or narrowing of the field of vision. It can be accentuated by poor lighting or simply by insufficient light.
This is confirmed by Isabelle Coupin, an orthoptist at Saint-Quay-Portrieux: "*Sight deterioration develops very slowly and quietly without one actually realising it. First of all contrast is less well perceived. Then details and fine colour nuances. We must always bear in mind that healthy eyes with no special problems need twice as much light at the age of 40 as they do at 20 and four times more at 60 than at 20.*"
Sight impairment develops insidiously. It is not really noticed and is thought to be "part of the job". According to Dr Maguy Lévy, a dental surgeon in Paris: "*Bad habits take hold without our realising it and we are only aware of their consequences when symptoms appear. We cannot understand why we get more tired, why it is harder to work, why our mood changes and why we are more irritable and stressed. We have an extraordinary ability to adapt until the limit is exceeded and the body stops responding in the same way!*".

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> **"80% of the information processed by the brain (to treat) is actually supplied by the sight"**

What to do

Work in the mouth requires meticulous care, precision and concentration and cannot be done in optimum conditions unless you can see what you are doing! 80 % of the information processed by the brain is actually supplied by the sight, in other words the vision associated with oculomotricity.

Therefore the lighting must facilitate surgical operations, detection of details, colour discrimination and good posture. The dentist makes numerous adaptations all day long. He moves close to the relevant tooth for a close-up look, in the absence of visual aids. He moves thousands of times a day from the oral cavity (brightly lit) to the working area (outside the field) or to the back of a drawer (dark) and then returns to the glare of the oral spotlight. When he does so, the cones of the iris deform to adapt to the amount of light and especially to its sudden variations. Of course they are made for this… but not at this frequency or level of variation which has no equivalent in nature. "*Our eyes move continually from the "garden" to the "cellar"*, remarks Dr Hervé Moyrand, a stomatologist, *causing great visual fatigue. Few fit-out contractors are aware of this problem and they do not realise that eye fatigue comes from the lack of a transition zone between the working level and the peripheral areas. Light and harmony between the different working areas need to be relearned in order to support the sight!*"

Our brain system has been formatted by daylight for millennia. It performs best in that light. Lighting which is too low requires our brain to correct the information it perceives, causing increased fatigue, irritability and stress for everyone including the patient. It is towards the end of days like these that our morale is low, we can easily get annoyed and our neural resistance is fragile. When we get home we just want to be alone and rest. On the other hand, good lighting which mimics daylight will energize and increase productivity and everyone's satisfaction.
"*The lighting in the treatment room is a vital part of our job*, maintains Dr Maguy Lévy. *Most importantly, to protect our sight. The better the lighting quality, the less effort needs to be sustained.*" ■

Survey

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Tension, headaches, nervous exhaustion… the light is to blame

We tell ourselves it is age, worry or poor physical condition and tell others "This job is killing me", and sometimes we take medication which causes other undesirable side effects, we know all the osteopaths in the city... but good lighting control at the surgery could soon put an end to our ordeal.

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Apart from the fact that it directly affects our internal biological clock, insufficient light also leads to a decline in visual acuity and therefore difficulty in discerning detail. This is particularly pronounced in long-sighted people. They find that they can "still read without glasses" in bright light, especially in the morning, but the same exercise is impossible in low illumination. Lack of light can cause imprecision in movements to pick up instruments, errors in judging contrast – which is already low in the mouth (white on white) – and greater difficulty in judging depths of field, because binocular vision and eye convergence are made more difficult by tiredness. The eye works like an autofocus making an automatic adjustment by adaptation movements. These variations, called microfluctuations, are imperceptible but can be disrupted in a period of visual fatigue: adjustment becomes tiring. The consequences of this eyestrain can be attention and concentration problems or adoption of poor working postures, which can lead to harmful musculoskeletal stress. "*We are supposed to have binocular vision all the time, but when we are tired the dominant eye, also called the "sighting eye", takes over,* says orthoptist Isabelle Coupin. *Oculomotricity has a marked effect on posture. If the eye muscles are not fully functional due to fatigue, the dentist will compensate, without even noticing, by the muscles at the base of the skull and in the neck and the trapezius muscles. There may even be repercussions for the whole body axis with feelings of dizziness and nausea…* "

© PhovOir

Isabelle Coupin
ortoptist
Saint-Quay-Portrieux

Eliminating glare

Glare is a stress factor for the patient as well as the dentist and assistant. Everything possible must be done to eliminate it.

Glare is the result of a light flux which is too high for the adaptation level of the eye. It can be direct, as is the case for example

Advice

If you have momentary sight problems, do not force it: blink your eyes and change the focus. Look straight ahead at least five metres in front of you. This is a reflex action which should be practised regularly to rest the eyes

when a car passes another vehicle at night with wrongly adjusted headlights. Or indirect; we often forget that reflections and reverberation on the ground or on reflective surfaces are a major source of discomfort. The sensation of being dazzled varies considerably depending on whether the light is located at the centre or the edge of the field of vision. The area most sensitive to glare is the centre of our field of vision, which corresponds to the central part of the retina. At the dental surgery glare may only be sporadic but is always followed by a period of recovery. Glare reduces visual comfort and results in a dip in performance. It causes stress and serious fatigue of the iris, together with after-images at the back of the eye.

The consequences are tension (Remember the police interrogations in movie thrillers?), serious eye fatigue at the end of the day, affecting visual acuity, and over time damage to the optical nerves, requiring correction. The stress of the operating team is reflected in a more strained atmosphere and irritation when the gaze moves from a lighted area to a darker one.

Visual comfort

Seeing well without straining the eyes: that is the basis of good visual comfort. To neglect this aspect of working life has many negative consequences, both at work and at leisure, in the evening or after retirement. Good visual comfort requires balanced light distribution without glare or shadowed zones in the working area and around the periphery.

Having good lighting means avoiding considerable fatigue. It means ending the day in good physical condition so that not only is the work not hard but there is a positive and pleasant feeling about the evening. Seeing well means delaying the use of sight correction (glasses or contact lenses) and maximising the use of visual aids (magnifying glass, microscope). Remember, the binocular loupe is not just intended for short or long sighted dentists.

It also helps you to see better with less visual fatigue. Seeing well means guaranteeing an effective diagnosis. The obvious example that everyone knows is selecting the shade. But there are some much more important ones like detecting an endo or working beside a bridge, because by 5 p.m. your eyes are so tired that your visual acuity and attention level has fallen. ■

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The benefits of twilight

We never have the opportunity to experience twilight. As soon as the daylight fades we turn on the lights inside our houses or offices. But twilight gives our cones (daylight vision) the time to hand over gradually to the retinal rods (night vision). Before electricity we needed our rods to move around at night and to warn of danger and dispel it if necessary. The balance of the eye requires stimulation of all its parts and what we don't use atrophies.
So we should take time to let our eyes rest in semi-darkness!

> **"One must be able to go home after a 10 hours working day without feeling like to isolate oneself to recover of the day"**

Recognising eye fatigue

Eye fatigue presents various symptoms: prickly eyes, irritation and dry eye sensations which are caused by insufficient lacrymal secretion. We blink our eyes between 12 and 20 times a minute, which allows the continuous formation of a lacrymal film to protect the surface of the eye. But some tasks, such as looking through a binocular loupe for a long time, can cause this blinking rate to be reduced and dry out the surface of the eyes (just like working on a screen).

Shade selection, what a headache

How many times have we fitted teeth without being happy with the colour? And how many fittings have we redone for the same reasons with the obvious consequences for our profitability? What if the light is to blame?

Considerable progress has been made in the field of cosmetic dentistry. However, the choice of shade is too often a chancy affair and a source of disappointment for the patient, frustration for the dentist and time and money wasted by everyone if the result is poor.

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Consider the lighting

Identifying a tooth colour is no easy matter: even with experience, there are many worrying factors which come into play in the choice of the right colour similar to the tooth in question. These factors include the quality of the lighting when selecting the shade at the dentist's and also the lighting in the lab., which may differ from the lighting in the surgery. Of course, brilliance, translucency and opalescence also play a part in the perception and therefore the definition of colour… it is still important to have selected the right base shade beforehand! Other influences are: the sunlight, the position of the patient, the time of day, the ambient colours, the dentist's fatigue level, the time available, the human competence level and even the number of shades on the tab! The more shades there are, the more comparisons have to be made. And the eyes tire while trying to select the colour nearest to the patient's teeth. Conversely, the fewer sample shades the tab contains, the more uncertain the shade selection is, because if the sample numbers are limited, there are large chromatic distances within the colour spaces.

Consider the brightness

To reproduce the live example faithfully, light is the main element to be controlled. As everyone knows, colour perception varies according to the light source (daylight, incandescent lamp or fluorescent tube). The conventional advice was to select the tooth colour in daylight facing north on a fairly sunny day. Unfortunately, not all surgeries have a north window and patients also go to the dentist in the evening. It is therefore preferable to standardise the choice of shade under an artificial light source which mimics daylight. Dr Pierre Galbois, a dental surgeon at Chantilly, has been using a degré K Albédo luminaire for four years: "Before installing the Albédo I had tried "daylight" spiral neon tubes and then a large unit combining an incandescent

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Dr Pierre Galbois
dental surgeon
at Chantilly

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Surgey

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> **"It is the poor light quality in our treatment rooms that is responsible for the majority of colour errors"**

lamp, U.V. and black light. But I was not always happy with the shades I chose. Yet I work from a classical shade tab and of course my prosthetist has the same tab and the same lighting as mine. If you make the four top teeth at the same time, you have a 100% chance of success. But if you make just one incisor, there is more risk of getting it wrong. The ideal is to have lighting which takes the shade without flattening and for that shade to be reproducible by the prosthetist and for the tooth to suit the patient once in the mouth. So the lighting must not change the shade and must be as close as possible to the natural light. In four years I have not had to re-touch a single shade!…"

Did you know?

The human eye identifies objects on the basis of its own chromatic information. Depending on this, its perception can be curtailed if an additional light source reflects onto the object. So this glare effect must be eliminated during any comparison of colours.

Consider the reflection

Colour vision is provided by the shade of the tubes, but only if the low glare requirements are met.

What the tube industry is now producing is so impressive in terms of colour reproduction that we are going beyond the eye's ability to discern nuances.

However, the brightness (brilliance) of the lit areas and lighting surfaces disrupts the eyes during colour analysis.

As the operating lamp is extremely dazzling, it is really necessary to turn it off (whatever it is) and just to use the light from a general medical lighting luminaire with very low brightness to select a shade. ■

Five tips for taking a shade

As recommended by Jean-Louis Portier, a prosthetist at Vaucresson: "A shade should be taken at the start of the session, when the tooth is wet. If the dentist selects a shade when the patient has been in the chair for some time, the tooth dehydrates and whitens and the shade changes." This also prevents the dentist suffering visual fatigue. The choice of shade must be made before anaesthesia to prevent the colour of the periodontal tissues being modified.

Shade selection should be done quickly and always trust your first instincts because the eyes tire after 5 to 7 minutes. The whole environment must also be as neutral as possible. Ask your female patients to remove their lipstick and cover brightly coloured clothing with a grey cloth. Make your choice quickly and always have faith in your first choice, because the eyes tire in time and judgements become less reliable. It is best to compare tooth and shade tab in 10 second phases. *"There are a large number of shade tabs on the market. None of them is perfect because their coverage of the colour space of the natural teeth is incomplete. This is why the choice of the sample closest to the base colour must be made quickly to avoid the phenomenon of visual accommodation"* maintains Dr Moyrand.

Small everyday irritations…

Is lighting responsible for all issues? Not really, but look how badly designed lighting can spoil the quality of life of the whole team.

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Back pain

How many times a day do you raise your arm and therefore your shoulder to adjust the operating lamp? This apparently harmless gesture exerts distortion on your spinal column, adding to the almost opposing distortion of its traditional twist so that you can look inside the oral cavity. Prof. Jean Ginisty, professor at René Descartes-Paris V University and a specialist in disorders of the musculoskeletal system, says that more than 80% of treatments are carried out in direct vision: "This method of working has the major disadvantage of increasing the dentist's anteflexion and the lateral rotating inclination of the torso and cervical vertebrae. The result, in addition to lower back pain, is a number of cases of cervicalgia combined with cervicobrachial neuralgia."

"*We always think we can avoid back pain by investing in an ergonomic chair and exercising but we often fail to take an interest in the light,* continues Dr Moyrand. *We often work for more than 40 hours per week in the chair and forget that ideal lighting of the whole intra-oral region helps to minimise bad posture and facilitates the treatment.*" What is expected of an operating lamp? Firstly: good lighting of the operating field whilst avoiding shadow zones and conveyed shadows (instruments, operator's hands and head), highlighting of contrasts, spaces and the details of the operating field as clearly as possible whilst limiting glare for the dentist and the patient. But this is not enough: it must above all be easy to manage. What is expected of ceiling lighting? To recreate a luminous environment suitable for carrying out dentistry work, which is very hazardous for the sight: extremely prolonged viewing of very small details in very low contrast. There is nothing more restrictive under standard EN12464-1.

Cleaning

The operating lamp is contaminated by spray from compressed air tools and working materials (after de-scaling for example) which interfere with its structural complexity and are difficult and time-consuming to remove. To avoid this job, the tendency is to move the lamp away, thus removing all its usefulness.

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“The main characteristic of efficient lighting : to be forgotten”

Some people protect the lamp with a transparent film… preventing the lamp to cool. Ceiling lights are normally out of reach of an assistant at the time. Their cleaning is deferred until there is a suitable moment occasionally to go up a stepladder to disconnect the luminaire, open its casing, clean the cells one by one and reseal it… would you agree that this job is often put off. The product used may be liable to damage the reflective surface of the cells and reduce its lighting efficiency.

Heat and noise

Due to the heat released by some lights (especially onto the top of the head), we tend to move them away or change their direction… to the detriment of efficiency. The fans also emit slight but irritating background noise. This outdated technology requires the lights to be switched off regularly.

Asepsis

The handles on operating lamps transmit bacteria from one patient to another. To avoid this cross contamination, it is common to fit a transparent film, which is tiresome to manage.

The hygiene chain may also be broken by the flow of hot air from a fan located just a short distance from the mouth which blows a continuous cocktail of aerosols and other atmospheric residues.

Finally, the ceiling light gathers dust and residue freely, in addition to the heat above the treatment area. ■

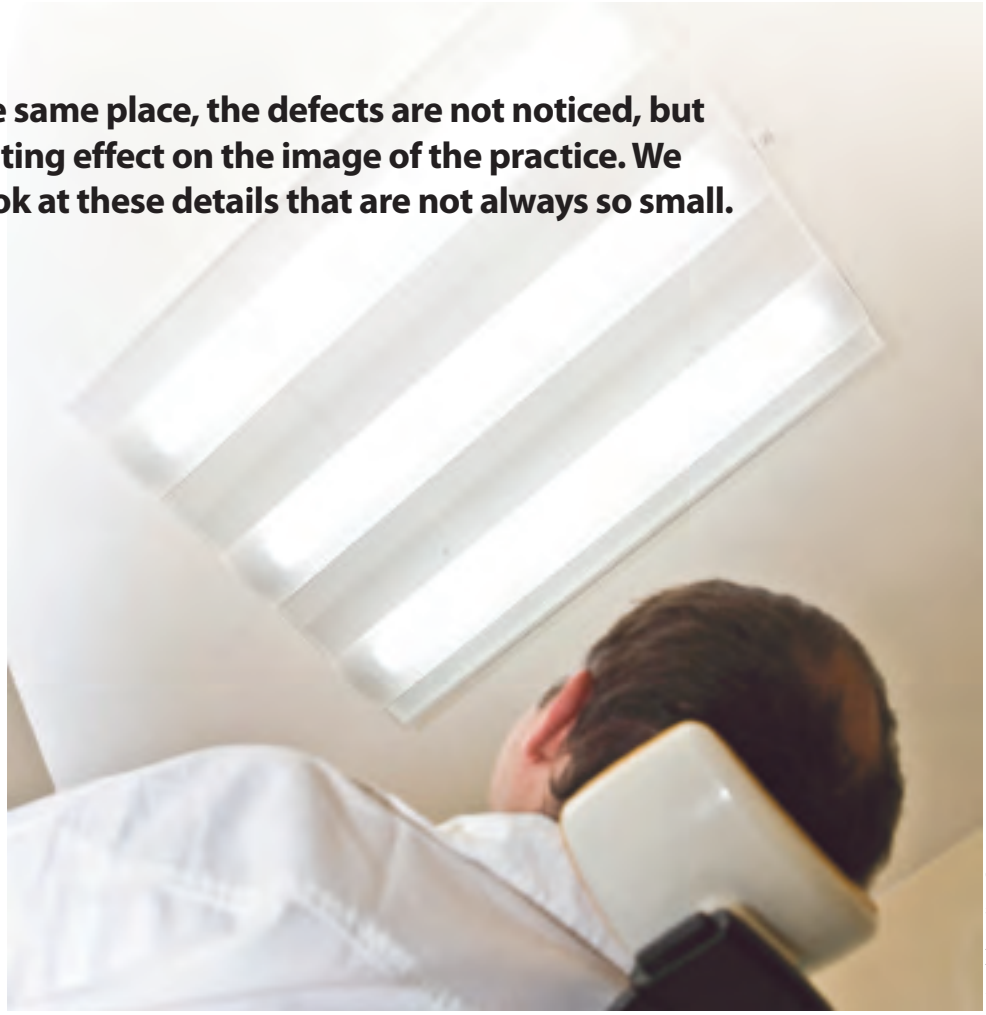
Dr Hervé Moyrand
stomatologist

Surgical scialytic lamp or not ?

The working conditions differ radically. In theatre the patient is asleep or has his eyes covered by an operating field, which is not the case in the surgery where he has his eyes open and is sensitive to glare. In a general surgery theatre the surgeon operates on variable, often wide fields (head, abdomen, torso…) whereas in dentistry the field is limited to the mouth. In theatre they work standing up, in a team (often 3 to 5 people) whereas in dentistry there are two at the most. It is quite obvious that the lighting conditions (shadows cast, amounts of light, depth of field, fields peripheral to the operating area) are very different and the appliances designed for an operating theatre will dazzle and stress the “dental” patient, light some fields which do not need it and create contrasts which are tiring for the operator.

The patient's viewpoint

At work every day in the same place, the defects are not noticed, but they can have a devastating effect on the image of the practice. We should take a careful look at these details that are not always so small.



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To use a dental metaphor: in people who suffer from halitosis, the cells lining the nose become desensitised to their own smell; close associates do notice it and are embarrassed (without daring to say so). In the same way, the dentist and his team in the practice do not notice the damp patches, the dog-eared magazines and other details, which will potentially upset new patients. They will be quick enough to judge the dentist by the only factors they are able to understand (waiting time, pain and empathy, but also the state of the waiting room and surgery and the look of the dentist and care team).

These "killer details" can take precedence over the clinical competence of the dental surgeon and hamper the development of the practice.

Glare from the operating lamp

Once is acceptable. But having to be treated while waiting apprehensively for the next flash is too much. Every time there is a change of position, the random adjustment of the operating lamp sends a beam like sunlight into the patient's eyes, and we know how much harm that does to the eyes.

Anyway, just worrying about this flash increases the patient's stress, something he does not need.

Over-brightness of the ceiling light

Remember the American thrillers in which the police tried to increase the gangster's stress and fatigue by shining the beam from a desk lamp on him just a few centimetres from his face? Permanent over-bright lighting tires and stresses the patient who does not have the same viewing angle as the dental team. Its members often notice nothing at all. Quite the reverse, the "well lit" effect gives them the opposite feeling. Nevertheless the lighting should be well distributed and without glare, to reassure and calm the patient who will then be easier to treat.

Asepsis

Although the patient does not have either the technical knowledge or the information necessary to assess your level of asepsis, he will pick up details which enable him to form an opinion (a false one?). The state of the toilets would be an example (as in restaurants). But the patient spends 80% of his time in the sur-

Survey

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> **“Patients react to problem by changing their practitioner, not by reproaching them to them”**

gery looking at the operating lamp and luminaire. He can see every little detail: stains, wear, dead insects trapped in the luminaire casing which cannot be taken apart, spray splatters on the operating lamp (the same marks as last week?) and many other details that the clinical team does not suspect, since they are looking in the opposite direction to the patient all the time

Fitting redone

Poor shade selection is never thought to be an honourable attempt to find the right colour, it is taken as the dentist's inability to decide professionally on something which is undoubtedly within his area of competence (why would a prosthetist be more competent?). And no allowance for the frustration felt after weeks of hope and expectation.

Unsatisfactory shade

His perception affected by the poor lighting conditions, the patient agrees to his central incisor being fitted and realises when he uses it that it does not suit (him). It is worth noting that this well-justified discovery is made most of the time when he is faced with the reality of daylight… with what consequences for the practice? At best a patient who asks for the work to be redone, at worst a patient who has the proof in his mouth for criticism of your quality level. ■

Ecological footprint

There is a marked trend in the expectations of consumers to look for the slightest impact on the environment and the ecosystem. The majority of practices have already adopted the civic approach and are reducing the ecological footprint of their practices, by seeking to lower the consumption of electricity and raw materials by their equipment and looking for solutions to produce less waste, such as reducing the number of tubes for the ceiling lights and using LED lamps which have a life of 20 years and need no replacement for the operating lighting.

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Treatment room lighting What do the standards say?

They are essential as evidence : the job of the lighting engineer is to reproduce natural working light conditions indoors. The standards define the optimum conditions for lighting in a dental practice. The "lighting plan" has to meet at least two in order to achieve the objectives of lighting comfort and safety at work. The operating team will then be working in optimum conditions.

In its introduction, the European Standard on lighting of indoor work places EN 12464-1 states: "To enable people to perform visual tasks efficiently and accurately, adequate and appropriate lighting should be provided […]. The degree of visibility and comfort required in a wide range of work places is governed by the type and duration of activity". Which means that the dental surgeon who demands the maximum from his eyes for long hours at a stretch is very specifically concerned with implementation of his lighting plan in accordance with the standard. There are two standards applicable to the practice lighting plan, at least in Europe. They are ISO EN 9680 (for the operating lamp) and EN 12464-1 for the full general and

What is a standard ?

A standard is an incontestable reference document on a given subject which is drawn up by consensus and approved by a recognised body and indicates the state of the science, technology, know-how, technical solutions, rules, guidelines or characteristics for activities or their results, guaranteeing an optimum standard within a given context.

An perfectly lighted operating area

> **“It is not enough to require a standard – demand that lighting designers prove compliance with the performance required by the standards”**

operating lighting. The purpose of these standards is to define the minimum conditions that a lighting plan must meet: lighting of the different areas, shadows cast, discomfort due to glare (UGR), light distribution (luminance), light colour (degree Kelvin) and colour reproduction index (CRI). If all the rules are followed, the plan meets the standard. The plan covers the treatment room and not the working area, therefore the work place architecture and the tasks performed are important. A 9 m^2 treatment room cannot be handled in the same way as a treatment and consultation room with the same appliances.

The lighting plan for the treatment room must always result in the standard being met, however.

The job of a responsible lighting engineer is to design luminaires that provide state of the art lighting (under the standards) and to certify them under the current treatment safety regulations (directives and their translation into national laws).

Start from the oral cavity

To provide good treatment room lighting, it is necessary to look into the overall need, starting from the oral cavity. This area is called the operating area and is situated 90 cm from the floor, and for this we need strong illumination (at least 20,000 lux) which is as uniform as possible over the area occupied by an open mouth, to avoid repeated adjustments of the operating light whenever the patient makes a slight movement. The illumination is limited by the reflection from the teeth – a source of glare for the dentist – and by the contrast with the adjacent area called the working area, where the patient's eyes are situated (1,200 lux max). The working area is the one where all the instruments, trays, tubs & drawers, suction support and instrument holder are kept, that is an area 120 cm square centred on the mouth. The average lighting should be 1,000 lux at 90 cm from the floor.

The movement area comprises the rest of the treatment room 75 cm from the floor; its average illumination should be 500 lux with uniformity of illumination, so that a minimum factor of 2 is observed between the average and minimum illumination.

Shade selection

Shade selection requires compliance with four parameters: a colour temperature of 6,500 K, a minimum colour reproduction index of 90%, a UGR (universal glare rating) of less than 16 and a high illumination level (5,000 lux). A luminaire achieving this performance is extraordinarily sophisticated

Take care of the transitions

The practitioner's eyes move from one area to another hundreds of times a day and every movement causes a reaction from the iris, which closes or opens to adapt to the changes in the intensity of the light. This is true in the horizontal and also in the vertical direction, on the walls and the ceiling. It is essential for those surfaces to be lit to control the contrast. For the same reason, furniture which is white and/or has gloss surfaces which reflect light very strongly should be avoided. The term used in lighting engineering is luminance contrast. After a few years in an unsuitable environment, the eyes tire and are damaged. The eye is designed for a "natural" environment and works perfectly and tirelessly in the light from the sun and the light from the sky, our two primary light sources. Good treatment room lighting will include a sun and a sky, an operating light and a general medical lighting luminaire, which must be controlled sensibly, "naturally".

The operating lamp called the scialytic lamp*

Standard ISO 9680 defines two elliptical sub-divisions of the illuminated operating area:

• Central area of at least 50 mm/25 mm in which the maximum illumination must be adjustable from 8,000 to 20 000 lux or over. The brightness around the edge of this area must be a minimum of 75%. The reduced intensity is due to the need to minimise curing of the composites during filling work.

• Concentric ellipse around the above area, the size of which is defined by illumination of at least 50% of the maximum. Therefore 10,000 lux when the central point is at 20,000 lux.

The collateral illumination must never exceed 1,200 lux in the patient's eyes.

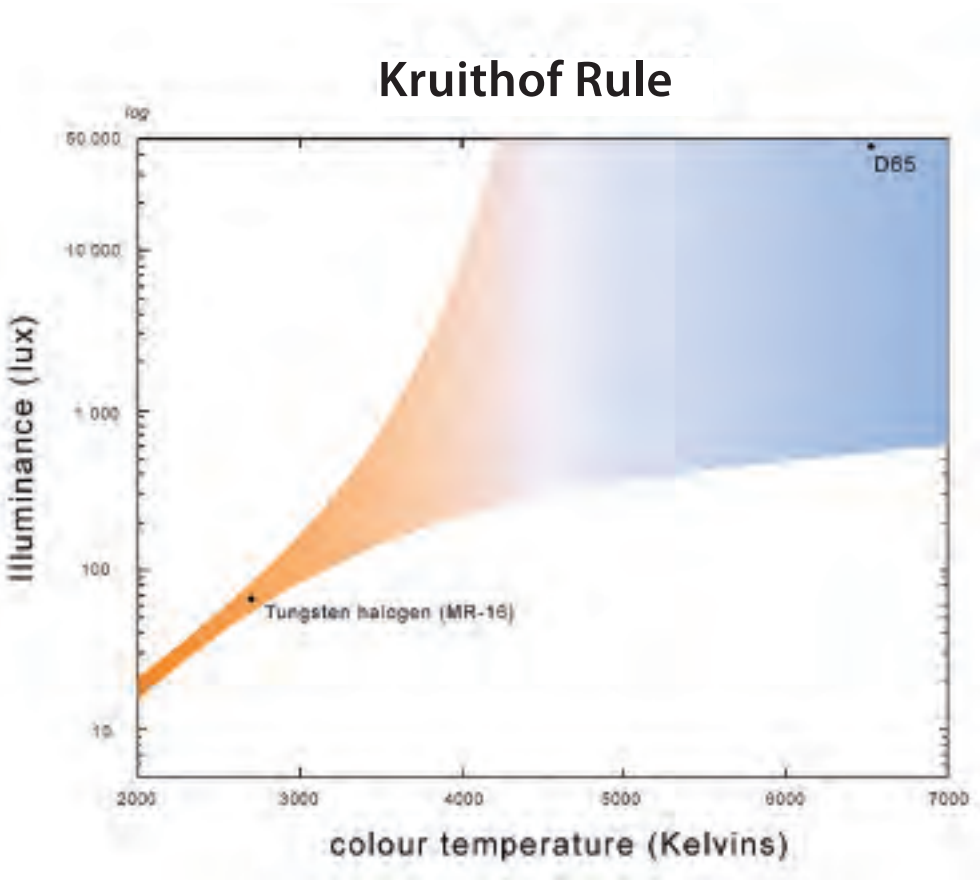
The scialytic lamp is positioned above the dentist's head so that the beam is in the same axis as his sight, if possible. This limits glare from shafts of light emerging sideways from the operating lamp reflector. The smaller the appliance, the less it is heated and the easier it is to achieve this position. The scialytic lamp can be fixed in various ways:

• To a pillar on the unit: in this case it rises and falls with the chair but also vibrates when it does so. If the arms are not long enough, it may be impossible to position it "in the practitioner's sight axis".

• Fixed to the ceiling: this is more ergonomic than on a pillar because it frees the patient's space, access to the chair and the working area of the operating team.

• Travelling: this has the further advantage of eliminating the "dislocating" movement of the shoulder when moving the operating light. This is undeniably beneficial for this joint, which is forced the wrong way dozens of times a day.

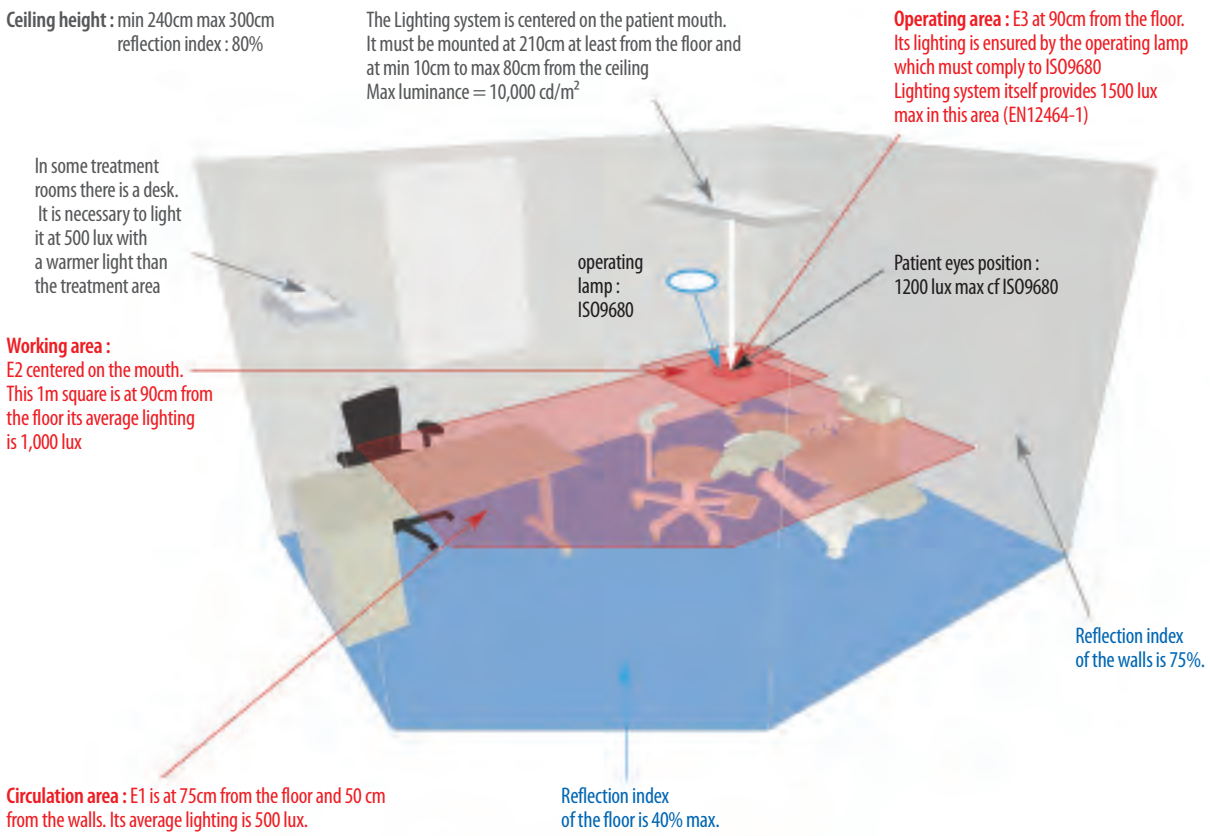
An operating light must have three axes of rotation. This is the requirement that each working position must have the possibility of being lit without any shadow caused by interference from the operators' heads. The appliance must be easy to dust and clean and be surface disinfectable. The handles must be removable and sterilisable.



Kruithof Rule : comfort lighting area in function of the colour temperature and the illuminance. Halogen is only comfortable at 80 lux (which corresponds to sunset or sunset light). Daylight lighting system enables to select the right colour shades from minimum 2500lux.

> **"Added to the requirements of the lighting standards are the requirements for asepsis of the lighting devices and our personal aesthetic requirements"**

Lighting standards



The general medical lighting luminaire, descending from the daylight ceiling light

Lighting of working and movement areas, walls and ceiling requires a very sophisticated appliance capable of performing in many different ways:

1. Luminance organisation: to ensure that the contrasts in the room (walls, floor, ceiling, vertical and horizontal surfaces of the furniture) do not cause recurrent glare for the operating team and the patient
2. Illumination (lux) control of the three areas, from the brightest – above the mouth – to the dimmest –along the walls
3. Shade selection: reproduction of daylight
   - Colour temperature: 6,500 K,
   - Colour reproduction index CRI of over 90%,
   - UGR: Universal glare rating of less than 16,
   - Illumination of over 2,500 lux only during shade selection.
4. Elimination of conveyed shadows
5. Very low luminance to prevent the patient being dazzled – and therefore stressed. Not only is a patient under stress more difficult to treat, he will also have bad memories of his treatment; the reputation of the practice may suffer.
6. Hygienic, in the sense that the appliance must not be a breeding ground for microbes or a receptacle for dust. The minimum standards for a treatment room are surface disinfection of the appliances.

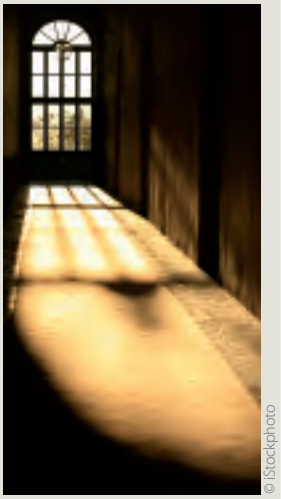
The lighting, whether it is a ceiling light or not, must be dustproof and preferably also aerosol resistant. As a luminaire heats up, even just a little, it forms an ideal microbe incubator right over the chair. ■

Lux

The illumination level is expressed in lux: 1 lux corresponds to the illumination of the full moon.
100,000 lux is a day of bright blue sky.

What is luminance ?

Luminance is a measure of luminous intensity. It is the amount of light per unit area emitted or reflected in the direction of observation. It is expressed in candela/m². We speak of primary luminance for a source: lamp or window; or secondary luminance for an illuminated surface that reflects light: the moon, a wall, a ceiling, the floor, a work surface, a metal tray. It is limited to 10,000 cd/m² for a dental ceiling light.



Integral lighting solutions

Degré K, an expert in dental practice lighting, offers I See, an integral lighting system which combines a general lighting luminaire, Albédo, with a high-performance operating lamp, LOLé. The combined unit provides good illumination of the whole treatment room.

Only a combination of two complementary systems can cover all the requirements in the dental lighting specification. The operating lamp provides illumination in area A (oral cavity). The general lighting luminaire is responsible for areas B and C. Good coordination between the two appliances makes it possible to move from one area to another, thousands of times a day if necessary, with ease and comfort and without stress or fatigue.

Jean-Marc Kubler, founder of degré K, has been committed to improving lighting in dental practices for more than 20 years. He is the designer of this combined unit, which is now accepted as the benchmark in the profession.

His lecture on the subject at the 2009 ADF Congress demonstrated the benefits of this combination, given that current technological developments do not enable a sin-

Survey

To benefit from a free personalized survey of your lighting, contact degré K on Fax :+33 970 80 1000 E-mail : dental-lighting @degrek.com

Illuminance repartiton per area

Aera A

Operating area
Lighted the mouth area by both:
- the operating lamp (ISO9680). Operating lamp spot lightens the cavité buccale till 50000 lux on a surface of 4x4cm
- by the lighting system with MAX 1500 lux in the mouth of the patient (Standard EN 12464-1)

Aera B

Treatment area
Lightened by the lighting system at 1000 lux.

Aera C

Circulation area
Lightened by the lighting system at 500 lux.

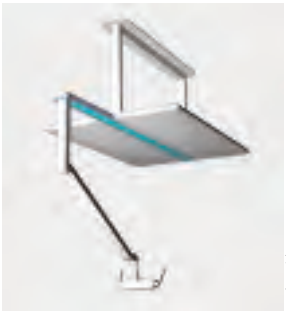
© degré k

“A single appliance is not enough to comply with all the requirements necessary for dental lighting and it is necessary to combine an operating lamp with a general lighting luminaire, designed to complement one another”

gle device to meet all the expectations of dental surgeons in relation to light.

The I See concept

Degré K designed “I See”, which is a single appliance incorporating a general lighting luminaire (Albédo) connected via a travelling function to an LED operating lamp (LOLé). This optimises the positioning of the lighting, which adapts to your working position and not the other way round. The travelling function reduces the force to be exerted for the translation movement of the operating lamp by more than 50% and its movements are fluid and comfortable. Because there are no brackets or rails fixed to the unit, it is easy for the team and the patient to move around, particularly when he arrives and leaves. The appliance is quick and easy to install and the low weight of the unit means that it can be fitted on concrete or timber structures without ceiling reinforcement. It is the only dental lighting system that guarantees compliance with the standards in terms of visual comfort and performance (EN 12464-1 and ISO 9680) governing a “dental lighting plan”, CE medical certification (MMD 93/42) and a dustproof and spray resistant rating of IP 50. ■



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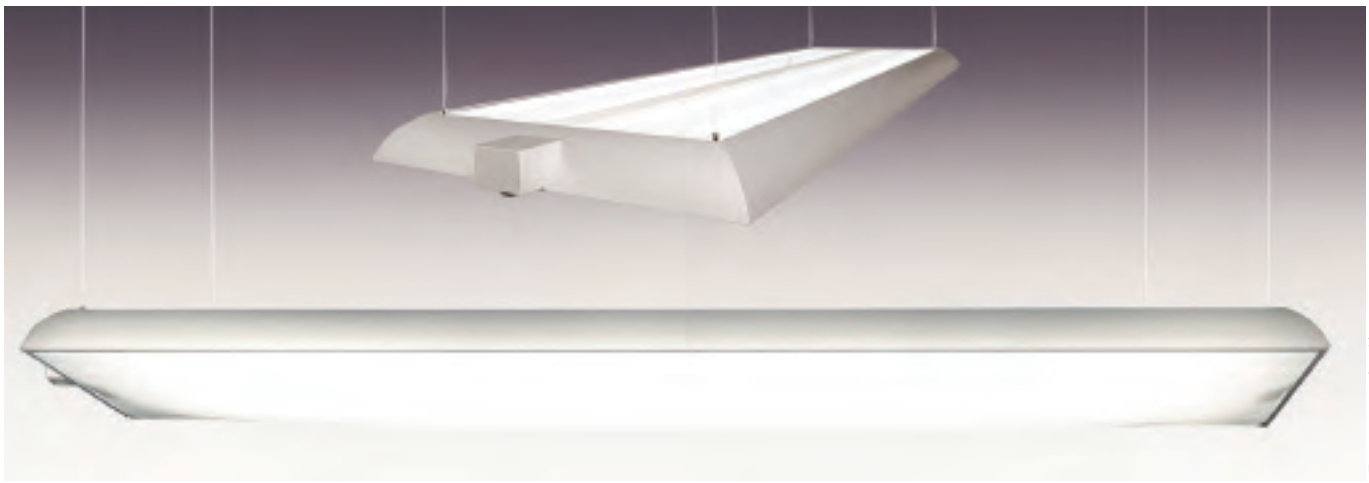
The travelling function :
- avoids the attachment congestion of operating lamps,
- frees up the patient’s arrival and departure area,
- facilitates the movement of the clinical team and reduces adjustment effort.

The range of movement makes allowance for all regular or extreme working positions (control of occlusion with a seated patient, back lighting of the lingual sides of the maxillary incisors, lateral operating lamp shift when the dentist moves to face the patient’s mouth).

Luminaire : Lighting the treatment room

You need to be able to work day by day in optimum visual comfort: without dark areas, without glare and the strain of repeated ocular accommodation when making the many movements from the very brightly lit oral cavity area to the surrounding areas. Albédo is a complete appliance.



It has a large enough surface to cover the working area directly in a quality equivalent to daylight, using tubes controlled by electronic ballasts. Albédo is obviously designed as direct-indirect lighting, which is the only way to distribute the illumination while diffusing the light around the rest of the room (up to 18 m² and 3 m high). When the light meets the ceiling, it is reflected and distributed uniformly around the treatment room. The higher the surface of the luminaire, the less shadow is cast. For four-handed work it is preferable to choose the highest possible model.

Glare

Its very low and extremely uniform luminance is very restful for the patient and the operating team. Uncomfortable glare due to moving from dull to very brightly lit areas is contained. The reflective surfaces themselves are less dazzling.

Colour

The system complies with the colour temperature (6,500 k) and reproduction index (> 90), high illumination level and the low luminance necessary to give shade selection in unmatched conditions. The northern daylight it recreates is much more comfortable and reliable and accurate choices can be made in a few seconds.

Asepsis

No more perilous standing on stepladders to try to clean an awkwardly shaped luminaire. The fully sealed casing of the Albédo and its fine, slender design make for easy cleaning – top and bottom of the appliance – and full surface disinfection simply by wet wiping, like all the treatment room appliances. It is dustproof, insect proof and spray resistant…

Adjustment

An infrared control activated by a simple hand movement (no touch) selects two levels of lighting, one of which is brighter (LUX +) for surgery, shade selection, orthodontics or Luminotherapy with a reduction in electricity consumption and energy loss of 20 to 25% compared with previous generations.

Standards

Albédo is the only luminaire that meets the requirements for visual comfort and performance (stan-

Survey

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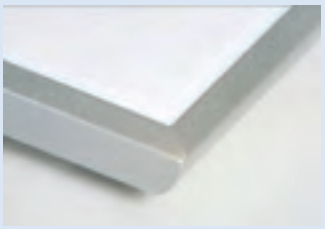
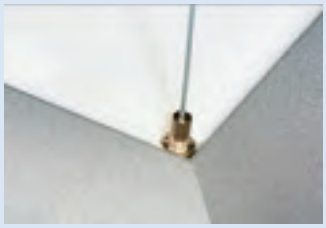
Light that has been sent back by the ceiling allows diffuses an harmonious lighting in the entire treatment room

“Albédo, the luminaire in the I See unit, gives optimum comfort in everyday work Visual : no dark areas, no glare and no accommodation effort during the many movements from the very brightly lit area of the oral cavity to the surrounding areas”



IP50 impervious



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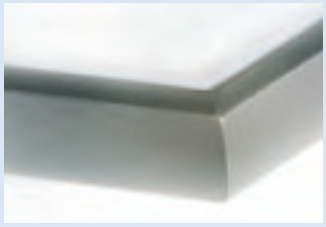

Desinfectable

Design

Sensor and Lux+ function control

dards governing the dental lighting plan EN 12464-1 and ISO 9680), the certificate of conformity with European regulations on medical devices (MMD93/42) and a rating of IP 50 for dust and spray resistance.

Luminotherapy

This technique is frequently used by the Scandinavians who have to endure prolonged winters. By scheduling two daily periods at daylight illumination at 2,500 lux, the emission of melatonin by the epiphysis can be modified via the photoreceptors in the human body, which restores dynamism and vitality, just as happens when the fine days return. The function is integrated in the appliance and is totally risk free. Note that only repeated and regular exposure produces results, so the patient is not affected at all.

LED or neon?

The growing success of LEDs is justified by the formidable performance of this semi-conductor technology which is doubling its performance every 18 months. After a few years at blue, green or red dominant, LEDs are coming ever closer to the white light of daylight. So why not use them to light everything? For directional lighting (road, picture, table, the oral cavity), the LED (100 lumens/watt) has already superseded the incandescent lamp (7 lumens/watt) and the halogen lamp (20 lumens/watt). But for distributional lighting (classroom, corridor, treatment room), fluorescent tubes (also 100 lumens/watt) are the only ones that can diffuse the light widely over a large area and in all directions (floor, walls and ceiling) to provide the necessary direct-indirect multidirectional illumination. No consumer market leader in professional or technical lighting has replaced its general fluorescent tube lighting range with LEDs, in contrast to spot lighting where this new technology is flourishing. But experts are agreed that in the end LED technology will overhaul fluorescent tubes when current developments are successfully completed, but not within the next 2 or 3 years. ■

Operating light
Lighting the oral cavity

The I See handset consists of a light and an operating light. The technology of LEDs now exceeds that of the halogen lamp and makes it possible to offer a light to meet clinical requirements whilst providing comfort, a good appearance and asepsis. Demonstration.

Ergonomics

LOLé has a lighting and intensity adjustment by capacitive sensing of the hand, when it is placed a few centimetres under the lighting head. We can thus control the lighting, shut off the operating light or adjust the lighting intensity. This "no touch" procedure limits the risk of cross contamination. The lamp head can be rotated along three axes, which allows the practitioner to vary the angles as needed, whilst maintaining the horizontal axis of the spot parallel to the lip line. The flexible display also enables the practitioner to avoid crossing the beam in certain observation or care positions. The size head and absence of heat make it possible for the LOLé to be positioned near the face of the practitioner, thus reducing the angle between the lighting and the practitioner's visual axis. This condition is necessary to reduce the extent to which the practitioner is dazzled by the reflection of light on white teeth. LEDs last for about 20 years, so the there is more change of bulb.

Asepsis

LOLé is classified IP 50 according to the IP standard (published by the IEC: International Electrotechnical Commission), ie. it is sealed against dust and spray. Its closed casing is smooth and accessible. There is no further need for cleaning the internal parts and cleaning is easy by wiping with a damp cloth or spraying with a surface disinfectant. The handles can be removed and sterilised. Everything ensures unparalleled asepsis and quick and easy maintenance.

Lighting

The rectangular shape of the large spotlight (80 x 165) provides complete visibility in the oral cavity and excellent protection from dazzling the patient's eyes during treatment. Even if he moves his head, no manipulation of the lamp is necessary. The light intensity gradually decreases on the extreme edges to facilitate eye accommodation.

The whole opening and depth of the mouth are lit uniformly by the central area of the spotlight. The spotlight, neutral white (4,300 K) and of standard colour rendering, uses the latest possibilities opened up by the September 2007 revision of standard 9680. It helps to identify shades of symptomatic yellow / red / brown for diagnosis and drilling, much better than with a cool white LED (6,500K), whether it is a matter of detecting caries, a gum inflammation or the approach of the pulp chamber during preparation. Its high light intensity is adjustable up to 50,000 lux.

The even view without eye accommodation in the care area is ensured.
The shadows are eliminated through accurately calculated positioning of the LED systems.

The spectral distribution of the light energy of LOLé LEDs has been carefully selected to avoid the effects of pre-curing amalgams known with halogen operating lamps, and to avoid any colour filtering, needed for other competing LED operating lights.

Note that the 50,000 lux of lighting are usable only if the rest of the treatment room is lit normally, to avoid sharp contrast between the mouth and the rest of the environment and thus accommodations that are the source of considerable eyestrain stress and wastage of time.

But, if the general lighting conditions are met, this strong lighting:
- enhances visual acuity during delicate care phases: endo, implants and surgery
- Makes it possible to have the operating lamp further away from the mouth when standing without having lower light levels and without dazzling the patient through the ingenious patented optics channelling light output from the LEDs and containing the height of the spotlight regardless of the height positioning of the LOLé.
Less critical acts may be practiced with 25/30,000 lux. ■

Strong points of the **LOLé operating lamp**

- The only operating light meeting standards in force
- High-intensity function for the implant
- No shadows
- No bulb replacement
- No noticeable heat emission
- No fan noise
- Negligeable electrical consumption, less than 5W at full power
- light colour favouring diagnosis
- uniform lighting of the open mouth (surface area and depth)
- Simplified cleaning

Certification

LOLé is the only LED operating light that takes into account both the ISO 9680 lighting standards and hygiene and cleaning standards in use in dental treatment rooms.

> **“LOLé, the operating light of the I See handset makes it possible to see everything in the mouth, the treated tooth, the neighbours, the antagonist, soft tissue, saliva leaking to the throat ... no settings, no shadows, without dazzling the patient nor interfere with operators”**

New version of standard ISO 9680 : what changes for the operating lights?

The ISO technical commission has changed the standard 9680 in 2007, in particular on:

1.The colour of the light and colour rendering index :
Before, the light had to be over 5,000 K and a colour rendering index of 80.
After, the colour rendering index is increased to 85 and the light colour field of is enlarged.
This is for an essential reason: the operating light is used for diagnosis and lighting during treatment and operations, but should never be used for the choice of colours.
But in diagnosis and treatment, it is vital to distinguish between shades of yellow / red / brown of gum tissue and teeth. A neutral white light is therefore needed (between 4,000 K and 5,000 K) with a very good colour rendering index (>85).
LOLé 2 respects this change of the standard: its colour temperature is 4,300 K with a colour rendering index of 85.

2.2. The central form of the spotlight - defined by lighting at least equal to 75% of maximum lighting – is brought from a circle of 50 mm diameter to an ellipse of minimum size (25 mm x 50 mm).
However, the opening of a mouth can reach 75 mm and many practitioners, including some members of the ISO technical commission expressed their disagreement with this reduction of the lighting "height".
Since the prescription of the standard is only a minimum, LOLé 2 has a much larger central spotlight, encompassing the entire mouth. In addition, it has a depth of field equal to that of a mouth (about 7 cm) so that the patient's mouth, even if it is large, is powerfully and evenly lit up over its whole surface and depth. The comfort of vision and visual acuity are maximums in the whole operating area. The patient movements no longer require more adjustments of the operating light. The vision in the back of the mouth with a bistoury is the same as at the incisors.

Enjoy the benefits of controlled light in your surgery

To enjoy the advantages of light control in your surgery, just contact your regional degré K distributor to arrange a personalized survey of your requirements, for integration in a total lighting plan for your treatment room.

The dental equipment installation contractors in the degré K network enjoy the support of the manufacturer and its vast experience in the design and production of hundreds of dental practice lighting systems. The I See combined unit is suitable in most cases, but if your practice has some unusual features it will be necessary to have a personalized survey carried out by degré K. The reasons for the survey may be the exceptional size of the room, its unusual shape, the wall colour required, the quality of the reflective surfaces, the unusual décor or the specifics of your practice.

« Work is more efficient with a lighting system designed by dental lighting specialists. »
Dr Maguy LÉVY (60)

© Francis Fanelli

TESTIMONY

Dr Harold KING
Dental surgeon, Marseille (13)

Des regrets

I did not give any particular instructions for the lighting when I established my practice, although I was very specific about the chair, the unit the furniture etc. But the lighting is so important for our daily work that if I had to start all over again I would integrate it fully into my plans as an essential element of ergonomics and comfort.

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« My tension and headaches have disappeared since the lighting was adapted to suit my practice. »
Dr Chantal RAQUIN (01)

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E-mail : dental-lighting @degrek.com

© Stéphane François

« Since I replaced my lighting, I have never had to redo a single shade. »
Dr Jean-François GARNIER (67)

“Lighting is an integral part of the surgery equipment, just as important as the chair, the unit and the furniture”

TESTIMONY

Patrice de PONCINS
Dental treatment centre manager, Paris (75)

Genuine daylight

Three of our treatment rooms had no external openings and everyone avoided working in them. We had a survey carried out to install devices reproducing daylight in those rooms. Since then the teams have made no distinction between the “blind” treatment rooms and those with an external opening. They even prefer the newly-equipped rooms on winter days or in bad weather.

Your creativity & skill deserves

I See

painting: Marc Goldstain
Photographer: Christian Baraja
Galerie Quai Est - F94 Ivry-sur-Seine

Integral Lighting system for dental treatment and surgery rooms:

LED operating lighting on Travelling rail and specialty treatment room light with LUX+ function

Dustproof and disinfectable – Luminotherapy & Surgery/implanto/endo application

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