Although the great majority of ophthalmologists worldwide systematically use a slit lamp for the clinical diagnosis of ocular diseases, by a rather strange paradox, we neglect this emblematic instrument as soon as we enter the operating room. During the last 20 years, I have been using a surgical slit lamp attached to the operating microscope and positioned at 5° from the axis, as my sole illumination system for more than 16 000 vitrectomies and 10 000 RDs without vitrectomy. The advantages of this illuminating system are linked to its three characteristics: first, it is a slit; second, it is fixed to the microscope; and third it is tilted between 5 and 7 degrees from the axis. We will first look at the general advantages provided by this system, before studying the more specific advantages for macular and retinal detachment surgeries.

A. General advantages

If one considers the general evolution of the different illuminating systems proposed to vitreoretinal surgeons during the last twenty years, one will be surprised to discover that they did not follow the surgeons' requirements and evolutions in surgery:

1) Complete Control

The period of Kloti's Vitrectomy Machine is over, when surgeons operated a mono speed cutter and the assistant aspirated with a syringe. Now the surgeon controls the cutting speed, the phaco power, the aspiration flow, the diathermy power, the microscope focus/zoom… like a one-man band! Forcing him to monopolize his left hand to illuminate the surgical field seems to be archaic! Why sacrifice the left hand of a one-man band? What kind of phacoman would accept to sacrifice his left hand in order to illuminate the anterior segment, and ask his assistant to maintain the crystalline nucleous while performing the cracking procedure with his right hand? Anterior segment surgeons naturally consider the microscope as a viewing system combined with an illuminating system. Why should posterior segment surgeons be punished and forced to sacrifice their left hand?

Equipped with a surgical slit lamp, the microscope, like consulting biomicroscopes used in the clinic, is a viewing and illuminating tool. When removing a suture in the office, at the slit lamp, when both hands are necessary to do the job (the left hand maintaining the patient's lids open and the right hand removing the suture), one would naturally take advantage of the biomicroscope illumination. With illumination provided by the microscope, the left hand is free to control the plano-concave lens positioning, stabilize the forceps and therefore control the manipulation precision, clean the instrument tip, make the scleral depression, and perform a real bimanual surgery.

2) **Bimanual surgery**

The period of performing vitreous removal only is over. Now, we also remove the pre and sub retinal proliferation, maintaining the tissue with one hand and cutting it with the other. The need for this bimanual surgery is so obvious that the industry has developed illuminating systems fixed to the sclera or to the surgical instruments—but this does not go without disadvantages. If one wants to cut and eat a steak in a dark room, three solutions are offered:

- One can fix one or two lights on the edge of the plate; this is what is provided with all the systems fixed to the sclera (MIS, chandelier…). However, they present some disadvantages, as they damage the sclera and increase the risk of vitreoretinal incarceration and crystalline lens injury.

- One can fix a light on the knife and/or the folk; the illuminating instruments present even greater disadvantages that led to their eventual disease, mostly due to the inescapable pitfall of the induced shadow. If an illuminated fiber is stuck on one side of the instrument, a large shadow is projected on the other side. If fibers are placed all around the tip, the instrument size is greatly increased and a centered shadow appears at the exact location where one is working. In addition, the photo toxicity risk is a problem when an illumination is provided so close to the retina.

- One can switch on the room light placed above the plate. This is what is done with illumination provided by the microscope.

3) **Mini-invasive surgery**

The period of “the great surgeons perform large incisions” is over. In all meetings today we can hear this “mini-invasive” concept. This is logical in that functional results are related to the surgical trauma intensity and as cosmetic considerations are becoming more important. This is observed in all surgical fields. But how can one praise the concept of mini-invasive surgery while ignoring all the advantages given by illumination placed outside the eyeball?

- Two sclerotomies only are required: no need for additional sclerotomy or sclerotomies (in case of MIS or chandelier) so no additional risk of vitreoretinal incarceration
- No additional risk of vitreous traction induced by intraocular fiber manipulations.
- No additional risk of crystalline lens damage due to intraocular pipe manipulations or scleral depression in the area of scleral fixated fibers. In addition, the posterior capsule visualization is increased by the optical cut produced by the slit lamp and this is even more protective for the lens.
- No risk of photo toxicity (or almost no risk)

4) **Low cost surgery**

The period when procedure cost was a minor problem is over. The cost problem becomes even more crucial as the world tries to reach the “zero risk “:

- The widespread evolution towards the “all disposable” is slowly becoming an inescapable development either because of governmental health codes or facilitation of defense in the case of legal proceedings
- The fixed price for each procedure given by public/private health systems will not follow the cost increase required to reach zero risk.
- The patient’s acceptance to pay for surgery is difficult to obtain. In fact, since the risk is lowered, healing has become a social right like paid vacation, therefore a patients no longer understand why they should pay for surgery.

By eliminating the cost of disposable intraocular fibers for each procedure, the slit lamp illumination system gives additional economical capacities. In my clinic (2000 retinal procedures a year), we calculated that the use of the slit lamp allowed to save, every year, about 100 000 Euros.

B. Specific advantages for macular surgery

1. The slit lamp is fixed to the microscope

- **The left hand is freed**

The freed left hand is then available to centre the plano-concave lens on the cornea, manipulate the forceps wheel in order to orientate the jaws perpendicularly to the membrane edges, and to clean the extremities of the instruments. This allows a more fluid procedure.
In any case, the main advantage that amaizes my visitors is that my left hand is available to stabilize the forceps, avoiding trembling movements and therefore increasing work precision. One appears a surgeon with fantastic dexterity, never touching the retina incorrectly and the procedure becomes faster.

- **Decreased photo toxicity**

In epiretinal membrane, macular hole or edema surgery, the macula is on and the photo toxicity risk is therefore higher. The phototoxicity is related to the square of the distance between the fiber and the retina.

In order to compare the illumination provided by a standard intraocular fiber to the one provided by a slit lamp, I conducted a small experiment. I carried out a chorio-sclerectomy on a fresh pig's eye in order to measure, with a photoelectric cell, the illuminations provided by a slit lamp (7,200 Lux) and by an intraocular fiber at 17mm (7,800 Lux), 8mm (30,500 Lux) and 4 mm (127,000 Lux) from the posterior pole.

An easy way to appreciate the intensity of delivered light when performing a vitrectomy is to use a camera with a fixed gain, set up to get a good image when the fiber enters the eye (at 17 mm from the macula). When the fiber is too close to the retina, the surgeon's papilla myosis compensates for the increase of illumination, something that the camera with fixed gain cannot do. In light of this, one should avoid approaching the intraocular fiber closer than 5 mm from the retina, if one wants to avoid inducing macular damage as illustrated in Fig 1.

The advantage of the slit lamp is that the delivered illumination is always the same, as the distance between the light source and the observed target remains constant.

With the scleral fixated illuminated fibers, the distance does not change either. However, the illumination provided by the slit crosses through the natural filters constituted by the cornea and the crystalline lens (or the IOL), and therefore will have in any case a lower retinal toxicity.

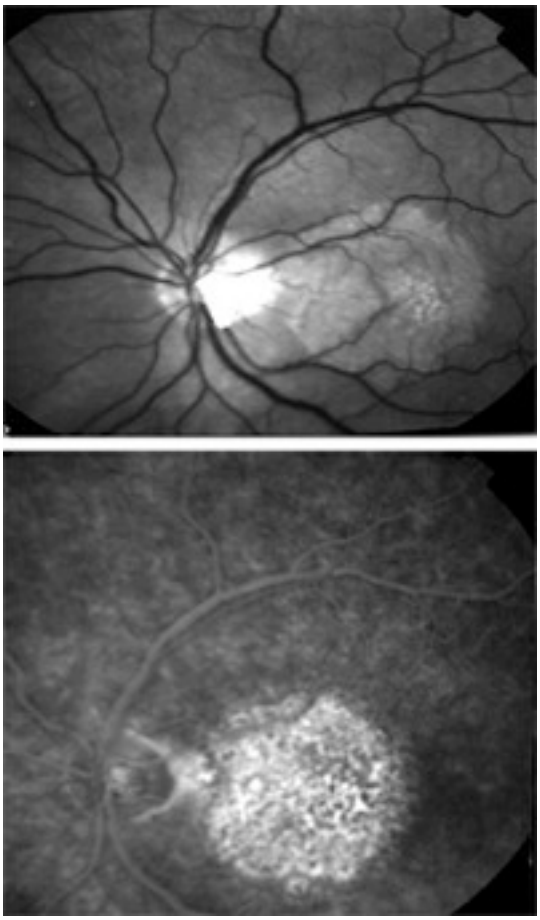

Fig 1: slides kindly provided by M.Mauget MD

2. The slit is tilted between 5 & 7 degrees from the axis

This produces a better visibility of diffracted light. For epiretinal membrane surgery or macular hole surgery, if dyes are not used, one needs to see the light reflected by the gliosed internal limiting membrane. Because the intraocular light source illuminates the macula with an angle of 25°, the great majority of reflected light remains inside the ocular globe as it bounces with an angle of 25° from the axis. On the contrary, the slit lamp light illuminating the macula at an angle of 5°, the great majority of reflected light will reach the surgeon's eye mirroring the reflection of the membranes.

3. In conclusion, slit lamp use allows a less traumatic and faster procedure

All the above specific and general advantages allow:

- A more mini-invasive procedure:
    - Two sclerotomies at 11 o'clock & 12 o'clock only are necessary.
    - Without vitreous traction induced by an intraocular fiber
    - Protection of the crystalline lens.
- A faster procedure
    - Only two sclerotomies
    - Faster peeling due to the improved precision given by forceps stabilization
    - As numerous visitors could observe it along the year, I routinely perform around 14 macular surgeries in one single operating room from 9 am to 1 pm, with 8 minutes operating room cleaning after each procedure.