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HISTORICAL PERSPECTIVE – THE INCREDIBLE SLIT LAMP

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ABSTRACT
For a modern ophthalmologist the slit lamp is indispensible. This article navigates through the wonderful journey of slit lamp through the ages till it evolved into its present form.

KEYWORDS: slit lamp, Allvar Gullstrand.

More than a century ago, in 1911, Allvar Gullstrand, Professor of Ophthalmology, and later of Physiological and Physical Optics at Stockholm, presented the first basic model of the slit lamp and detailed its optics and applications before the German Ophthalmological Society in Heidelberg.[1]

Today, an ophthalmologist's armamentarium without a slit lamp biomicroscope is inconceivable, and we take it for granted. It seldom crosses our minds how it has come to take its present feature-loaded avatar.

The story of evolution of the slit lamp is a fascinating one.

The watershed event in this journey was, of course, Gullstrand's seminal contribution to our calling – the first Slit Lamp that was his invention, which, though rudimentary, saw the coming to fruition of the efforts of several others who, before him, had struggled for nearly a century and a half to devise a method of illumination that could enable the satisfactory examination of the anterior parts of the living eye.

Unbelievable as it may sound today, but it is true that early ophthalmologists examined the eye in daylight, since it was the best available option, the others being candle light or oil lamps! (fig.1). The need for a good source of illumination and magnification was recognized and thus began the journey culminating in modern day slit lamp.

It all began when ophthalmologists started observing the anterior ocular structures with the use of a biconvex condensing lens and a monocular ophthalmic loupe. Later on, to achieve stereoscopic vision, prisms were added in the binocular loupe.

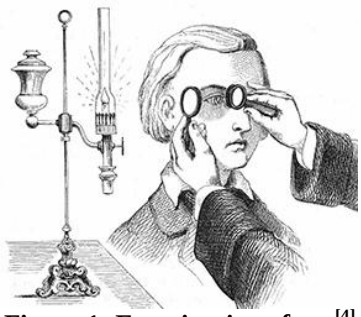

Figure 1: Examination of eye[4]

The underlying principle of the slit lamp [focal or oblique illumination as a means of examining the eye] was first enunciated in 1806 by Karl Himly [1772-1837]. However the utility of oblique illumination received due recognition only later, when Von Helmhotz and Von Grafe explained this technique, and it then came to be widely recognized.[2]

However there were serious inadequacies in the instrument developed so far. The cause of this was identified by Gullstrand, when he pinpointed the inherent limitation in the technique, that by using oblique illumination by means of a simple condensing lens, a beam truly focused could never be obtained.

Gullstrand also found an effective solution to overcome this fault. He demonstrated the superiority of employing a method where instead of projecting rays of light emitted from a luminous body, those emanating from an image of the light source was put to use. This made available a beam of light, strongly focused, and capable of being controlled with ease (fig.2). The importance of this development was immense, and it would not be an exaggeration to say this single advance that actually enabled biomicroscopy of the eye.

Figure 2: Gullstrand slit lamp -1912.[5]

The genesis of the slit lamp biomicroscope, in which the system of illumination and magnification are now inseparably wedded, has another equally important and independent facet too. Around the time when the utility of oblique illumination was stressed by Von Graefe, Liebreich propagated a theory he had developed – combining the use of a microscope to examine the eye with oblique illumination. Further, Liebreich also devised the method of making use of prefocal and postfocal portions of the beam of light obtained by oblique illumination.

A binocular corneal microscope was presented in the 1891 Ophthalmological Congress in Heidelberg by H.Aubert. Czapski modified and further improved it subsequently. This binocular microscope designed and modified by czapski-zeiss had a full stereoscopic effect produced by a system of porro prisms with four reflections. The eye –pieces were made adjustable to suit the inter-pupillary distance of observer.

Another significant step forward was the mounting of both the slit lamp as well as the terminal illumination lens on a single horizontal arm. The design of this integrated unit was such that it had sufficient mobility since the whole was fixed to a vertical pivot attached to the table by an articulated arm.

Since then, several variations of the slit lamp have come and gone over the past many decades, but the underlying fundamental principle of all of them is that which was put forward by Gullstrand.

Post- Gullstrand, in the journey of the evolution of the Slit Lamp Biomicroscope, there are some important milestones worthy of mention here. In the year 1920, a coiled tungsten filament nitra bulb was introduced successfully in the illumination system by Vogt. Another significant development was effected by Koeppe in 1923 in the B&L Slit Lamp which allowed co-axial rotation of the illumination system and the microscope. A year later, in 1924, Fincham linked the two systems in such a manner that they remained in focus with each other, always. Goldmann in 1937, added a joystick to control the simultaneous movement of the lamp and the microscope.

Further improvements were made such as by Schmidt in 1958. He set the slit lamp vertical and freely movable around a separate pillar. This resulted in a clear vision through the microscope since the illuminating beam did not overlap the optical path of the microscope and the co-axiallity is maintained throughout.

What distinguishes diffuse illumination from biomicroscopy is that the latter has the advantage, to the maximum effect, of focal illumination which is nothing but light projected by a single condensing lens or a system of such lenses.

To explain it very briefly, such a system works in a fashion that at the focal point of the system, light becomes intensely concentrated. The oblique beam, if generated using only a simple condensing lens, is not only insufficient but even obscures details. On the other hand, Gullstrand's innovation, further improved upon by Vogt, renders it possible to use the beam to examine successive layers of the transparent media. This is due to the fact that it becomes possible by this method to illuminate each layer by light in exact focus. The illumination is limited to a small section of tissues, which corresponds to the size and shape of the controlled beam of focused light as it passes through the transparent media of the eye.

Modern slit lamps use the Koehler system of illumination, and halogen lamps have replaced the old nitra bulbs. [3] Today's highly maneuverable slit lamps can give the desired illumination in any section and direction. The use of slit lamp along with contact lenses for Gonioscopy, fundus examination and applanation Tonometry has made it indispensible. All these can now be used at several levels of magnification without disturbing the focus and the working distance.

The mobility of eye, which had been a source of constant worry, has also been taken care of in the modern instruments. Immobility can be achieved by the use of a small low-power auxiliary lamp placed in front of the fixing eye. This lamp can be moved as required and the eye can be examined in any position and the degree of movement can be fine tuned.

The newer modifications in slit lamp are only add-ons to the original. At this moment one cannot but help note that Allvar Gullstrand remains the only ophthalmologist ever to have been awarded the Nobel Prize, which he was conferred upon in 1911 for his pioneering "work on the diffraction of light as applied to the eye".

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