

The power of observation

O poder da observação

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“The eye cannot see what the mind does not know” was a quotation that my teachers used to often recall during my medical student days, to emphasize the fact that without study and acquisition of knowledge one would miss many clinical signs and clues, which would be unbecoming of a medical practitioner. This line of thinking was expounded further by DH Lawrence in his famous quote “What the eye doesn’t see and the mind doesn’t know, doesn’t exist”, even if it does! I might add.

While the inference contained in the above quotes may apply to many, it is not entirely correct, for if it was, there would be no progress. Perhaps that is the difference between ‘seeing’ and ‘looking’. Only when one can look at something and see beyond what the mind knows can one discover new things and enhance understanding. Millions of people must have looked at millions of apples (or other fruit) falling from trees but it was Newton in 1666 who saw in this event the force of gravity. Archimedes, like millions before him, stepped into a bath tub for what is considered a routine act, but emerged with the theory of buoyancy and an accurate way to measure volume of objects, for his body had displaced a certain volume of water. Such “Eureka” moments have happened to many sung and unsung commoners and heroes through history and continue to happen to people around us while most of us lesser mortals go about our routine business. All such individuals who have contributed to our progress have had one thing in common, the eye to see things that the mind did not know. In simple language, this is the power of observation.

Is it a ‘gift’? A talent? Or a ‘Power’? Perhaps none of these but just an inquisitive mind; a mind that does not brush aside what does not make sense but tries to make sense of what the eye is transmitting to it; a mind that questions anything that does not fit the norm, rather than ignore it as ‘one of those things’ or ‘Nature’s little mysteries’.

Great scientific discoveries have been made by accident; accidents that happened to individuals who noticed something out of the ordinary and took the all-important next step of pursuing the observation. Their ‘power’ was not in the observation but in the pursuit of the observation. A laboratory worker dropped a glass beaker, which smashed into many pieces on hitting the floor. He noticed that the pieces were not sharp and angular but rather more rounded and ‘held together’. He could have swept the pieces and trashed them but he inspected the broken beaker and noticed that it had not been cleaned properly and was still coated with the plastic material it had contained. This led to the invention of shatter proof safety glasses! Alexander Fleming’s discovery of penicillin was an accident. His bacterial culture plates were contaminated with mould. Instead of throwing them away and starting the cultures again, he paused to inspect the plates. He noticed that there was a clear area around the mould colonies where the bacterial organisms had stayed away. Penicillin is regarded as one of the greatest discoveries in medicine. Pfizer was testing a pill to treat angina related to ischaemic heart disease. It did not work but the test patients noticed that it worked elsewhere. The company’s scientists took note and Viagra sales broke all records.

Not all observations and their significance have to be ‘great’. Simple things too can make a difference. Some examples from my own experience, though nowhere in the same league as the events narrated above, have made a small difference.

In the late 1980s and early 1990s, whilst studying corneal abrasions as most trainees do, I noted that circular abrasions with an intact limbus did not heal by forming circles of smaller diameter. Instead two, three or up to six convex sheets migrated from the remaining surviving corneal epithelium, the sheets made contact with adjacent sheets to give the abrasion a geometrical shape - triangular, quadrilateral, pentagon or hexagon. The sheets continued to migrate centripetally and eventually closed by forming ‘Y’ shaped contact lines, much like the ‘Y’ sutures of the lens, which too are the meeting points of epithelial sheets. These lines represent the ‘pseudodendrites’ associated with healing corneal abrasions⁽¹⁾. In some patients, especially with superficial mild chemical injury, I noted that the epithelial defect involved the limbus and adjacent conjunctiva. In these patients, a preferential circumferential migration of two tongue-shaped sheets of epithelium occurred, one sheet arising from each end of the remaining surviving epithelium. However, when the circumferentially migrating sheets met each other and the limbus was re-epithelised, healing followed the first pattern as for a central abrasion with

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an intact limbus⁽²⁾. In a proportion of patients, the conjunctival epithelium, which was also migrating centripetally, crossed the limbus and covered a varying area of the corneal surface. The area covered with conjunctival epithelium was thin, irregular, stained (late) with fluorescein and attracted blood vessels. When across the pupil, it affected vision^(3,4). This led to the development of the procedure now called sequential sector conjunctival epitheliectomy (SSCE), whereby the conjunctival epithelium is repeatedly brushed off the surface of the cornea or limbus until corneal epithelial cover with corneal epithelium is re-established⁽⁵⁾. SSCE is now an established procedure employed in ocular surface reconstruction either independently or as part of auto or allo limbal transplantation and these rules of corneal epithelial wound healing guide my management of ocular surface injuries⁽⁵⁾.

In 1983 the term Hurricane keratitis was coined by Mackman et al.⁽⁶⁾, to represent punctate fluorescein staining seen on corneal grafts, resembling the symbol of a hurricane on a weather map. This was attributed to the influence of sutures on the migrating epithelial cells from the limbus. In 1993 I happened to observe by chance the presence of a very well defined hurricane pattern on an eye which had not had a corneal transplant. My colleagues and I were able to demonstrate hurricane keratopathy in several patients who had not had corneal grafts^(7,8). We also noted that the vast majority of the whorls were oriented clockwise and postulated that this was related to the electromagnetic fields of the eye⁽⁷⁾. We went on to demonstrate the formation of whorls by cultured corneal epithelial cells under the influence of magnetic fields⁽⁹⁾. Latterly we and others^(10,11) have demonstrated that the sub-basal plexus of corneal nerves too have a whorl configuration and relates to the whorl pattern of the epithelial cells. There is more going on than meets the eye!

During my work on corneal wound healing and stem cells I came across a section of the limbus where there was a prominent extension of epithelial cells from the posterior end of a limbal palisade into the episcleral stroma. The first reaction was to pass it off as a gland of Henle. Closer inspection showed that the extension was a solid cord of cells and not an invagination of surface epithelium. This observation was pursued further and the limbal epithelial crypts⁽¹²⁾ were discovered, which seem to be repositories or niches of stem cells⁽¹³⁻¹⁵⁾. Soon after the publication of the first paper on limbal epithelial crypt (LEC)⁽¹²⁾ a colleague from a neighbouring city wrote to me to say, 'I read your paper with interest. I must say that my colleagues and I had seen these structures in many slides but did not explore them further' or words to that effect.

Recently we published on the existence of a distinct layer in the pre-Descemet's corneal stroma (the pre-Descemet's layer or Dua's layer)⁽¹⁶⁾. Like many other corneal surgeons I had switched to performing deep anterior lamellar keratoplasty (DALK) by the big bubble technique (BB), for corneal stromal pathology. DALK was then described as a Descemet's baring technique⁽¹⁷⁾. On several occasions I had questioned whether I had actually laid the DM bare. I ignored the first clue, then the second clue came along and so on until it was a couple of years and four clues later that I decided to investigate the procedure. By simulating BB DALK in human donor sclero-corneal discs we were able to demonstrate the presence of a distinct layer that formed the posterior wall of the BB along with the DM. Notwithstanding the contention by purists whether it truly is an anatomical layer, Dua's layer (DL) is now accepted by most corneal surgeons as a definitive part of the surgical anatomy of the cornea. It has considerably improved our understanding of the BB DALK procedure and the different kinds of bubbles that can form in different anatomical planes. It has made the procedure safer. In the year since publication of the first paper it has been shown that at the corneal periphery, DL collagen extends as the core of the trabecular meshwork⁽¹⁸⁾; that DL together with DM and endothelium can be harvested to perform endothelial keratoplasty (PDEK) with certain advantages⁽¹⁹⁾ and that phacoemulsification with lens implant can be carried out under the exposed layer in the procedure termed DALK-Triple⁽²⁰⁾. It has led to further understanding of the microanatomy of the peripheral cornea where we have demonstrated the presence of holes in the layer through which air can escape during BB DALK to access the plane between DL and DM to separate DM without DL⁽²¹⁾. Such BBs (type-2 BB)⁽¹⁶⁾ are more prone to bursting intra-operatively. We can now recognise which type of BB is formed and take precautions to avoid bursting of the bubble. Together with a veterinary colleague (Dr. Christiane Kafarnik) we have even demonstrated the layer in animals.

There is anecdotal evidence that DL may persist over a descemetocoele, giving it strength until it too melts and the descemetocoele bulges further with risk of perforation. Similarly, in some cases it has been noted that when acute hydrops occurs in keratoconus, the DL also ruptures together with the DM allowing rapid hydration of the altered corneal stroma (unpublished observations). A recent paper has shown pathological separation of DL in fungal keratitis⁽²²⁾.

At an international meeting soon after my presentation on DL an acknowledged expert in corneal surgery came up to me and said "I am delighted that you have discovered this layer, but I am disappointed that I did not do so myself because I have seen this happen under my very eyes every day".

It is absolutely certain that very many of our colleagues have reported and published numerous discoveries arising from simple observations, that have enriched our knowledge. Equally I am certain that I and many like me have also missed opportunities to realise the full potential of innocuous observations. In our busy schedules and crowded lifestyles, taking a moment to pause and think of what we see, is all that is needed to allow the eye to see what the mind does not know.

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