Editorial

Where Do We Stand with The Ever Evolving Technology?

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Pak J Ophthalmol 2019, Vol. 35, No. 2

"Imagination is more important than knowledge. For knowledge is limited, whereas imagination embraces the entire world, stimulating progress, giving birth to evolution." Albert Einstein.

"Once a new technology rolls over you, if you're not part of the steamroller, you're part of the road". Stewart Brand.

The developments in the field of ophthalmology have gone through tremendous and fast evolution over the last 40 years. The purpose of this evolution is the well being of our patients. In the surgical field we aim at efficiency, safety and predictability. Technological innovations are always aimed to improve a surgical need or a patient outcome.

For example with the development of modern phacoemulsification machines and techniques it became possible to aspirate the hardest of nuclei through a tiny incision down to 1.8 mm, which was not possible manually. So innovations in surgical techniques have evolved rapidly to improve the use of the technology. Another example is the introduction of excimer laser technology in refractive surgery which gave us the opportunity of precision in carving the corneal surface to attain the desired refractive result which was not possible with any previous technique.

Therefore the idea has always been that when we have a certain disease there are many ways of treatment but these can have various problems. So technology pitches in to improve results and safety, followed by innovative techniques to make the use o technology easier and safer.

Any new technology that does not add efficiency, safety or makes procedures easier will rapidly die fast. An example of this is the developments of the phaco laser using erbium YAG laser aimed to reduce energy production during phacoemulsification (cool Phaco)[1],. This rapidly disappeared despite the fact that many machines were developed and techniques were advocated. The only reason was that it did not add anything solid enough to replace the old technology.

We can have so many different examples in all fields of ophthalmology where a technological development appears and soon disappears. We always have the industry pushing us to use and buy new machines which we should totally understand. But as surgeons we are puzzled with so many new technologies that are introduced in the present era that it becomes difficult to decide which is of real benefit.

With any new developing technology we have two aspects one is the scientific value and the other is marketing value. We should always stress on the first aspect to make sure that we have an added value to the patient and the surgeon and then if this proves true we can use it as a marketing tool. We should never be trapped to focus on marketing first without assuring value.

Let us focus on the controversy of the Femto technology developed to improve all avenues of anterior segment surgery from refractive to corneal and cataract surgery. Let us disassemble each of its uses and check the added value.

Starting with flap creation in LASIK surgery, Femto laser has clear advantage over regular rotational mechanical microkeratomes[2] It has reproducible flap thickness, reproducible flap diameter and ablation area., planar flap with better coaptation and healing., better post operative quality of vision, no affect of K readings whether steep or flat, ability to create oval flaps, no problem with suction loss and no button holes. This is true and is great but,

at the same time we have the linear mechanical microkeratomes[3] which are able to create a reproducible sub-bowman membrane Keratomelusis (SBK) as thin as 90 microns with a standard deviation similar to Femto. They also produce a planar flap, have different suction rings for very steep or flat corneas as well as oval flap creation. The, produce an excellent bed even smoother than a femto created one particularly with early models, have very low suction time and very rapid flap creation with no button holes reported and excellent postoperative quality of vision. So it is true Femto flaps are a great advancement but when we compare them we should do so with linear SBK microkeratomes rather than rotational ones. Only then we can find little differences and we can advise our patients about the best possible option for their particular case.

The idea of using the femto Laser as a new technology to treat ametropia in small incision lenticule excision (SMILE) is a promising technique, but it needs more refinements to achieve excellent refractive quality as has been seen with Excimer laser. The main claim of this technique is that it improves the bio-mechanical stability of the cornea by preserving the strong anterior lamella, (based on a theoretical model, which has not been proved clinically by any solid evidence based studies). A second advantage is the decrease in postoperative dry eye by preserving more corneal nerves and may be this is the only solid advantage to date[4]. Improvements in this technique are evolving to overcome the drawbacks which include decreased quality of vision, challenges for repeat surgery, astigmatic and hyperopic treatments.

Moving to a second domain we find that when using intracorneal ring segments (ICRS) the use of Femto laser is clearly advantageous[5]. The use of Femto here has clearly improved the reproducibility of deep tunnels which have improved the results as well as decreased the frequent complication of ring extrusions. Moreover it has the versatility to create tunnels which are accurate and can be of variable lengths and positions. So clearly this is a plus addition to our armamentarium.

Femto Assisted cataract Extraction (FLACS) still has a debatable advantage over traditional phacoemulsification. The advantages claimed so far, is the reproducible size, shape and site of capsulorhexis which helps in better centration of intraocular lenses (IOLS) especially premium IOLS and can be of help in subluxated cataracts, intumescent cataract and shallow anterior chambers. A second claimed advantage is decrease in the energy used during phacoemulsificaion as a result of prior Femto fragmentation of the nucleus. The ability to do Astigmatic keratotomy at the same time is a clear advantage in cases associated with astigmatism. That being said, manual capsulorhexis is fast and can be reproducible following rules and even has stronger edges compared to the Femto rhexis which is an excellent can opener capsulotomy in essence. Energy can be reduced during phacoemulsification by the use of chopping techniques which allow slicing of the nucleus before emulsifying, so that the vacuum is the main player.

Femto use has shown to increase the incidence of postoperative uveitis and cystoid macular edema, probably due to use of extra energy in capsulorhexis and nuclear segmentation. Still this technique has to improve to deliver better results both intra-operatively and postoperatively as compared to the advanced current status of phacoemulsification which is very efficient. Use of Femto cataract surgery also has to justify the extra time and cost of each procedure[6].

Another avenue is keratoplasty[7], where Femto technology offers an advantage in penetrating keratoplasty of cutting different shapes of the graft and recipient bed precisely e.g. top hat, mushroom etc. This provides better fitting of the graft-host junction and hence less need of sutures with better cooptation, early rehabilitation and production of less postoperative astigmatism. Compared to the present day high end manual trephines this might hold true for easier fitting of graft to host, but the astigmatism part which is most important might not hold true. Post operative astigmatism is related to many other factors like, differential wound healing, suturing technique, depth and tightness of sutures that are surgeon dependent.

In deep anterior lamellar keratoplasty which is the more commonly done technique nowadays, the role of Femto is still limited[8]. Because it is related to how deep the cut with femto can safely go so that it does not damage the endothelium. And still the surgeon will need to inject air to create the big bubble. The advantage of femto in my opinion will come when it is possible to go deep enough guided by the online OCT mounted on the machine and to create a tunnel into the remaining stroma to inject air precisely in the right place. This will make the procedure much more reproducible and less surgeon dependent which will then be a great addition. There are currently some

machines which are achieving this but they need more refinement and research.

Similarly for the different techniques of endothelial keratoplasty (DSAEK[9] and DEMEK) there has to be some improvements and convincing results to justify using Femto laser in these procedures rather than the well established manual or microkeratome assisted techniques.

In conclusion the development of Femto Laser is a promising evolving technology in the field of anterior segment surgery. Still, it needs refinements and improvements in both techniques and technology to achieve better results, and safety for both the patient and the surgeon. Advantages have to be clear to justify the large financial burden incurred on all parties.

Until this becomes a reality, it is perfectly acceptable for you and me to carry on with the best available techniques and technologies while learning and trying to improve the evolving technology.

"*Technology presumes there's just one right way to do things and there never is.*" Robert M. Pirsig

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