Commentary

Advancing microsurgical instrumentation into the 21st century

As we move into the 21st century, so technology continues to advance at an astounding pace. As a consequence, ophthalmology is exposed to rapid developments in the areas of surgical techniques, biomaterials, and 'high tech' instrumentation. For example, in the field of cataract surgery, the advances in the technique over the past 30 years have come about through a combination of the application of the phacoemulsification technique[1] and small incision surgery,[2 3] along with intensive research and development of better biomaterials.[4] These innovations continue through researchers striving for even smaller incision cataract surgery[5 6] and the application of laser phacolysis.[7–9] However, is there such a great interest in the research, development, and implementation of improvements in surgical instrumentation?

The importance of modifying and designing ophthalmic surgical instruments to meet the needs of new procedures has been highlighted in the past.[10] At the time, the advent of the microscope to ophthalmic surgery revealed the damage to ocular tissues caused by inappropriate instrumentation. The need to refine forceps, to provide sharper cutting tools, and to have more accurate needle holders was paramount. Subsequently, there was a search for a more suitable raw material—titanium emerging as the material of choice.[11 12] It is lighter than stainless steel, resists corrosion, is capable of repeated sterilisation, and can have a non-reflective surface.[12] Furthermore, alloys of this material, such as 6AL-4V, provide improved qualities of hardness and durability, as well as being non-magnetic with low thermal conductivity.[12] Such physical attributes enable specialised manufacturers to produce arguably more superior high precision instruments than those of stainless steel.[11 12] The only property which titanium does not provide is that of a sustained sharp edge, although this can be achieved by incorporating the physical qualities of diamonds as the cutting surface.[13]

In recent years, however, high technology and digital instrumentation appear to have taken a higher profile than the apparently less sophisticated microsurgical instrument. On reflection though, ophthalmologists undoubtedly use surgical instruments far more than most other pieces of equipment in their department. Perhaps it is time for us to redress the balance and focus in more detail on the quality of instrumentation that we are using in our operating theatres. For instance, do the instruments that we currently use perform the task we want them to? Are they easy to use and do they feel comfortable in the surgeon's hand? Could our operating techniques be improved in both simplicity and efficiency by the availability of better quality instrumentation? And finally, are our patients getting the optimum outcome they deserve?

The considerations for designing and developing a high quality functional surgical instrument are several fold. An essential requirement of any instrument is the ability to complete the task it is intended to carry out in an efficient and precise manner. In order to achieve this, are the dimensions of the tip of the instrument in proportion to the tissues being operated on? Is there enough strength in the mechanism of action to overcome the resistance within the tissues? Is the weight of the instrument in keeping with the task at hand? And of similar importance, does the handle of the instrument provide the balance and comfort that will enable a smooth and well controlled execution of the surgical manoeuvre?

To achieve this aim, the designer of any instrument should consider consistency in the ergonomic handling characteristics of the instruments. There should ideally be uniform working distances from the tip of each instrument to the position of the instrument in the surgeon's hand. The handle should feel comfortable, allowing a natural grasp but also providing a well balanced distribution of the instrument's weight. Arguably, this may be better achieved by having a longer handle length with a rounded body, although the availability of shorter handles and differing profiles is necessary to cater for the whole range of hand sizes and individual surgeons' preferences. The instrument's mechanism of action, including the tension in any spring element, should enhance the surgeon's control of the procedure, while the tip design should maximise the efficiency in performing the task but also minimise the trauma to the tissues.

An illustration of such advanced instrument design is observed in the Barrett integrated instrument design set,[14] which provides a range of instruments based on the aforementioned concepts. A more specific example of the application of such principles is in the Inamura cross action capsulorhexis forceps.[14] The use of a cross action mechanism positions the fulcrum within the incision, minimising the amount of gape and thereby reducing the amount of viscoelastic loss from the anterior chamber. Furthermore, a fulcrum closer to the instrument tip provides more exquisite control of the action, while allowing continual tip alignment. The use of serrations at the tip enhances the grip of the anterior capsule tissue, thereby facilitating the procedure of complete curvilinear capsulorhexis.

The Microsurgical Instrumentation Research Association (MICRA) was founded in 1971 in an attempt to investigate the possible use of titanium and its alloys in the production of ophthalmic surgical instruments.[12] Since then, the precision engineering manufacturer originally producing these instruments has acquired expert knowledge on the feasibility of designing, developing, and manufacturing new ophthalmic instruments in this most useful material. Perhaps it is now time that ophthalmologists are made more aware of the existence of such companies dedicated to the design, development, and production of extremely high quality titanium ophthalmic surgical instruments.

As we venture into the next millennium, it is perhaps prudent for us to consider a closer look at the instrumentation we are using in our operating theatres. We mustn't settle for what's available or what has been used for the past 40 years. Instead, we should consider surgical instruments that will facilitate today's surgical procedures and subsequently improve the quality of the outcome. A closer harmony between the ophthalmic surgeon and the instrument engineer or manufacturer will bring improvements in surgical techniques and instrumentation, ultimately providing a higher quality service. It is time to advance ophthalmic microsurgical instrumentation into the 21st century.

Conflict of interest: AW is a director of Duckworth & Kent Ltd; TW is managing director of Duckworth & Kent Ltd.

This commentary is dedicated to John Pearce, an innovator in ophthalmic surgical instrumentation.

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