Implantation of Artificial Intraocular Lenses—A Brief History

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The very first replacement of an opacified natural lens by a clear artificial lens was performed by Harold Ridley at St. Thomas' Hospital in London on 29 November 1949. The implant was largely modelled after the natural lens, both in shape and size, and was inserted into the capsular bag after extracapsular lens extraction. The circumstances leading up to the event are stuff of legend and surrounded by numerous anecdotes—It is said that Ridley was inspired by a student who watched him perform cataract surgery and naively asked why he did not simply insert a new lens in the place of the old one. The meetings between Ridley and John Pike of Rayner & Keeler, the manufacturer of the first IOL, used to occur huddled together in Harold Ridley's Bentley. Finally, his choice of Perspex PMMA plastic was inspired out of tragedy—during the second world war, Royal Air Force pilots presented with intraocular shards of the material when their aircraft canopies shattered. Ridley observed that despite the damage, the material remained inert inside the eye and could perhaps be shaped into an effective implant.

Like many disruptive, paradigm shifting innovations, the process was extremely controversial in ophthalmology. The initial furious rejection by the establishment however was at least tempered by the fascinated acceptance of a few who also saw the true potential of the intraocular lens.

In the 1950s however, the trend of intracapsular cataract extraction increasingly replaced the previously preferred extracapsular surgery. This left no capsular bag to support an IOL so naturally inhibited the further adoption of the Ridley lens implant. Intraocular lens innovation however did not remain dormant, but in the absence of a capsular bag, a new fixation principle was required. This need led to the introduction of anterior chamber lenses, supported by the chamber angle, and as a result, lens implantation experienced a new upswing at that time. Again, the leading innovators of the time met the similar fierce resistance that had hounded

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Ridley. The lens models of these IOL pioneers; Dannheim and Schreck in Germany, Barraquer in Spain and, last but not least, Choyce in England, to name only the most prominent, helped the new principle in gaining increasing interest, though at that time it was reserved for very selected cases, namely younger patients with unilateral aphakia. Lens implantation as a routine correction of aphakia was not considered to be possible, even then.

The initial enthusiasm of the short-term results was eventually followed by a period of considerable disillusionment as the long-term results and complications began to roll in. Increasing reports of complications due to ingrowth of the haptics into the chamber angle, secondary glaucoma, chronic inflammatory reactions, corneal decompensation—to name only the most important ones—fired the opposition. Those performing IOL implantations were considered to be taking unnecessary risks and were seen to be on the fringe of mainstream ophthalmology. The problem however was not the concept of an IOL itself but rather the limitations in surgical methods and options to treat complications compared to what we have nowadays. As a result, in the late 1960s/early 1970s, lens implantation, the greatest innovation in anterior segment surgery, was widely considered obsolete and irresponsible.

But good ideas are seldom forgotten and fortunately, the official ban from the establishment did not stop some ophthalmologists from advancing IOL development. Peter Choyce refined the principle of the chamber angle fixation with his design to such an extent that the complication rate decreased considerably. In the Netherlands, Cornelius Binkhorst developed a completely new fixation principle, namely to the previously ignored iris, with his 4-loop lens. In the mid to late 1970s, the first surgeons in Germany started testing these new lenses. This was again disruptive and as controversial as in Ridley's time: When I myself moved from Heidelberg, the center of the "never again IOL coalition" to Mainz in 1977, the first Binkhorst 4-loop lenses had just been implanted there. The controversy in German ophthalmology was fierce and the bias was passed on to the younger generations throughout the academic institutions.

This controversy and debate still raged even as the next paradigm shifting development challenged ophthalmology: the rebirth of extracapsular cataract surgery in its modern refined technology. The debate was now to include the choice between Dr. Charles Kelman's new phacoemulsification technique to perform an extracapsular cataract extraction and the "classic" but now microsurgically reliable "large incision" cataract surgery.

The refinement of the extracapsular technique in the late 1970s finally made S. Shearing's introduction of the posterior chamber lens possible and feasible. Its two J-shaped haptics were based on Barraquer's earlier anterior chamber lens—but the lens was now to be placed retroiridially, in the ciliary sulcus. This change in positioning was only fractions of a millimeter more posterior than the anterior chamber placement but a decisive difference. When the refinement of the anterior capsulorhexis technique with a continuous closed edge (capsulorhexis) made secure and permanent fixation in the capsular bag possible in 1984, the circle of lens

development—at least up to its current state—was closed. The IOL had returned into the capsular bag, just where Ridley had originally intended it to be.

The beginning of the 1980s was, without exaggeration, turbulent in the field of cataract surgery: ICCE versus ECCE, to perform phacoemulsification or not, to implant a lens or not, and if so, which lens design or fixation method was best….

It is beyond the scope of this brief description to describe the many tortuous ways that the development and the decisions and statements of the professional associations in this context have taken during this time. Where the development has led to in a comparatively short time is more than obvious today. In cataract surgery today, phacoemulsification is the leading surgical technique and—lens implantation is an indisputable standard. The controversy of whether to implant a lens or not is resolved. Discussions today are more related to the optical-refractive properties and refinements of the lenses.—The implants have grown more sophisticated in what they can offer and one of the newer challenges is how to advise patients correctly in this area, which is demanding in terms of both time and understanding the complicated details and physical principles underlying the lens technologies….

It is not an exaggeration to say that Sir Harold Ridley's epochal invention has very significantly improved the quality of life of millions and millions of people. He, fortunately, lived long enough to finally receive the recognition and honors he deserved from the international scientific community from the mid-1980s onwards. In 1999, on the 50th anniversary of the first implantation, the annual meeting of the ESCRS in Vienna payed honor to the man who had long been rejected by the establishment. The elevation to the peerage of Sir Harold Ridley by the Queen of his country in the year 2000—was satisfying and touching.

From someone who has witnessed this development over the last 47 years—and had the opportunity to help shape it a little—I would like to share this appeal.

While what is new is certainly never automatically good—it is also never a priori bad. It may just be ahead of contemporary understanding. One should always remain critical and curious at the same time—and if curiosity prevails a little, it is less harmful and potentially more useful than if "establishment-always-good" arrogance prevails.

In the end, the words of my revered mentor and friend Richard Kratz remain valid:

Do not talk too much—do good work—and be available.

Bibliography

1. Apple, DJ, Mamalis, N, Olson, RJ, Kincaid, MC. Intraocular lenses. In: Evolution, Designs, Complications, and Pathology. Baltimore: Williams & Wilkins;1998.
2. Apple DJ, Sims J. Harold Ridley and the invention of the intraocular lens. Surv Ophthalmol. 1996;40(4):279–92.
3. Neuhann Th. The development of modern cataract surgery in Germany. Ophthalmic Surg. 2019;31(2):98–106.