The Evolution of Cataract Surgery

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In addition to the clinical presentation and diagnosis of cataracts, a summary of the development of cataract surgery is presented. Indications for cataract surgery are now based on subjective visual impairment rather than measured visual acuity. Cataract surgery can now be done safely through 3mm self-sealing incisions with excellent results and rapid recovery.

Key words: cataract, lens, phacoemulsification, visual acuity, red reflex.

Clinical Presentation

Patients with cataracts present with a number of clinical symptoms, but difficulty with reading is probably the most common complaint. In the early stages, simply strengthening the glasses can treat this problem. As the lens progressively opacifies, however, a point is reached where further strengthening will be of no benefit. Another frequent complaint is difficulty with night driving. Due to the scatter of light as it passes through the cataract, people see various distracting visual anomalies when they look at streetlights or at the headlights of oncoming vehicles. A less common but more disabling symptom is glare from the sun or from other bright lights (e.g., fluorescent lights).

Aging of the cells within the lens is the cause of most cataracts (Table). The structural changes found in cataracts include alteration in protein metabolism, lens edema, increased cellular proliferation or disruptions of the lens fibre continuity. These changes cause interference with the transmission of light through the lens. The failure of cell metabolic function also can be brought on by other factors such as trauma, drugs (e.g., antipsychotic agents, steroids) or systemic diseases (e.g., diabetes).

Diagnosis

Measuring a reduced visual acuity and observing lens opacification usually establish the diagnosis of the cataract. This is best done with a slit lamp, but a very good estimate of the severity of the cataract can be obtained with a direct ophthalmoscope by noting how much the red reflex is diminished. Age-related cataracts, the most common type, appear to have a central homogeneous clouding of the lens nucleus ranging from green to brown in colour as the cataract matures. Cortical cataracts, involving the outermost layers of the lens, often have a spoke-like appearance. Posterior subcapsular cataracts involve the layer of cells immediately beneath the posterior lens capsule. Although this type of cataract is only a single cell layer thick, it can have a great impact on the red reflex, ranging from a small black dot in the centre of a normal reflex all the way through to complete elimination of the red reflex.

Cataract Surgery

In the past, the indication for cataract surgery was largely based on the recorded visual acuity. Recent studies have shown that subjective complaints from the patient are a better predictor of a patient’s satisfaction with their vision as well as of the potential gain they are likely to experience from cataract surgery. Various scoring systems, such as the VF-14, have been developed to standardise and quantify subjective patient complaints, and these tools are now being used to help prioritise patients for surgery in areas where there are long waiting lists.

Cataract surgery has evolved enormously over the last few decades, and is currently one of the most common surgical procedures performed. Originally, a long straight blade was used to cut half of the cornea away from the sclera, following which the lens and its capsule were removed with either a surgical spoon or a cryoprobe. This technique was used before the advent of sutures fine enough to be used in the cornea. Patients therefore had to be kept immobile while the wound healed and were required to lie in bed for a week with sandbags around their head to keep them still. After surgery, patients were fitted with extremely thick glasses that allowed them to function reasonably well despite significant optical distortions.

This procedure evolved to extracapsular cataract extraction surgery, whereby an opening was made in the lens capsule and the lens was manually expressed through the opening between the cornea and the sclera, slightly more than one-quarter of its circumference. By this time, suture technology had evolved so that it was now possible to securely close the wound. The stitches were very delicate, however, so patients were instructed to avoid bending, lifting or straining for six weeks after surgery. Intraocular lens technology also had developed at this time so that lens implants became routine and patients were able to function with relatively normal strength glasses after surgery. The major optical problem with extracapsular cataract extraction surgery was that the extensive scar often was associated

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Cataract Surgery

1. Incision: A small incision, approximately 3mm in width, is made at the corneal margin.

2. Emulsification: Phacoemulsification probe is inserted through corneal incision and ultrasound breaks cataract up into microscopic fragments, which can then be aspirated using the probe tip.

3. Intraocular Lens Implant: The artificial foldable intraocular lens is inserted and, once inside, the lens unfolds.

4. Result: The new lens is in place, the small incision heals naturally without the need for sutures, and vision is restored.

with a significant degree of astigmatism (different degrees of curvature in different axes), resulting in some distortion of images.

In the last two decades, surgery has been greatly refined with the introduction of phacoemulsification. This technique uses high-energy ultrasound waves to fragment the lens into tiny particles, allowing the lens to be removed through a small opening. With this technology and advanced lens technology, it is now possible to perform cataract surgery routinely through openings of approximately 3mm (Figure). Surgical wound architecture also has improved, so it is now possible to make a self-sealing wound when small incision techniques are used. Sutures are not required and patients are allowed to resume virtually all of their usual activities almost immediately after surgery. Small incision surgery also has greatly reduced the problem of postoperative astigmatism.

Anesthesia for cataract surgery has changed dramatically as well. General anesthesia is almost never used and is reserved for patients with severe movement disorders or profound mental impairment who could not otherwise lie
Cataract surgery is extremely successful. In most studies well over 90% of patients achieve 20/40 visual acuity or better, with similar rates of satisfaction. Failure to achieve this level of visual acuity is usually because of the coexistence of other ocular pathology. Complications do occur occasionally. The most frequent complication is rupture of the posterior lens capsule during surgery, which is reported to occur in 1–4% of cases.

Intraocular lens technology has developed rapidly. Lenses made of polymethylmethacrylate have been the standard for years but are now being replaced by lenses made of silicone or acrylic because of their pliability, which allows them to be folded and therefore inserted through smaller wounds. Recently, new lenses have been introduced that have built-in correction for astigmatism. A major goal for synthetic lens developers has been to create a lens that will focus both at near and distant, eliminating the need for glasses. Several attempts in the past at creating multifocal lens implants have failed due to problems with loss of contrast sensitivity. A multifocal lens released in the last few years appears to be somewhat better than its predecessors in terms of contrast sensitivity. However, this new lens has gained only limited acceptance due to occasional intolerance in patients, necessitating explantation.

Several new lens designs presently in the trial phase hold great promise for the future. One design incorporates a flexible hinge between the optic and the support structures that hold the lens implants inside the patient’s own lens capsule. This hinge allows the optic to move forward and backward as the patient’s eye naturally accommodates, changing its position in the eye and therefore changing its relative focusing power. Another design uses a flexible polymer to fill the original lens capsule, which will then behave like the original lens and change configuration when the muscles of accommodation contract. Another exciting lens concept involves the implanting of a lens constructed of heat-sensitive material. After implantation, the focusing strength can be adjusted by burning it with a laser to obtain the most precise focus possible.

Cataract surgery is likely to continue to evolve significantly in the years to come. Most research is currently directed towards refining surgical techniques for the least traumatic methods through the smallest incision possible. The rate of cataract surgery is likely to grow in the future because of anticipated demographic shifts. To date, the only significant preventive measure that has been identified is the regular use of sunglasses when outdoors. Hopefully, future research will identify other preventive measures that can be employed to reduce the need for surgery in the future.

No competing financial interests declared.

References