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Manual Small-Incision Cataract Surgery

By Ankur Nahar BS | Mentor: Brenton D. Finklea MD

Of the 49 million people living with blindness worldwide, 15.2 million are blind due to cataracts, making it the leading cause of preventable blindness.^{1,2} Furthermore, 65.2 million people experience moderate to severe vision impairment from cataracts, according to the World Report on Vision published by the World Health Organization (WHO).³ While global cataract surgery efforts have been a major success over the past three decades, an aging population has resulted in a rapid rise in cataracts, primarily in low- and middle-income countries (LMICs).^{2,4} To address the increasing demand for cataract treatment, countries must perform an equal or greater amount of surgeries than the incidence of cataracts.

LMICs experience a unique set of obstacles to overcome in addressing the cataract surgical need. Methods of cataract surgery via phacoemulsification, as performed in affluent countries, are not suitable due to the unfavorable cost, speed, and availability of this surgical technique. Manual small-incision cataract surgery (MSICS) has, therefore, become the gold-standard in LMICs as a result of its low cost, short case time, and excellent outcomes when compared to phacoemulsification.⁵

Modern MSICS is a technique that cannot be attributed to a single individual but rather has been developed over the past three decades by a cohort of highly skilled

surgeons. One of the first major steps towards modern MSICS was described by Dr. Michael Blumenthal and colleagues in 1992 as a modification to extracapsular cataract extraction (ECCE), where the entire natural lens is removed through a large limbal incision in the eye.⁶ MSICS using the Blumenthal technique requires a 5-7 mm superior scleral incision to extract the cataractous lens. The sclero-corneal tunnel architecture was designed such that when the eye is pressurized, the wound is watertight and requires no sutures for closure. The technique was further modified by Dr. Sanduk Ruit and colleagues in 1999, whose surgical steps have formed the backbone of most current MSICS styles.^{7,8} In Dr. Ruit's technique, the cataract is removed from the eye using an irrigating Vectis, as opposed to the prior Blumenthal technique which utilized an anterior chamber maintainer and hydrostatic force to push the lens out of the eye. Both techniques allow the surgeon to remove the cataract lens en-bloc and without the need to disassemble the cataract into smaller parts. In contrast, standard phacoemulsification surgery uses ultrasonic waves to emulsify and fragment the lens nucleus, which is then removed by suction through a small clear corneal incision.⁹ While phacoemulsification produces excellent results with low complication rates and minimal induced astigmatism, MSICS produces similar visual outcomes with shorter average surgical

times and at a significantly reduced cost.

Speed and outcomes alone were not enough to address the burgeoning cataract rate in third-world countries; an infrastructure that would allow for high-volume and low-cost cataract surgeries was needed. In 1994, Dr. Sanduk Ruit and Dr. Geoffery Tabin created the Himalayan Cataract Project (HCP) to establish an eye care infrastructure in Nepal. By 1999, the team had reduced the cost of MSICS to less than \$20 per surgery and now has programs in underserved areas of the world including Nepal, Ghana, Ethiopia, Bhutan, and India.

A primary reason for the success of HCP was its unique cost-saving measures. For example, HCP adopted a cross-subsidization model where wealthy patients pay a higher fee for the services rendered to support patients who have severely limited means.¹⁰ One critical factor that enabled MSICS to become an inexpensive procedure was the development of low-cost intraocular lenses implanted at the time of surgery. Key to this was the creation of the non-profit Aurolab by the Aravind Eye Hospital in Tamil Nadu, India. Aurolab reduced manufacturing costs by utilizing a workforce predominantly of young women from rural areas who used this internship as a stepping-stone for further career opportunities.¹¹ By maximizing India's labor cost advantage, Aurolab introduced its first intraocular lenses (IOLs) at \$10 compared to about \$105 in the United States.¹² Today, Aurolab produces 19% of the world's IOLs and sells them for as low as \$2.13.

Despite the lower cost and greater efficiency, visual outcomes from MSICS do not significantly differ from phacoemulsification. A landmark prospective randomized control trial by Ruit et al. compared phacoemulsification to MSICS and found comparable best-corrected visual acuities and complication rates with shorter operative time for MSICS.⁵ Furthermore, some academic centers have found a more rapid acclimation to MSICS than to phacoemulsification in those surgeons who have previously trained in ECCE due to the similarities between procedures.¹⁴ Phacoemulsification, on the other hand, does have its benefits. It requires a smaller incision than MSICS (2.2-2.75 mm vs 6-8 mm respectively), which results in improved intraocular pressure control, minor to no astigmatism, and quicker rehabilitation.¹⁵ For these reasons, phacoemulsification continues to be the gold standard in affluent nations. Nevertheless, MSICS will still play a role in treating the most advanced and dense cataracts in all countries regardless of their GDP. When phacoemulsification is used for severely dense cataracts, there is an increased risk for corneal endothelial cell loss and iatrogenic corneal edema.¹⁶ Future efforts in modernizing MSICS will focus on minimizing induced astigmatism while maintaining the endothelial-friendly aspects of the procedure.

The success of high-volume MSICS centers throughout the world is a testament to the individual and combined efforts of the many surgeons and public health professionals who have dedicated their lives to treating avoidable blindness. Several barriers

remain as gender, socioeconomic status, poor health literacy, and the perceived cost of eye care continue to limit patients from accessing these sight-saving surgeries.³ Women in LMICs are significantly less likely to undergo cataract surgery than men as they may have limited financial decision-making power or barriers preventing access to transportation.¹⁷ Others may perceive vision loss as a normal part of aging and are thus less likely to seek care.³ Future efforts to combat cataracts worldwide must not only address accessibility of a low-cost cataract surgery infrastructure but also take into account the unique socioeconomic and cultural milieu of each region. A multifaceted approach, which examines the broad spectrum of risk factors for and barriers to cataract surgery, will bring us one step closer to eradicating preventable blindness throughout the world.

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