

World Sight Day: Singapore's Contribution to Alleviating Corneal Blindness

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World Sight Day which falls on October 11 this year is an annual day of awareness to focus global attention on blindness, visual impairment and rehabilitation of the visually impaired. This editorial focuses on Singapore's contributions and roles in alleviating corneal blindness, one of the more common causes of blindness in Asia.

World Health Organization (WHO) currently estimates that there are 285 million who are visually impaired worldwide, of which 39 million are blind, and a further 246 million people have low vision. Ninety percent of global blindness is found in the developing world, namely Africa and Asia, and Singapore lies in close proximity to neighbouring countries which have the highest prevalence of blindness. The major global causes of visual impairment are uncorrected refractive errors (myopia, hyperopia, or astigmatism), cataract, glaucoma, and age-related macular degeneration. While corneal blindness has been suggested to be the fourth leading cause of world blindness, after taking trachoma, onchocerciasis, other eye infections and vitamin A deficiency (which causes corneal and ocular surface damage) into consideration, it in fact becomes the major collective cause of global blindness after cataract.¹

While clearly the solution to corneal blindness lies in preventative strategies, there are still millions of people who are currently blind from a wide variety of degenerative, dystrophic, infectious and inflammatory corneal disorders, and corneas remain the most commonly transplanted tissue worldwide, with an estimated 100,000 corneal transplants performed annually. It is inevitable that eye banks globally cannot match this demand, thus resulting in long corneal transplant waiting lists in majority of the developing countries, especially in Asia.

In Asia, Singapore has taken a lead in corneal blindness prevention, in several ways. The Asia Cornea Society (ACS), a professional non-profit organisation of corneal specialists within the Asian region, was formed in 2007. Headquartered at the Singapore National Eye Centre (SNEC), ACS has spearheaded major clinical, educational and research initiatives to alleviate corneal blindness in Asia. As part of its educational initiative, ACS holds biannual scientific corneal meetings around Asia, with host countries to date including

Singapore and Kyoto, and an upcoming meeting in Manila this November. ACS also organises corneal symposia at major regional and international ophthalmology meetings throughout Asia, Europe and the United States (US). Next year, ACS will launch a new educational initiative in the form of an international database of corneal fellowship training opportunities, to provide fellowship training opportunities for young corneal specialists, starting both in the US and throughout Asia, in collaboration with the International Cornea Society. The close linkage between ACS and the US-based Cornea Society has come about fortuitously because the author, who is currently the President of ACS was also elected this year to be the concomitant President of the Cornea Society, and is its first international president.

ACS has also embarked on an ambitious multinational study on infectious keratitis, the ACS Infectious Keratitis Study (ACSIKS). Again headquartered in SNEC, ACSIKS with 11 clinical sites in 8 Asian countries (China, India, Japan, Korea, Taiwan, Thailand, Philippines and Singapore), aims to recruit in excess of 6000 patients for this study, the largest of its kind worldwide. It also aims to garner an invaluable central repository of both bacterial and fungal isolates for subsequent future research into antibiotic susceptibility profiles across different Asian communities and other forms of antimicrobial research. Finally, to tackle the issue of inadequate high quality corneas and variable eye banking practices across Asia, ACS formed the Association of Eye Banks of Asia (AEBA), with representation of major eye banks in Asia. To date, besides drafting a preliminary Asian medical standard for eye banking practices, AEBA has also spawned the concept of model eye banks to serve as centres of excellence in eye banking. In collaboration with AEBA, the Singapore Eye Bank (SEB) established a new model eye bank in Colombo, Sri Lanka, in collaboration with the Sri Lankan health ministry. Opened in February 2011, the National Eye Bank of Sri Lanka (NEBSL) to date has acquired over 500 corneas for transplantation, with an unprecedented 88% donor consent rate. At present, NEBSL has not just fulfilled the demand for corneas within Sri Lanka, but is also exporting corneas to Singapore. SEB and NEBSL are currently working in tandem to organise

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exportation of corneas to other Asian countries, through Singapore.

Over the last 2 decades, Singapore's significant contribution in corneal transplantation research has earned her mark as a centre of excellence in corneal transplantation. Today, at the Singapore National Eye Centre, almost 50% of the transplants involve overseas patients who fly in from the region to benefit from the trials and clinical transplant programmes. Our role in the development of new forms of lamellar transplant surgery have resulted in greatly improved outcomes and cornea graft survival, and the major review of these new advances in corneal transplantation has just been published in the May 2012 issue of the *Lancet*. Also, during this period, over 200 scientific articles in corneal research have been published from our group at SNEC and the Singapore Eye Research Institute (SERI), including 5 other invited reviews on corneal transplantation.²⁻⁷

The Singapore Corneal Transplant Database (SCTS), one of the largest clinical databases of corneal transplantation, has tracked over 5500 transplants since 1991.^{8,9} Analysis of SCTS data has shown that the newer forms of corneal transplantation have rapidly replaced the more conventional full-thickness penetrating keratoplasty (PK) procedure, thus resulting in significant improvements in long-term graft survival, better visual outcomes, and reduced allograft rejection and other postoperative complications. Termed Selective Lamellar Keratoplasty, these newer forms of transplants now represent 80% of all transplants performed in SNEC (possibly the highest percentage of lamellar keratoplasty worldwide); they involve targeted lamellar replacement of selected corneal layers, and include the new procedures of deep anterior lamellar keratoplasty (DALK) which replaces the corneal stroma leaving the healthy endothelial layer intact, and various evolving forms of endothelial keratoplasty (EK), in which only the inner endothelial layer of the cornea is replaced, of which Descemet's Stripping Automated Endothelial Keratoplasty (DSAEK) is the most common EK procedure. Our most recent audit of graft survival shows that while the 1-year graft survival for PK, DALK and DSAEK are fairly similar, namely, 90%, 96% and 97%, the 4-year graft survival rates are 70%, 87% and 95%, respectively, showing enhanced graft survival of DALK and DSAEK procedures over conventional PK surgery, clearly demonstrating the case for conversion to the selective lamellar procedures (Table 1 and Fig. 1).

DSAEK is a sutureless, small incision replacement of posterior stroma and endothelium, and from our National Research Foundation (NRF) funded Translational Clinical Research (TCR) Flagship Grant, we developed the patented Tan EndoGlide, currently the leading donor inserter surgical device which has the lowest published

Table 1. Corneal Graft Survival Rates from SNEC's 2012 Clinical Audit Data

SNEC Clinical Audit Data	PK (n = 1117)	ALK (n = 276)	DSAEK (n = 210)
1-year survival rate	90%	96%	97%
2-year survival rate	80%	94%	95%
3-year survival rate	74%	92%	95%
4-year survival rate	70%	87%	95%
5-year survival rate	65%	83%	-

PK: Penetrating Keratoplasty; ALK: Anterior Lamellar Keratoplasty; DSAEK: Descemet's Stripping Automated Endothelial Keratoplasty

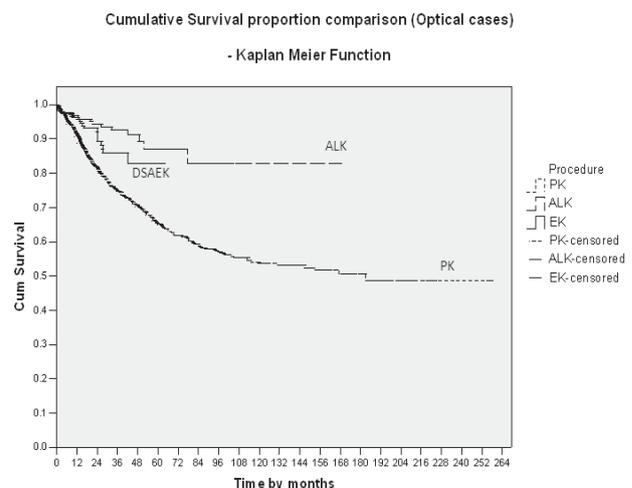


Fig. 1. Kaplan Meier Graft Survival: SCTS database. DSAEK: Descemet's stripping automated endothelial keratoplasty; DALK: Deep anterior lamellar keratoplasty; PK: Penetrating keratoplasty

1-year corneal endothelial cell loss rate of 15%, halving the conventional cell loss rate of 30%.⁴ The newest SERI innovation is the development of the Descemet's Mat (D-Mat) device, a polymer mat carrier, used in clinical trials for the latest surgical procedure of Descemet's Membrane Endothelial Keratoplasty (DMEK). In this procedure, only pure descemet's membrane and the endothelial layer are transplanted and introduced into the eye using the D-Mat device. Currently, corneal clinicians and researchers in SERI and SNEC are actively engaged in the research on human corneal endothelial cell culture, development of the artificial cornea, and development of new femtosecond laser procedures in corneal surgery.

Corneal blindness remains a major cause of blindness in our part of the world. Singapore will continue to play a significant role in alleviating corneal blindness through our corneal transplantation programmes and research efforts to develop new therapies, and through advocacy for corneal subspecialty development and eye banking in the region.

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