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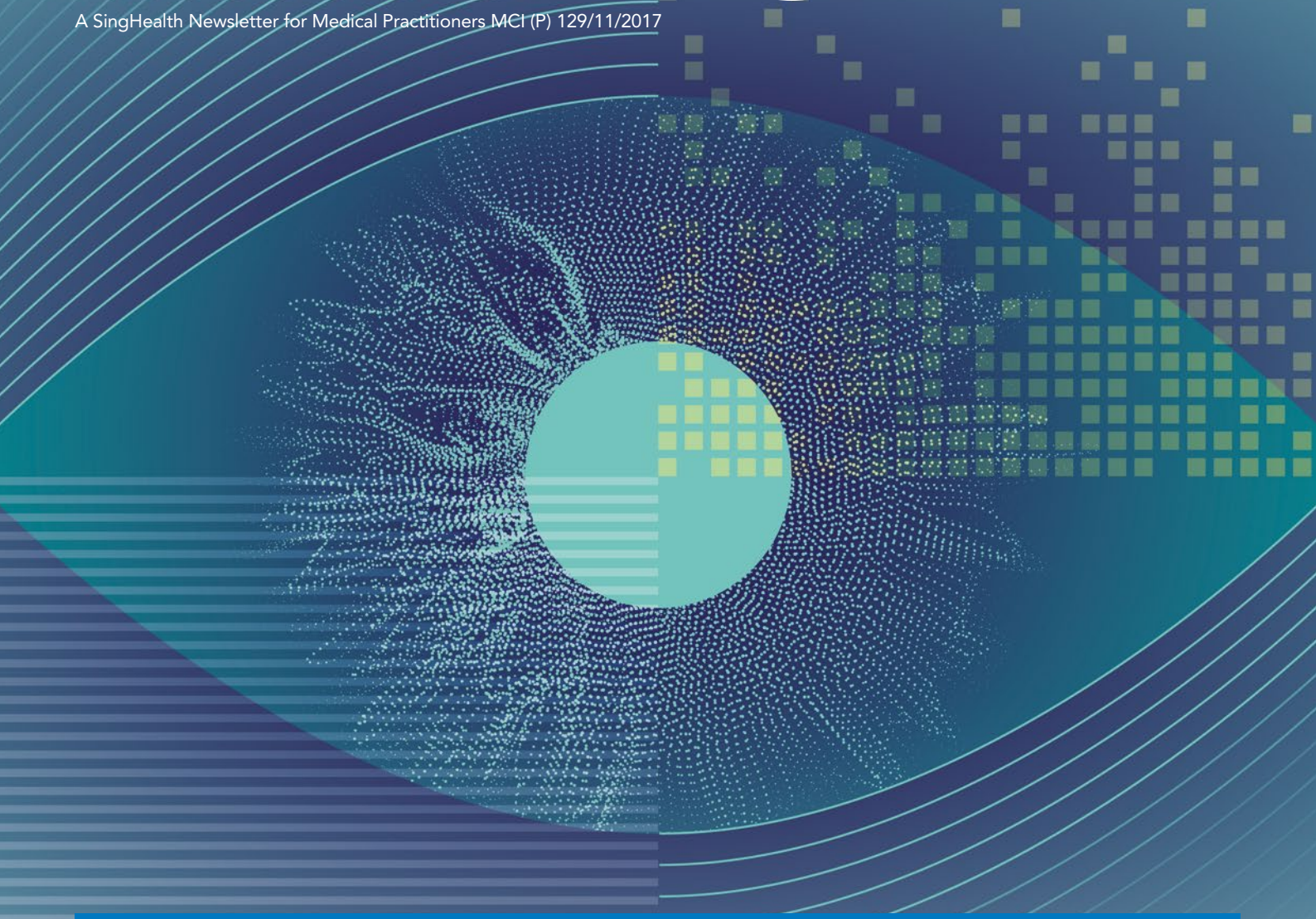

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Update On Glaucoma Surgery – Minimally Invasive Glaucoma Surgery

Dr Annabel Chew, Consultant, Department of Glaucoma, Singapore National Eye Centre

INTRODUCTION

Glaucoma is an optic neuropathy with characteristic changes in the optic nerve head and visual field. It is a leading cause of irreversible blindness worldwide. The number of people with glaucoma in Asia is estimated to increase to 59.51 million in 2020, and 80.87 million in 2040.[1]

From the Singapore Chinese Eye Study, the age-standardised prevalence of glaucoma in Singapore is 3.2%.[2] Currently the Intraocular Pressure (IOP) is the only modifiable risk factor, and lowering it is the only proven treatment to reduce disease progression. Treatment is life-long, and can be achieved with topical medications, laser or surgery.

Poor adherence to glaucoma medications and multiple side effects, including ocular surface toxicity, are major barriers to effective medical therapy. Non-compliant rates of at least 25% are commonly reported in glaucoma patients.[3]

While the conventional trabeculectomy and tube shunt surgeries are effective in lowering the IOP, they carry significant surgical risks and are usually offered to patients with more severe disease or uncontrolled IOP on maximum tolerated medical therapy.[4]

NEW SURGICAL PROCEDURES

In recent years, a new group of surgical procedures known as Minimally Invasive Glaucoma Surgery (MIGS) have emerged. They lower the IOP by increasing drainage of the intraocular fluid (aqueous humour) with minimal dissection and tissue disruption.

They have shown promising results in the short-to-medium term, and have a higher safety profile and faster recovery time than conventional glaucoma surgeries.

As there is less IOP reduction compared to conventional glaucoma surgeries, these procedures are targeted at patients with mild to moderate glaucoma. They can be performed together with cataract surgery, or as a stand-alone procedure.

1. **Schlemm's Canal Devices**

iStent

The **iStent** (Glaukos Corporation, Laguna Hills, CA, USA) is a 1mm snorkel-shaped titanium device that increases drainage of the intraocular fluid. The device is injected into the Schlemm's canal, a part of the eye's drainage system, from the inside of the eye using a special viewing contact lens. It was FDA-approved in 2012.

The largest multicentre trial studying the device found that more eyes that underwent phacoemulsification with a single iStent implantation had controlled IOP without glaucoma medications, compared to phacoemulsification alone at 1 year (72% versus 50%, P<0.001), and 2 years (61% versus 50%, P=0.036).[5,6]

Two meta-analyses concluded that iStent implantation is effective in reducing the IOP and the number of glaucoma medications, either combined with phacoemulsification, or as a solo procedure.[7, 8]

For iStent as a solo procedure, the IOP reduction was 22% at 18 months after 1 implant, 30% at 6 months after 2 implants, and 40% at 6 months after 3 implants.[8]

iStent Inject

Currently there is a newer, second generation implant, called the **iStent Inject** (Glaukos, Laguna Hills, CA, USA). The new device has a cone-shaped design for easier implantation, and a modified injector that can be simultaneously loaded with 2 stents *(Refer to Figure 1)*.

Figure 1 The iStent Inject is the world's smallest medical implant. It allows aqueous humour to drain directly from the anterior chamber into the Schlemm's canal, increasing aqueous outflow.

A prospective multicentre study has found that following implantation of 2 iStent Injects, majority of the patients (86.9%) achieved a reduction in the number of glaucoma medications.[9]

There were few to no adverse events reported following implantation of the iStent and iStent Inject.

Hydrus Microstent

The Hydrus Microstent (Ivantis Inc, Irvine, California, USA) is an 8mm nitinol device. Like the iStent, it is also injected into the Schlemm's canal, a part of the eye's drainage system, from the inside of the eye. It acts as a scaffold, and dilates 3 clock hours of the canal, promoting circumferential flow of the intraocular fluid into the drainage system *(Refer to Figure 2).*

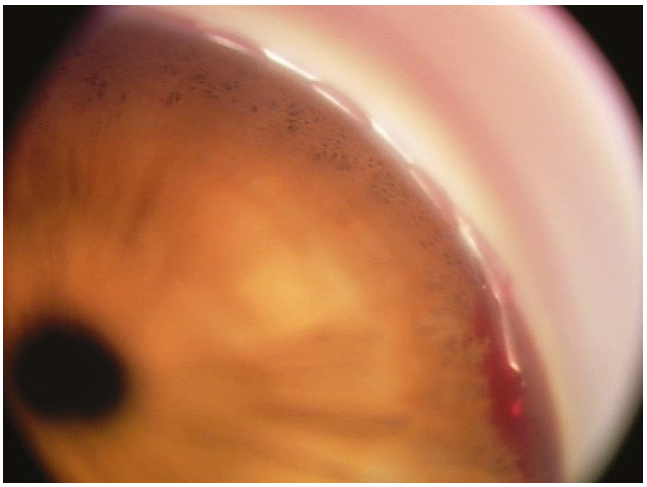

Figure 2 An intraoperative photo of the Hydrus Microstent after it has been implanted into the Schlemm's canal.

The multicentre HYDRUS II study randomised 100 patients with open angle glaucoma and cataracts to undergo either cataract surgery with Hydrus Microstent or cataract surgery alone.[10]

At 24 months, there was a significantly lower diurnal IOP in the eyes with the Hydrus Microstent (16.9 +/- 3.3mmHg versus 19.2 +/- 4.7mmHg, P=0.0093), and a greater proportion of eyes with the Hydrus Microstent not on glaucoma medications (73% versus 38%, P=0.008), compared to eyes with cataract surgery alone. Adverse events were similar in the 2 groups.

In another multicentre study, there was a significant IOP lowering, following cataract surgery with Hydrus Microstent implant in eyes with primary open angle glaucoma, with an average drop in IOP of 4mmHg from baseline at 2 years post implantation (P<0.001), and 64% of the patients were medication-free.[11]

2. Subconjunctival Devices

XEN Gel Implant

The XEN Gel Implant (Allergan, Dublin, Ireland) is a biocompatible 6mm porcine collagen-derived gelatin tube, that is inserted from the inside of the eye into the subconjunctival space. That is the space between the outer membrane of the eye (conjunctival) and the white wall of the eye (sclera).

Conjunctival dissection is avoided, unlike in conventional glaucoma surgery. The inner lumen size of 45microns and the tube length provide flow restriction to minimise excessive lowering of the IOP. Aqueous drains into the subconjunctival space and a bleb is created. It was FDA-approved in 2016.

A multicentre cohort study of 354 eyes compared the efficacy and safety of the XEN Implant to trabeculectomy in various types of uncontrolled glaucoma (primary and secondary open angle glaucoma, and primary angle closure glaucoma).[12]

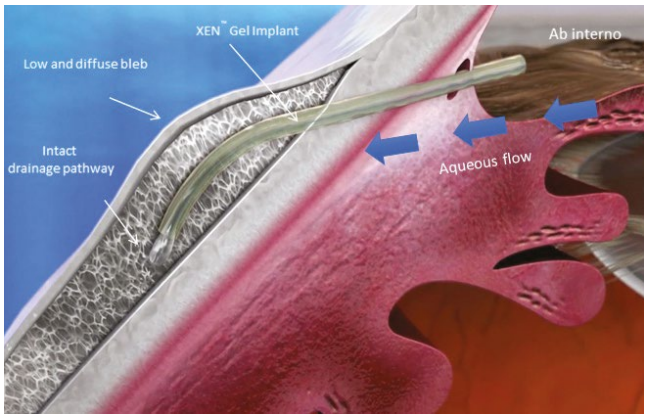

Figure 3 The XEN Gel Implant drains aqueous from the anterior chamber into the subconjunctival space.

There was comparable IOP reduction, overall success rates and safety for both procedures up to 30 months of follow-up. The preoperative median IOP was 24mmHg, and that was reduced to 13mmHg postoperatively in both groups. Bleb needling was higher in the XEN group (43% versus 31%) *(Refer to Figure 3).*

3. Suprachoroidal Devices

CyPass Micro-Stent

The CyPass (Alcon, Fort Worth, TX, USA) is a fenestrated 6.35mm long polyamide implant, that is inserted from the inside of the eye into the suprachoroidal space between the white wall of the eye (sclera) and the thin layer of tissue behind the retina (choroid). The CyPass Micro-Stent was FDA-approved in 2016.

The CyPass device demonstrated a sustained 2-year reduction in IOP and glaucoma medications in patients

with mild to moderate primary open angle glaucoma in the multicentre COMPASS trial.[13] There were 505 patients who underwent either phacoemulsification with CyPass or phacoemulsification alone.

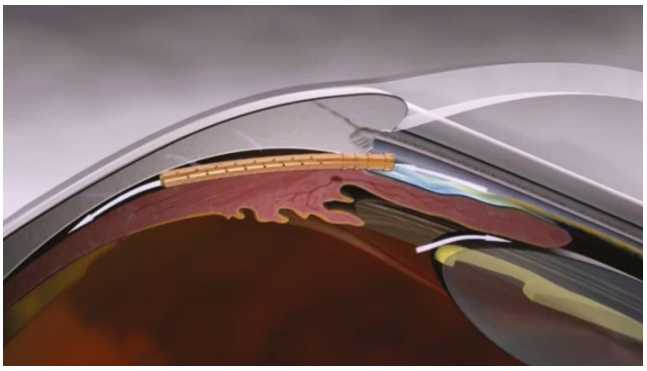

Figure 4 The CyPass Micro-Stent drains aqueous from the anterior chamber into the suprachoroidal space.
Figure is taken with permission from myalconstore.com.

At 2 years, the mean IOP reduction was greater in the CyPass group compared to the control group (7.4mmHg versus 5.4mmHg, P<0.001), and more patients in the CyPass group were medication-free (85% versus 59%, P<0.001).

Reported adverse effects were usually transient and did not affect the visual outcomes (*Refer to Figure 4).*

CONCLUSION

Current data suggest that MIGS can benefit patients with mild to moderate open angle glaucoma in the short-to-medium term, with a good safety profile. While they provide more surgical options to patients with less severe disease, further studies are needed to determine their long-term safety and efficacy.

The iStent Inject, Hydrus Microstent, and XEN Gel Implant are currently available at the Singapore National Eye Centre (SNEC). The CyPass Micro-Stent is still pending HSA approval.

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Endothelial Keratoplasty and Emerging Therapies for Corneal Endothelial Disease

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INTRODUCTION

Corneal transplantation or keratoplasty has evolved rapidly over the past decade. While Penetrating Keratoplasty (PK) may still be the dominant procedure of choice for the optical correction of corneal diseases worldwide, the advent of newer selective lamellar transplantation techniques has sparked a paradigm shift in the surgical management of corneal diseases.

Instead of replacing all layers of the cornea (as in PK), lamellar keratoplasty selectively replaces only the diseased component of the cornea, namely *Anterior Lamellar Keratoplasty* (ALK) in corneal stromal diseases without endothelial dysfunction, and *Endothelial Keratoplasty* (EK) in cases where only the endothelium is compromised.[1]

In this article, we will focus on the evolution of endothelial keratoplasty techniques, and emerging therapies on the horizon, for the treatment of corneal endothelial diseases.

DISEASES OF THE CORNEAL ENDOTHELIUM

Pathophysiology

The cornea comprises of five main layers: the epithelium, Bowman's membrane, stroma, Descemet Membrane (DM) and the endothelium.

The endothelium is the monolayer of cells that lines the posterior corneal surface, which is derived from the neural crest during embryologic development.

The metabolically active endothelium serves the important function of maintaining the health and clarity (and therefore transparency) of the corneal stroma through ensuring stromal deturgescence, by both acting as a barrier to fluid movement into the cornea and osmotically drawing water into the aqueous humour as an active pump.

Corneal endothelial cells, however, have a poor capacity for regeneration when lost due to any traumatic insult or disease.

With significant attrition of endothelial reserves below a critical level needed to maintain corneal deturgescence, the cornea is said to have "decompensated", heralding the onset of edema which disrupts the orderly lamellar organisation and critical spacing of collagen fibrils within the stroma and in turn, degrades the optical transparency of the cornea *(Refer to Figure 1)*.

Etiology

Diseases of the corneal endothelium may be broadly classified into **primary** and **secondary corneal endotheliopathies**.[2]

The most common **primary endotheliopathy** is Fuchs' Endothelial Corneal Dystrophy (FECD), an inherited bilateral disease which becomes evident from the fifth decade onwards *(Refer to Figure 2)*. It is characterised by slowly progressive corneal endothelial dysfunction and guttate excrescences on the posterior corneal surface *(Refer to Figure 3)*. Various genetic loci and mutations have been found in both adult and early-onset disease. A gender preponderance towards females is also well recognised in this disease.

Other primary endotheliopathies include posterior polymorphous dystrophy, congenital hereditary endothelial dystrophy

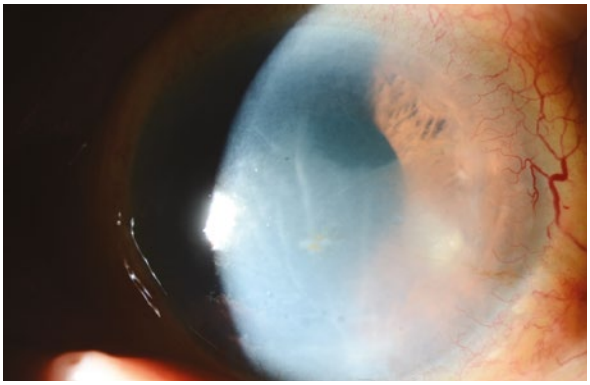

Figure 1 Corneal decompensation

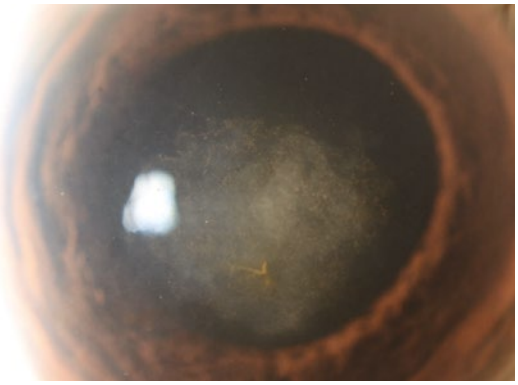

Figure 2 Fuchs' endothelial corneal dystrophy

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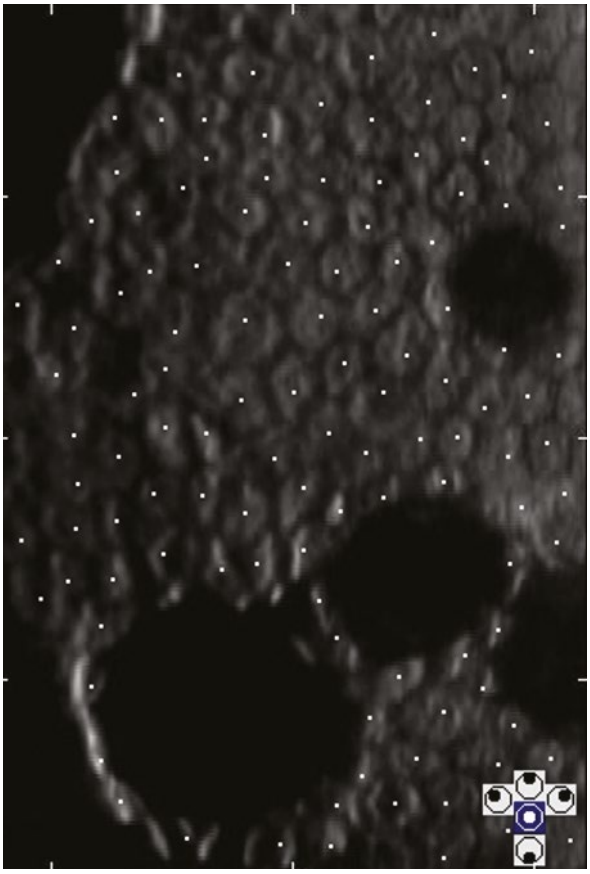

Figure 3 Corneal guttata as seen on specular microscopy

in the paediatric age group and iridocorneal endothelial syndrome, of which the clinical details and characterisation are beyond the scope of this article.

Secondary corneal endotheliopathies may be the result of any extrinsic factor or ocular condition which contributes to the loss of endothelial cell structure and function, including intraocular surgery (in particular cataract extraction), laser peripheral iridotomy performed in eyes with angle closure, chronic ocular inflammation (such as uveitis and viral endothelitis), glaucoma and contact lens use.

Of these, corneal decompensation after cataract surgery or Pseudophakic Bullous Keratopathy (PBK) is a major indication for corneal transplantation worldwide and locally *(Refer to Figure 4)*. Depending on the amount of surgical trauma, a variable extent of endothelial cell loss is usually expected 1 to 5 days after cataract surgery.

Even after these initial cell losses, it has been shown that endothelial cell attrition continues at a rate of 2.5% for at least 10 years after surgery, around 4 times higher than the average rate of 0.6% in unoperated eyes.[2]

Clinical Presentation

Clinical manifestations of corneal endothelial dysfunction may range from mild to severe.

Before the onset of frank corneal decompensation and edema, many patients may be asymptomatic and features of dystrophy seen in FECD or posterior polymorphous dystrophy may be incidentally detected during a routine ophthalmic examination.

- Common to all eyes with corneal decompensation and edema, patients may then experience increasing glare and blurred vision.

  Patients with FECD may often complain of such symptoms being worse in the morning due to the build-up of corneal edema with lid closure overnight.

- In advanced cases of corneal decompensation, epithelial edema and bullae formation from large separations of epithelium from the underlying Bowman's membrane may result in pain and ocular surface grittiness.

- Occasionally, such patients may present with acute eye pain, redness and tearing if the bullae ruptures to form an epithelial defect (or abrasion) over the cornea, which may also be prone to secondary infection.

IMPACT OF FUCHS' ENDOTHELIAL CORNEAL DYSTROPHY AND BULLOUS KERATOPATHY WORLDWIDE AND IN SINGAPORE

Fuchs' endothelial corneal dystrophy and bullous keratopathy (predominantly pseudophakic) are the major indications for corneal transplantation globally.

Interestingly, there are clear differences in the disease indications for corneal transplantation between developed (mainly Western) countries (such as the United States, the United Kingdom, Italy, France, Australia), in which FECD was the major indication, and less developed countries (mostly in Asia, Africa and the Middle East), where PBK was the main indication for surgery, accounting for 31%-38% of cases.[3]

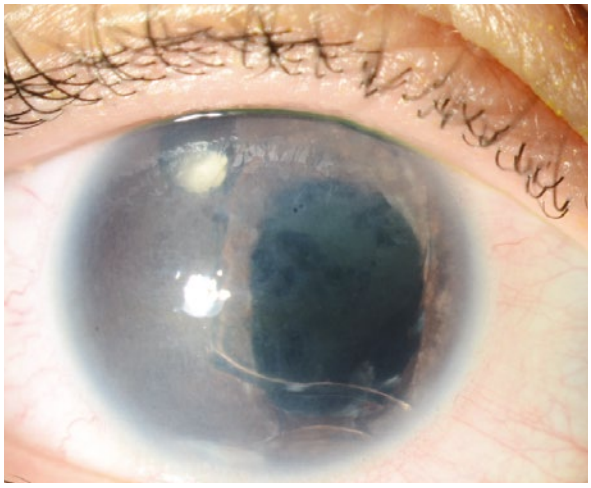

Figure 4 Pseudophakic bullous keratopathy secondary to an anterior chamber intraocular lens

In Singapore, PBK alone accounted for 32.4% and 46.6% of penetrating and endothelial keratoplasty done at the Singapore National Eye Centre (SNEC) between 2000 and 2011 respectively. Comparatively, only 10.1% of PK and 32.0% of EK cases were performed for FECD locally.[3]

ENDOTHELIAL KERATOPATHY: CURRENT STANDARD OF CARE

Over the past decade, endothelial keratoplasty has overtaken penetrating keratoplasty as the corneal transplantation technique of choice for endothelial diseases, as a result of its superior safety profile, as well as more rapid and predictable visual outcomes as compared to PK.

Briefly, **penetrating keratoplasty** is a full thickness transplantation procedure, in which the host diseased cornea is trephined and completely excised before a full thickness corneal graft is sutured to the recipient bed *(Refer to Figure 5)*. It is a relatively undemanding technique which can be employed for all forms of corneal disease (stromal and/or endothelial) and potentially offers the best optical result due to the absence of a lamellar corneal interface.

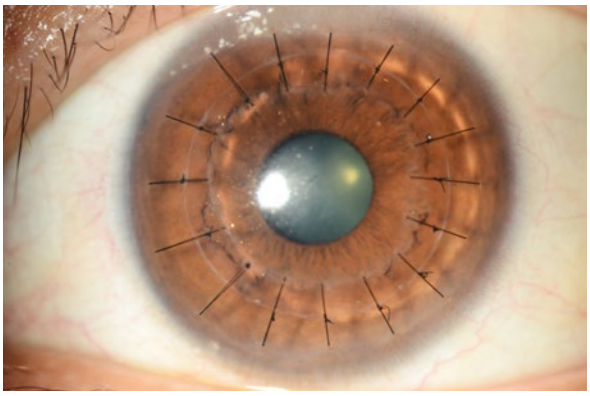

Figure 5 Penetrating keratoplasty

However, endothelial failure with cell loss of 30%-40% at the time of surgery, followed by progressive attrition of endothelial cells for 10 years after the procedure, is a major cause of graft failure.

Penetrating keratoplasty is also associated with a high risk of graft rejection estimated at 20% by 5 years, which may adversely affect long-term graft survival. The full-thickness, "open-sky" surgical approach in PK may also be associated with serious complications, such as suprachoroidal haemorrhage and endophthalmitis, often with blinding consequences.[1]

Endothelial Keratoplasty (EK), on the other hand, involves stripping the host Descemet's membrane and endothelium, and attachment of the donor endothelium and Descemet's membrane, with or without residual donor stromal tissue.

Over the years, EK techniques have evolved to be progressively selective in the layers of corneal replacement. From:

- **Deep Lamellar Endothelial Keratoplasty (DLEK)** with donor tissue comprising of stroma and endothelium,
- **Descemet Stripping Endothelial Keratoplasty (DSEK)** with a thinner stromal layer,
- **Descemet Stripping Automated Endothelial Keratoplasty (DSAEK)**, in which donor tissue is prepared with an automated microkeratome, to finally:
- **Descemet Membrane Endothelial Keratoplasty (DMEK)** with the transplantation of only Descemet membrane with endothelium, without any donor stromal tissue.

i. Descemet Stripping Automated Endothelial Keratoplasty (DSAEK)

With progressive refinement in surgical technique and donor preparation by eye banks, DSAEK has rapidly emerged as the main EK technique among surgeons and replacing PK as the procedure of choice for endothelial disease *(Refer to Figure 6)*.

Chiefly, DSAEK offers faster visual rehabilitation compared to PK, due to the reduction of surgically induced astigmatism as fewer sutures are used. Many of the disadvantages of PK, such as suture-related complications, graft rejection and wound dehiscence, are also greatly reduced in DSAEK.[1]

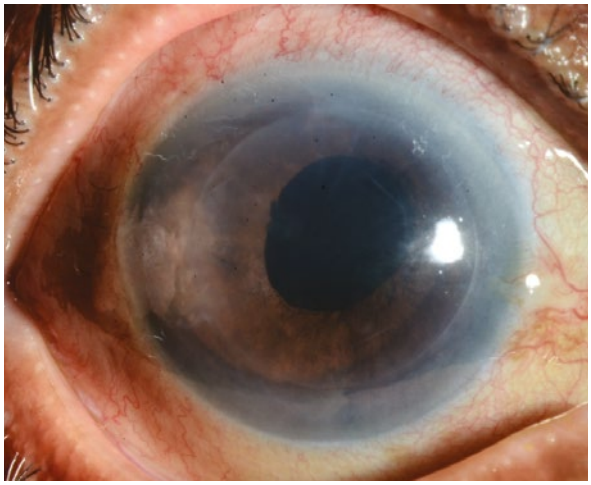

Figure 6 Descemet stripping automated endothelial keratoplasty

ii. Descemet Membrane Endothelial Keratoplasty (DMEK)

DMEK represents the next step in the evolution of EK technique. Despite all the benefits of DSAEK, the presence of residual stroma tissue in the donor may contribute to a postoperative hyperopic shift in the patient's refraction and in some cases, suboptimal visual recovery.

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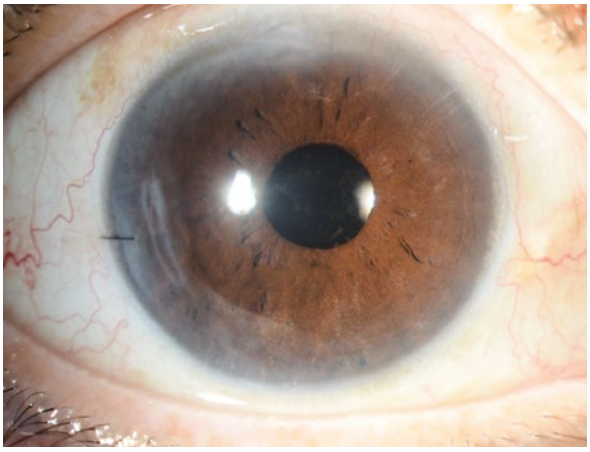

Figure 7 Descemet membrane endothelial keratoplasty

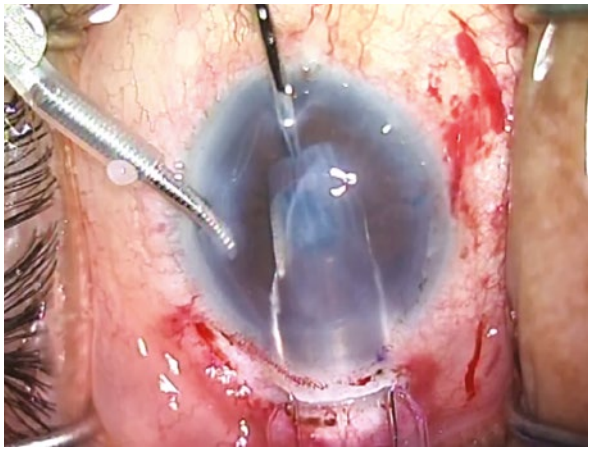

Figure 8 EndoGlide insertion of donor tissue

DMEK overcomes this issue through a more anatomically accurate replacement of only donor Descemet Membrane (DM) and endothelium without any stromal tissue, potentially leading to a more rapid visual recovery with minimal refractive change *(Refer to Figure 7)*.

Other purported advantages of DMEK include better visual outcomes and a lower risk of graft rejection, requiring a shorter, less intensive postoperative steroid regimen with a lower likelihood of elevated intraocular pressure and glaucoma.

However, difficulty in donor preparation and the technically demanding nature of DMEK surgery has thus far limited its widespread adoption.[4]

THE SINGAPORE NATIONAL EYE CENTRE (SNEC) EXPERIENCE

Singapore National Eye Centre (SNEC) performs approximately 85% to 90% of all corneal transplantations in Singapore.

All transplantations done in SNEC are tracked by the Singapore Corneal Transplant Study (SCTS), an ongoing prospective registry maintained by the Singapore Eye Bank, which is the national eye bank in Singapore supplying corneal tissues.[3]

The SNEC Endothelial Keratoplasty (EK) programme was started in 2006 and since then, we have had a high adoption rate, with over 50% of all corneal transplantations being EK from 2012.

Our surgical technique has evolved with time in order to adapt to the unique configuration of the Asian eye (generally smaller, shallower anterior chamber and higher posterior vitreous pressure), which made EK surgery more challenging.

We started with the standard taco-folding technique at that time (donor folded into a taco shape before insertion into anterior chamber) and progressed to adopting pull-through techniques using either the Busin Glide (donor coiled into an open-ended metal spatula inserted through a temporal wound and pulled into eye by a coaxial forceps from a nasal paracentesis) or Sheets Glide (donor placed on a plastic sheet inserted through the wound into the anterior chamber).

One of the key innovations which our centre has contributed to the field of EK surgery was the development of a donor inserter device, the **EndoGlide**, which improved the surgical control of both the donor tissue and anterior chamber dynamics during insertion *(Refer to Figure 8)*.

This resulted in a lower endothelial cell loss of 13.1% and 15.6% at 6 and 12 months after surgery respectively, much lower than those published with the taco-folding and Busin Glide techniques.[5] Given the technical advantages, short learning curve and better donor endothelial cell preservation, EndoGlide DSAEK very quickly became the donor insertion method of choice in our centre and has also been widely adopted worldwide.

Our data has shown that the 5-year graft survival of DSAEK (79.4%) was superior to that of PK (66.5%) with a lower rate of endothelial cell loss seen in DSAEK (48.7%) over PK (60.9%).[6]

In our hands, DSAEK also provided significantly better long-term best spectacle corrected visual acuity and lower astigmatism, compared to PK over 5 years of follow up.[7]

In recent years, our centre has increasingly performed DMEK, as an alternative to DSAEK for patients with endothelial dysfunction and corneal decompensation, with more than 150 cases done to date.

Two main surgical techniques of donor insertion are used in our centre, namely with a glass injector and the EndoGlide, in which a thin layer of stromal layer is retained as a carrier for the thin donor graft to improve handling characteristics, before the donor is pulled through into the anterior chamber.

Unpublished data from our series have suggested better graft survival in DMEK over DSAEK and PK, with lower rates of graft rejection and postoperative elevation of intraocular pressure or glaucoma.

EMERGING THERAPIES

There is now mounting interest in medical, cell and gene therapies, which have emerged as potential alternatives to keratoplasty in the management of endothelial dysfunction over the past few years.[8]

Rho-associated Kinase (ROCK) inhibitors have been extensively studied as a novel pharmacological adjunct in the management of endothelial disease, in particular FECD.

The agent, Y-27632, first demonstrated efficacy in stimulating corneal endothelial regeneration via enhancement of *endothelial cell proliferation, migration and adhesion* in in vitro experiments. These effects were also replicated in subsequent in vivo animal models and ex vivo studies. However, the safety and efficacy of ROCK inhibitors have not yet been evaluated in adequately power human clinical trials.

With the vast improvements made in techniques used to enhance both the quality and quantity of cultured human corneal endothelial cells, cell therapy with the introduction of engineered endothelial cells onto the posterior corneal surface to replace or reform the endothelial cell layer, represents a promising approach to treating corneal endothelial disease.

Different methods of delivery of these cells, either by **direct injection** into the anterior chamber or **via a cell carrier**, have been proposed.

With the **cell carrier approach**, synthetic or biological endothelial grafts may be constructed by seeding the cultured endothelial cells at physiological density (which may be controlled, hence overcoming the issue of biological variability of endothelial cell count in cadaveric donors) onto a thin, transparent biomimetic material. These tissue-engineered grafts may then be inserted into the recipient using techniques similar to DSEK or DMEK. A clinical trial to evaluate the safety and efficacy of this technique will soon be conducted at our centre.

Lastly, with advances made in our understanding of the genetic basis of FECD and drawing from the experience and clinically promising results of novel gene therapy modalities in the treatment of other trinucleotide repeat diseases, such an approach may also be applicable to FECD in the future.

CONCLUSION

Endothelial Keratoplasty (EK), which provides excellent clinical results in the form of **improved visual outcomes, faster visual recovery, higher graft survival rate and a lower rate of postoperative complications** compared to PK, will likely remain the mainstay of treatment for corneal endothelial diseases in the near future.

Various novel cell and gene therapies, as well as pharmacological adjuncts, are on the horizon in this rapidly evolving field.

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Common Strabismus in Children: A Brief Overview

Dr Tay Su Ann, Consultant, Department of Paediatric Ophthalmology and Strabismus, Singapore National Eye Centre

Strabismus or squint is a condition where there is a misalignment of the eyes. The types of strabismus vary among different age groups and present differently in different parts of the world. In Asia, exotropias or divergent squints are the most common type of strabismus, consisting of 65%-85% of total childhood strabismus. On the flip side, esotropias or convergent squints are 2-4 times more common in the West than exotropias.

It is important to distinguish a comitant from an incomitant squint. **A comitant squint** is one where the angle of the ocular deviation is similar in all directions of gaze, whereas an **incomitant squint** is one where there is a difference in the angle of the deviation in different directions of gaze.

Comitant squints are characteristically found in patients with congenital or early-onset strabismus. On the other hand, *incomitant squints* are usually a result of a restrictive cause (a tight intraocular muscle in thyroid eye disease), or a paralytic cause (an acute sixth nerve palsy causing limitation in abduction of the lateral rectus muscle on the affected side). As a result, limitation of eye movement is usually present in such cases and is an important differentiating factor *(Refer to Figure 1)*.

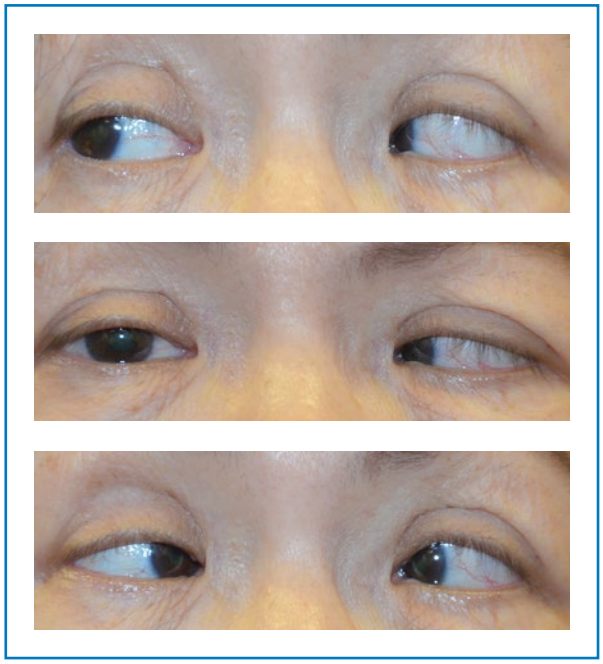

Figure 1 Patient with a left sixth nerve palsy showing an incomitant esotropia. The esotropia is significantly larger in left gaze due to the limitation of abduction of the left eye.

This article will focus mainly on comitant squints encountered in children, their features, and treatment and clinical assessment.

ESOTROPIA

Pseudoesotropia

In a survey performed at the Singapore National Eye Centre (SNEC) and KK Women's and Children's Hospital (KKH) from 2000-2002, pseudoesotropia was found to be the most commonly encountered 'squint' in our clinics. This is due to Asian babies having a flatter nose bridge and wider epicanthic folds, giving the false impression of a convergent squint *(Refer to Figure 2)*.

While reassuring parents that their child does not have a true squint, this does not mean they will not develop an actual strabismus later in life, and parents need to be advised to return if there is a change in the eye alignment.

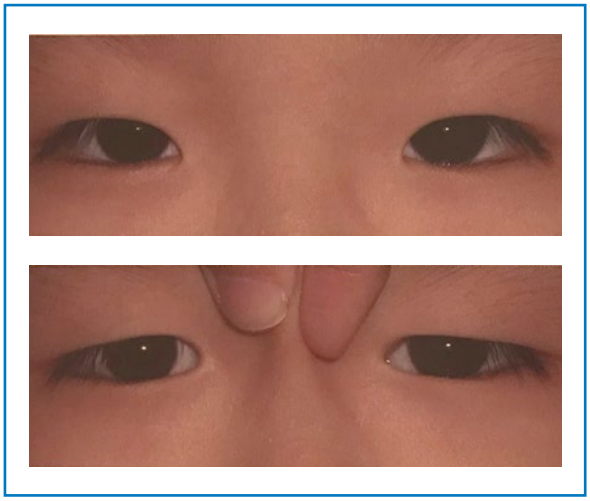

Figure 2 Pseudoestropia in a child with prominent epicanthic folds. Note the eyes appear esotropic (top), but this improved with pulling of the epicanthic folds toward the nose bridge (bottom). Note the Hirschburg light reflex is also central.

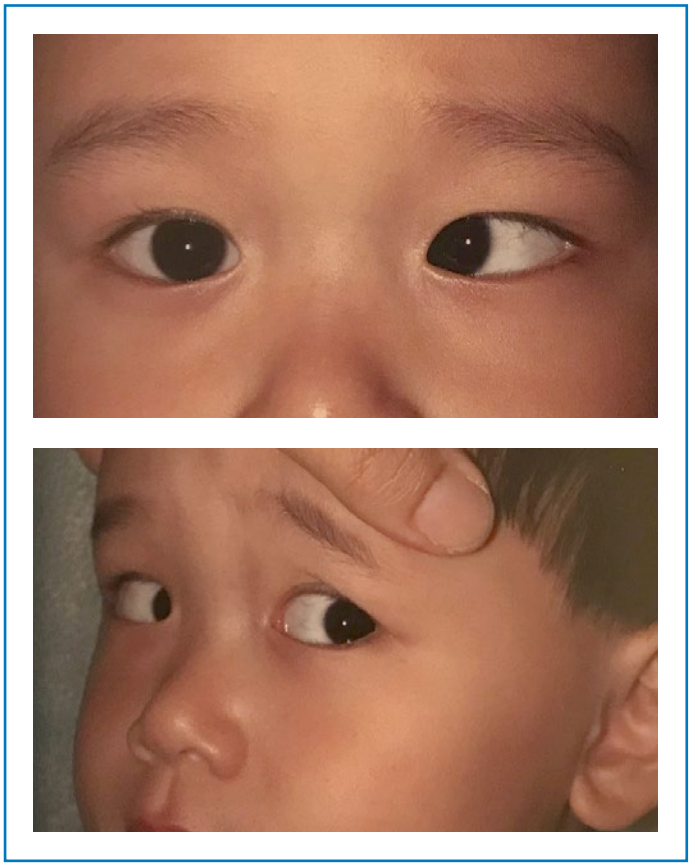

Figure 3 Infantile Esotropia. Child has a left esotropia (top). Doll's head manoeuvre showing full abduction of the left eye (bottom).

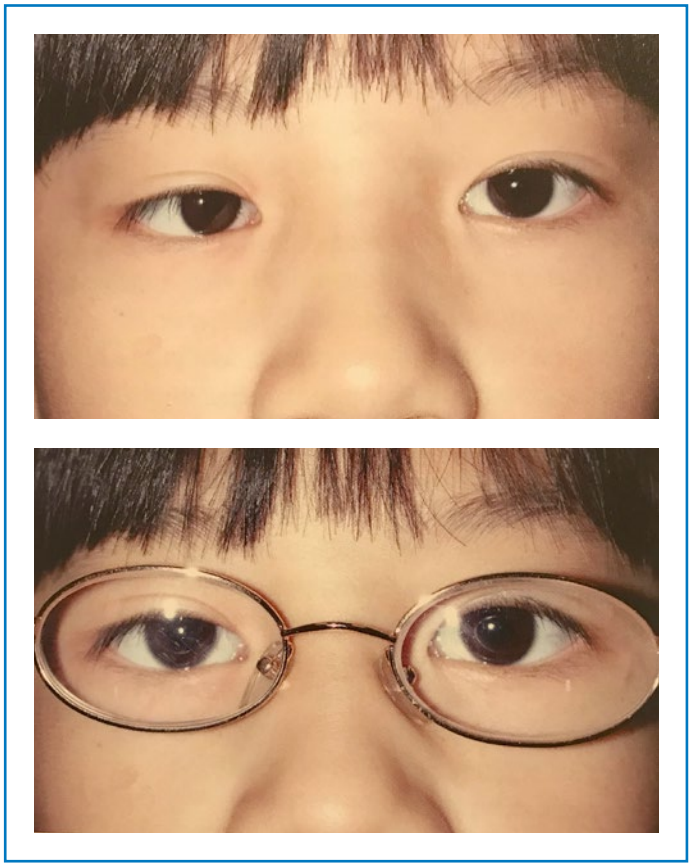

Figure 4 A child with a fully accommodative esotropia. A right esotropia is present (top) which is fully corrected with hypermetropic glasses (bottom).

Infantile Esotropia

Infantile esotropia is a constant, large angle esotropia (usually more than 30 prism diopters) that typically appears before the age of 6 months.

It is important to assess the ability of the eye to fully abduct, in order to differentiate it from a lateral rectus (sixth nerve) palsy that could be life-threatening. In children, where getting them to follow a target may be difficult, performing the doll's eye manoeuvre can be useful *(Refer to Figure 3)*.

Surgery is the treatment of choice in this condition, though the best time for it is still controversial.

However, the general consensus is that it should be performed before the age of 18 months to give the child a better chance of developing binocular function.

Accommodative Esotropia

This type of esotropia usually appears between the ages of 18-36 months, but can occur as early as 2 months and up to 6 years of age. It is related to excessive hypermetropia, resulting in overaction of the accommodative reflex.

Accommodative esotropia can be completely or partially corrected with glasses.

In a child with a fully accommodative esotropia, the convergent squint is eliminated completely with the use of glasses to correct the full amount of hyperopic refractive error *(Refer to Figure 4)*. It is important that glasses are worn full-time.

In those with partially accommodative esotropia, glasses will only correct part of the squint and surgery will be required to correct the residual deviation.

Near vision involves both *accommodation* and *convergence*. In some cases of accommodative esotropia, the deviation at near is significantly larger than that at distance. This is due to a high Accommodative Convergence/Accommodation (AC/A) ratio, in which a unit of accommodation is accompanied by a disproportionately large amount of convergence.

Children with a high AC/A ratio have an esotropia which is larger angle at near, and require the use of executive bifocal glasses to help correct their near misalignment.

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EXOTROPIA

Of the true squints that are seen in our clinics, intermittent exotropias are the most common and consist of approximately 60% of cases seen in our clinics.

Intermittent Exotropia

As its name suggests, this outward exodeviation tends to occur intermittently. At times, the child is able to control the exodeviation, and at other times is unable and breaks down into a manifest exotropia *(Refer to Figure 5)*.

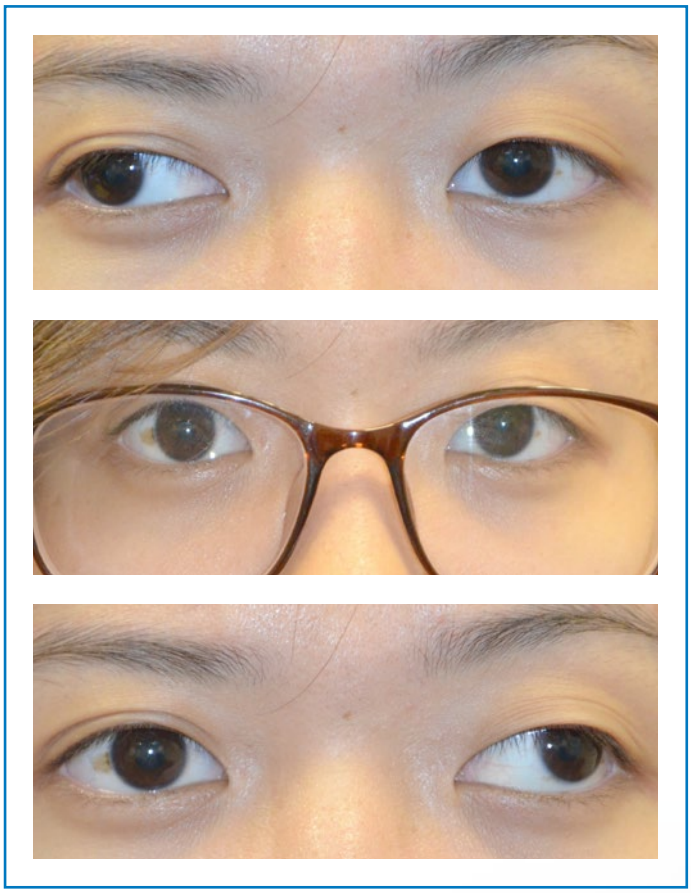

Figure 5 Intermittent Exotropia. At times, either eye is divergent, (top/bottom) and at times the patient is orthotropic (centre).

However, some patients may progress from *exophoria* to *Intermittent Exotropia (IXT)*, and then to *constant exotropia*. The size of the exotropia can also change over time.

Patients with intermittent exotropia can present with varying degrees of control. If control is good, ocular alignment is often maintained and eyes do not dissociate or deviate easily. However, if control is poor, patients may frequently exhibit a manifest exotropia.

Intermittent exotropia can be broadly classified into 3 types:

1. Basic IXT: where the exotropia measures similarly at near and distance

2. Convergence insufficiency IXT: where the exotropia measures larger at near compared to distance

3. Divergence excess IXT: where the exotropia measures larger at distance compared to near (divergence excess)

The onset of IXT is usually in early childhood. It can be precipitated by illness, tiredness, and bright light or daydreaming.

Children may blink in order to regain binocular function or close 1 eye under bright light, the symptom that is sometimes first noticed by parents. Some children may also experience eyestrain or headaches as they try to maintain binocular fusion by accommodation and convergence.

TREATMENT

Treatment options for IXT include convergence or fusion exercises, patching, over-minus lenses and surgical correction. Generally, if control were good to moderate, non-surgical treatment would suffice.

The **MyEyeGym application** is an orthoptic eye exercise application developed by the Singapore National Eye Centre (SNEC) for people with an intermittent squint. It allows users to perform different types of fusional exercises using their handheld smart devices *(Refer to Figure 6)*.

At the same time, there is also a progress and summary report with daily reminders that can motivate children to perform their exercises regularly. In general, these fusional exercises would be useful only in older children as a degree of understanding would be required.

Figure 6 MyEyeGym Application

Children who would benefit from **surgery** include those with poor or deteriorating fusion, increasing frequency of breakdown of their IXT, increasing size of the exodeviation or increasing symptoms of asthenopia. However, if possible, surgery should be performed when the child is older than 4 years of age to minimise problems encountered with over-correction.

CLINICAL ASSESSMENT OF A CHILD WITH A SUSPECTED SQUINT

A thorough history is important. Important factors include:

1. The age of onset
2. The character of the squint: intermittent or constant
3. Its evolution: more or less frequent, whether there is a fixation preference (especially important in younger children less than 8 years old where there is a risk of amblyopia)
4. Any predisposing factors: trauma, illness etc.
5. Any other associated symptoms: such as diplopia (that may suggest an acute onset or an incomitant cause), headache, nausea or vomiting (that may suggest more dangerous causes, such as raised intracranial pressure resulting in a false localising sign)

In younger children whose vision is not yet fully developed (those under 8 years old), a frequent or constant deviation of 1 eye can result in amblyopia-decreased visual acuity, as a result of monocular suppression of the deviating eye. Hence an accurate visual assessment is important.

In older children, visual acuity can be assessed using the Snellen visual acuity chart. For preverbal children, specialised visual acuity tests that work on the basis of preferential looking *(Refer to Figure 7)* are available in our clinics.

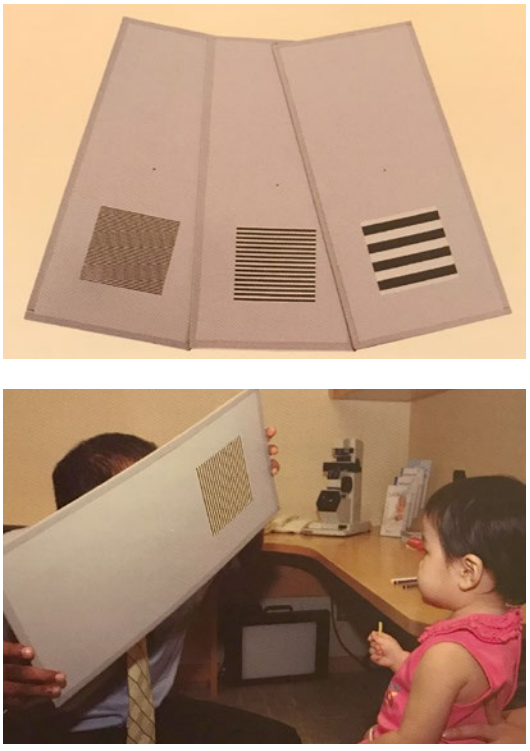

Figure 7 Teller Acuity cards. A quantitative measure of grating acuity can be assessed in infants.

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Vision in these younger children can also be grossly assessed by the child's fixation behaviour. The ability of a child to maintain central steady fixation, and fix and follow a target with their eyes can be assessed using a brightly coloured toy (or your face!). Occlusion of either eye at a time may reveal a preference for the use of 1 eye and a poorer visual acuity in the other, if a child objects strongly to the occlusion of 1 eye.

Observe the child for any gross ocular misalignment. A simple Hirschberg (pupil light reflex) can reveal the presence of a manifest squint *(Refer to Figure 8)*. A cover uncover test can bring forth a latent squint (e.g. an intermittent exotropia with control). Ocular motility should be tested, and both versions and ductions assessed, to examine the range of eye movements and any limitations present.

All children with a squint will require a complete ocular examination to exclude any potential ocular causes of poor vision resulting in a squint, for example, a unilateral congenital cataract resulting in poor vision and hence, exodeviation of that eye. Therefore, in all children with suspected strabismus, a referral to an ophthalmologist should be made.

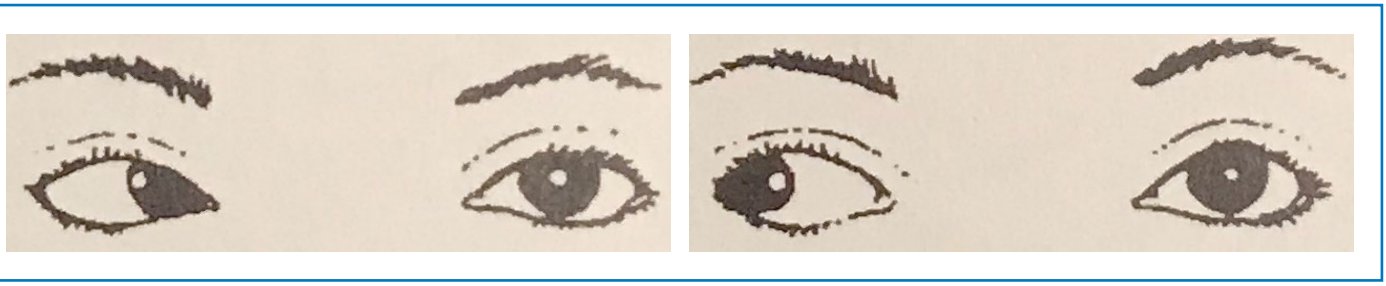

Figure 8 Hirschburg light reflex showing a right esotropia (left), and a right exotropia (right)

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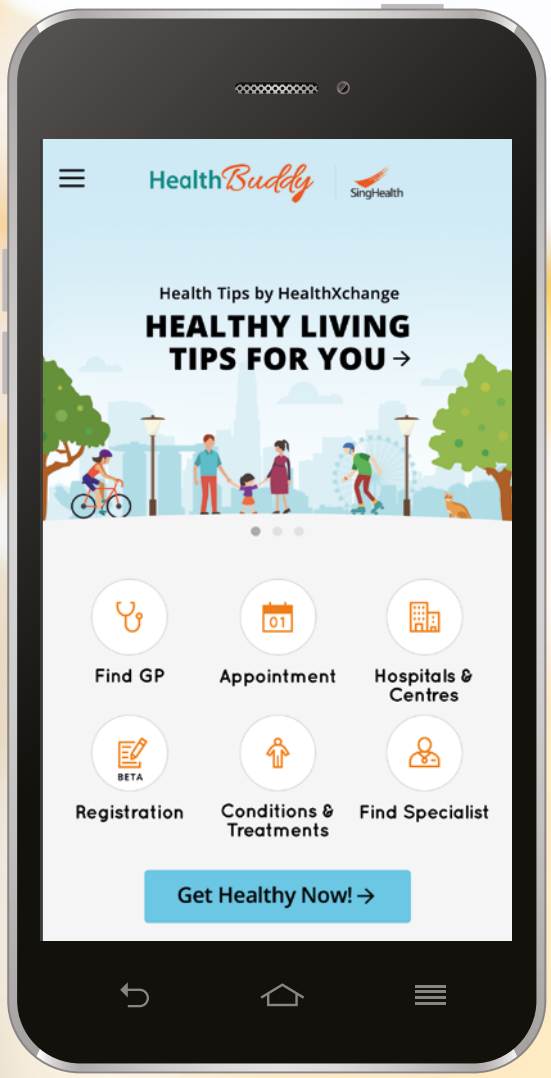

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Impaired Colour Vision in Diabetics

Risk factors of this lesser known visual complication now brought to light

Visual complications in the form of diabetic retinopathy have long been established in patients with Type 2 Diabetes Mellitus (T2DM). What is lesser known is the **higher risk for Impaired Colour Vision (ICV)** that these patients are also subjected to.

A local cross-sectional study conducted by the Department of Research, SingHealth Polyclinics, found that one in five T2DM patients developed ICV, specifically *tritanomaly or blue-yellow colour deficiency*. And given that the prevalence of T2DM in our population is expected to rise to 15 percent in 2050, more individuals are likely to experience the poorer quality of life and reduced social functioning associated with ICV.

"The subtle effect on colour vision may not be noticed by the patients as adaptation sets in," said Dr Tan Ngiap Chuan, principal investigator of the study.

"But we anticipate that selection of items for daily use, including fruits such as bananas, may be affected. Recognising traffic lights is potentially an issue, but affected patients can take cues from the blinking lights," he added.

The study, which was published in *BMC Endocrine Disorders*, also found that the risk of ICV increased for each additional year after the onset of T2DM, with most patients developing it after 6 years.

The authors therefore suggest ICV screening after patients have had T2DM for 6 years or longer, following further feasibility and cost-effectiveness evaluation.

"In the meantime, clinicians can initiate screening using the Farnsworth D-15 instrument. They can also consider partnering with optometrists or exploring digital screening platforms," suggested Dr Tan.

Ultimately, Dr Tan hopes that the study will help to increase awareness of ICV among clinicians, so that they can advise their patients appropriately.

"What they can do is to constantly remind patients to be prudent and keep their diabetes under good control to avoid any potential adverse visual or other vascular complications."

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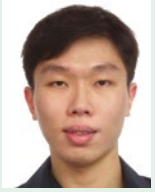

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Dr Yeo Yen Ching
Head

Cytology Service & Histopathology Service

Dr Chay Pui Ling
Head

Dental Service

Dr Tan Ee Shien
Head

Genetics Service

Dr Soh Shui Yen
Head

Haematology/Oncology Service

Dr Tagore Shephali
Head

Dept
Maternal Fetal Medicine

Adj Assoc Prof Matthias Gotthard Maiwald
Head

Microbiology Service

Dr Thia Wee Hong Edwin
Deputy Head

Dept
Maternal Fetal Medicine

NATIONAL CANCER CENTRE SINGAPORE

Appointments: 6436 8288
Email: callcentre@nccs.com.sg

PROMOTIONS - SENIOR CONSULTANTS

Dr Tan Kiak Mien Veronique
Senior Consultant & Head, SingHealth Duke-NUS Breast Centre

Surgical Oncology

Sub-specialty
Oncoplastic Breast Surgery

Dr Ravindran Kanesvaran
Senior Consultant

Medical Oncology

Sub-specialty
Uro-oncology & Thoracic-oncology

Dr Anuradha Thiagarajan
Senior Consultant

Radiation Oncology

Sub-specialty
Thoracic-oncology

PROMOTIONS - CONSULTANTS

Dr Lo Tong Jen
Consultant

Supportive and Palliative Care

Sub-specialty
Palliative Medicine

Dr Neo Hui Shan Shirlyn
Consultant

Supportive and Palliative Care

Sub-specialty
Palliative Medicine

Dr Sim Yirong
Consultant

Surgical Oncology

Sub-specialty
Breast

NATIONAL CANCER CENTRE SINGAPORE

Appointments: 6436 8288
Email: callcentre@nccs.com.sg

NEW APPOINTMENTS

Prof Lim Soon Thye
Head & Senior Consultant;
Deputy Medical Director, National Cancer Centre Singapore (Clinical)

Division of Medical Oncology

Dr Thng Choon Hua
Head & Senior Consultant;
Director, Innovation & Analytics

Division of Oncologic Imaging

Dr Loh Wei-Jen Kiley
Consultant;
Director, Cancer Education & Information Services

Division of Medical Oncology

NATIONAL HEART CENTRE SINGAPORE

Appointments: 6704 2222
Email: central.appt@nhcs.com.sg

PROMOTIONS

Dr Koh Si Ya Natalie
Associate Consultant

Dept
Cardiology

Dr Huang Weiting
Associate Consultant

Dept
Cardiology

Sub-specialty
Echocardiography & Cardiac Magnetic Resonance Imaging

Dr Huang Zijuan
Associate Consultant

Dept
Cardiology

NATIONAL NEUROSCIENCE INSTITUTE

Appointments: 6357 7095
Email: appointments@nni.com.sg

PROMOTION

Dr Low Yin Yee Sharon
Consultant

Dept
Neurosurgery (TTSH Campus)

Sub-specialty
General Neurosurgery

NEW APPOINTMENTS

Prof Lo Yew Long
Senior Consultant;
Chairman, Centralised Institutional Review Board (CIRB);
Director, Patient Safety & Clinical Quality

Dept
Neurology (SGH Campus)

Sub-specialty
Clinical Neurophysiology

Assoc Prof Tan Kevin
Senior Consultant;
Education Director, National Neuroscience Institute

Dept
Neurology (TTSH Campus)

Sub-specialty
Neuroimmunology & Neuroinfectious Disease

SINGAPORE NATIONAL EYE CENTRE

Appointments: 6322 9399
Email: appointments@snec.com.sg

APPOINTMENT

Dr Lim Hou-Boon
Associate Consultant

Dept
General Cataract & Comprehensive Ophthalmology

Sub-specialty
Ophthalmology

PROMOTION

Dr Fong Chee Yang Allan
Head & Senior Consultant

Dept
General Cataract & Comprehensive Ophthalmology

Sub-specialty
Ophthalmology

Don't Limit Your Challenges. Challenge Your Limits.

If you are a qualified doctor, a challenging career awaits you at SingHealth. We seek suitably qualified candidates to join us as:

- STAFF REGISTRARS / SERVICE REGISTRARS
- RESIDENT PHYSICIANS
- MEDICAL OFFICERS
- PRIMARY EYECARE PHYSICIANS

Interested applicants are to email your CV with full personal particulars, educational and professional qualifications (including housemanship details), career history, present and expected salary, names of at least two professional references, contact numbers and e-mail address together with a non-returnable photograph.

Please email your CV to the respective institutions' email addresses/online career portals with the Reference Number MN1807.

SingHealth

The SingHealth Duke-NUS Academic Medical Centre draws on the collective strengths of SingHealth and Duke-NUS Medical School to drive the transformation of healthcare and provide affordable, accessible, quality healthcare.

With 42 clinical specialties, a network of 4 Hospitals, 5 National Specialty Centres, 9 Polyclinics and Bright Vision Community Hospital, it delivers comprehensive, multidisciplinary and integrated care.

In 2018, SingHealth welcomes the assimilation of the Changi General Hospital in the provision of seamless patient care in the eastern region of Singapore.

The Sengkang General Hospital and the Sengkang Community Hospital will also be completed to better serve the north-eastern community.

To enhance community care, the new Outram Community Hospital on the SGH Campus will be completed in 2020.

Singapore General Hospital

Departments seeking Resident Physicians and Staff Registrars:

- Surgical Departments (such as ENT and General Surgery)
- Staff Clinic

Website: www.sgh.com.sg
Career Portal: www.sgh.com.sg/subsites/sgh-careers/medical/pages/career-opportunites.aspx
Email: careers.medical@sgh.com.sg

KK Women's and Children's Hospital

Department seeking Resident Physicians and Staff Registrars:

- Emergency Medicine

Website: www.kkh.com.sg
Email: medical.hr@kkh.com.sg

Sengkang General Hospital

Departments seeking Resident Physicians and Staff Registrars:

- Anaesthesiology
- Cardiology
- Family Medicine
- General Surgery
- General Medicine (with interest in Endocrinology, Gastroenterology, Geriatric Medicine, Rehabilitation Medicine, Renal Medicine and Respiratory Medicine)
- Intensive Care Medicine
- Neurology
- Orthopaedic Surgery
- Plastic, Reconstructive, Aesthetic Surgery Service
- Urology Service

Website: www.skh.com.sg
Career Portal: www.skh.com.sg/careers/Pages/careers.aspx
Email: careers@skh.com.sg

National Heart Centre Singapore

Departments seeking Resident Physicians:

- Cardiology
- Cardiothoracic Surgery

Website: www.nhcs.com.sg
Email: hr_mgr@nhcs.com.sg

National Neuroscience Institute

Departments seeking Resident Physicians and Service Registrars:

- Neurology
- Neuroradiology
- Neurosurgery

Website: www.nni.com.sg
Email: nni_hr@nni.com.sg

Singapore National Eye Centre

Department seeking:

- Resident Physician, Opthalmology
- Primary Eyecare Physician (Locum)
- Medical Officer

For more information, please visit the **Career Opportunities** section on the **Singapore National Eye Centre** website.

Website: www.snec.com.sg
Email: recruitment@snec.com.sg

SingHealth Community Hospitals (Sengkang Community Hospital, Outram Community Hospital and Bright Vision Hospital)

Departments seeking Resident Physicians and Staff Registrars:

- Family Medicine

Website: http://www.singhealthch.com.sg/
Career Portal: www.singhealth.com.sg/SCH/careers/Pages/Careers.aspx
Email: schrecruitment@singhealthch.com.sg

Forum for Healthcare Professionals

15th Practice Update in Paediatrics

Old Issues, New Perspectives

Date 3 November 2018, Saturday	**Time** 1.00pm to 5.10pm
Venue KKH Auditorium (Training Centre) Level 1, Women's Tower	
Fee $11 per pax (Includes lunch, tea and parking)	**CME Points Accreditation** CME, SNB-CPE and CDE points will be awarded
Organised by: Division of Medicine and Division of Surgery, KK Women's and Children's Hospital	

PROGRAMME

Time	Topics
1.00pm	Registration and Lunch Reception
2.00pm	**Current Knowledge and Practice in Food Allergy** **SPEAKER** **Assoc Prof Anne Goh** Head and Senior Consultant Allergy Service, KKH
2.30pm	**Current Knowledge and Practices in Kawasaki Disease** **SPEAKER** **Assoc Prof Thaschawee Arkachaisri** Head and Senior Consultant Rheumatology and Immunology Service, KKH
3.10pm	**Updates in Genetic Testing and Counselling** **SPEAKER** **Ms Breana Cham Wen Min** Senior Genetic Counsellor Genetics Service, KKH

Time	Topics
3.40pm	*Tea Break*
4.00pm	**Management of Inguinoscrotal Swelling in Children** **SPEAKER** **Dr Rambha Rai** Consultant Department of Paediatric Surgery, KKH
4.30pm	**Upper Limb Fractures in Children – What We Need to Know** **SPEAKER** **Dr Kenneth Wong** Associate Consultant Department of Orthopaedic Surgery, KKH
	Paediatric Feet and Lower Limbs: When Physiological becomes Pathological **SPEAKER** **Dr Zackary Chua** Associate Consultant Department of Orthopaedic Surgery, KKH
5.10pm	End of forum

REGISTRATION REQUIRED BY 31 OCTOBER 2018, WEDNESDAY.
For more details, please call **6394 8746 (Monday – Friday, 8.30am – 5.30pm)** or log on to **www.kkh.com.sg/events**

Seats are confirmed upon full payment on a first-come, first-served basis. Registration fee is non-refundable.

SingHealth

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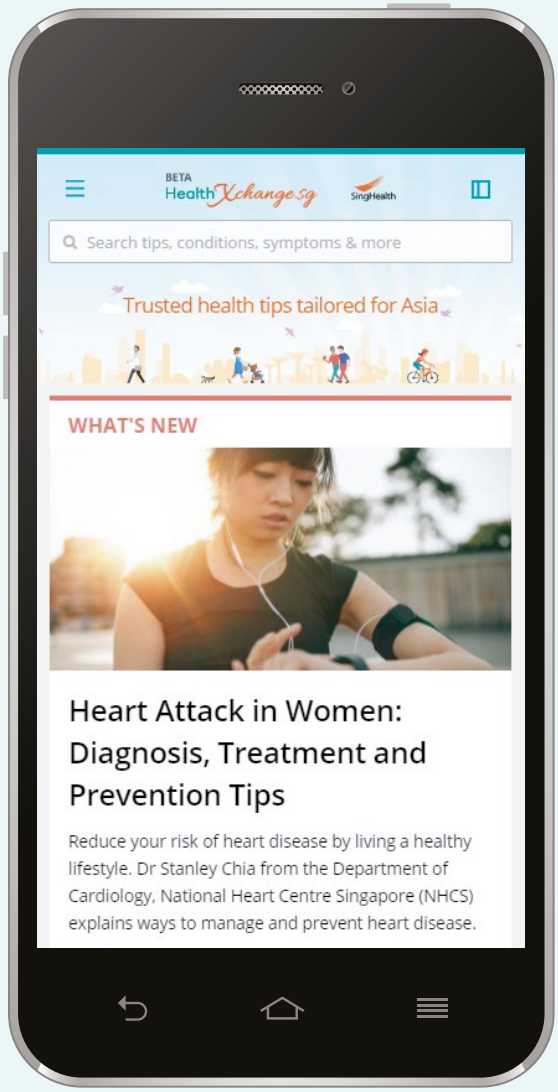

HIGHLIGHTS

Over 1000 health articles by SingHealth doctors and medical professionals

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Support groups from fellow patients, survivors and caregivers

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- CANCER
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- CHOLESTEROL
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- HEART & LUNGS
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SingHealth
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Forum for Healthcare Professionals

Inaugural Paediatric Respiratory and Sleep Medicine Symposium

Venue: KKH Auditorium, Training Centre, Level 1, Women's Tower	
Paediatric Sleep Medicine Workshop	**Paediatric Respiratory Medicine Symposium**
Date: 8 March 2019, Friday	Date: 9 to 10 March 2019, Saturday to Sunday
Time: 8.00am to 5.00pm	Time: 8.00am to 5.30pm
CME points will be accredited	

KEY SPEAKERS

DR COLIN WALLIS
Division Lead and Consultant
Paediatric Respiratory Medicine
Great Ormond Street Hospital for Children, London, United Kingdom

DR SADASIVAM SURESH
Consultant, Senior Staff Specialist
Paediatric Respiratory and Sleep Medicine
Lady Cilento Children's Hospital, Brisbane, Australia

ASSOC PROF TEOH OON HOE
Head and Senior Consultant
Respiratory Medicine Service
KK Women's and Children's Hospital, Singapore

DR MAHESH BABU RAMAMURTHY
Head and Senior Consultant
Paediatric Respiratory and Sleep Medicine
National University Hospital, Singapore

DR BIJU THOMAS
Senior Consultant
Respiratory Medicine Service
Programme Director
Inaugural Paediatric Respiratory and Sleep Medicine Symposium
KK Women's and Children's Hospital, Singapore

PROGRAMME HIGHLIGHTS

- Paediatric sleep medicine workshop
- Chronic cough
- Difficult asthma
- Bronchiectasis
- Childhood interstitial lung disease
- Pulmonary hypertension
- Congenital lung anomalies
- Aspiration-related lung disease
- Respiratory problems in children with neuromuscular diseases
- Paediatric chest imaging
- Cardiopulmonary exercise test
- Hands-on sessions on
  - Paediatric polysomnography
  - Lung function tests
  - Home ventilation for technology-dependent children

REGISTRATION CLOSES ON 5 MARCH 2019 (TUESDAY).
Early bird registration closes on **7 January 2019 (Monday)**.
Pre-registration is required. For more details, please call **6394-8746 (Monday to Friday, 8.30am to 5.30pm)** or log on to **www.kkh.com.sg/events**

Seats are confirmed upon full payment on a first-come, first-served basis. Registration fee is non-refundable.

GP FAST TRACK APPOINTMENT HOTLINES

Singapore General Hospital	6321 4402
Changi General Hospital	6850 3333
Sengkang General Hospital	6472 2000
KK Women's and Children's Hospital	6294 4050
National Cancer Centre Singapore	6436 8288
National Dental Centre Singapore	6324 8798
National Heart Centre Singapore	6704 2222
National Neuroscience Institute	6357 7095
Singapore National Eye Centre	6322 9399

DIRECT WARD REFERRAL CONTACT NUMBERS

Singapore General Hospital	6321 4822
Changi General Hospital	6788 8833
KK Women's and Children's Hospital	6394 1180

SINGHEALTH DUKE-NUS ACADEMIC MEDICAL CENTRE

- Singapore General Hospital
- Changi General Hospital
- Sengkang General Hospital
- KK Women's and Children's Hospital
- National Cancer Centre Singapore
- National Dental Centre Singapore
- National Heart Centre Singapore
- National Neuroscience Institute
- Singapore National Eye Centre
- SingHealth Community Hospitals
- Polyclinics SingHealth

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