

Therapeutic use of refractive surgery laser technology



Dr Ian Chan, Ophthalmologist,
Subiaco. Tel 9388 1828

It is seldom discussed outside of sub-specialist corneal units, but refractive surgery lasers can also be used for therapeutic/rehabilitation purposes. Current laser refractive procedures have excellent refractive predictability and stability, resulting in over 17 million patients having undergone LASIK globally. The technologies involved are excimer lasers (that reshape the cornea) and femtosecond lasers (used as non-mechanical scalpels) – both can be harnessed for therapeutic medical use.

The cornea performs 75% of the focusing of light in the eye. Therefore, a small change in corneal shape has a large impact on vision quality. Various diseases or trauma can opacify the cornea or alter the shape of it, leading to severe vision loss. In selected cases, the lasers mentioned can be used to restore corneal clarity and optimal optical shape. As well, therapeutic laser treatment can sometimes help to delay or even avoid corneal transplantation.

Excimer laser and therapeutic use

Excimer lasers are high energy ultraviolet lasers. The cornea can be reshaped by precise placement of these tissue vapourising laser spots. Modern lasers are fast (up to 1000Hz) and can rapidly follow the patient's eye in four axes during the treatment. Current diagnostic platforms accurately capture the three-dimensional shape of the cornea as well as analyse the optics of the eye, all in unprecedented detail. This data is then fed into software that programs the treatment pulses required.

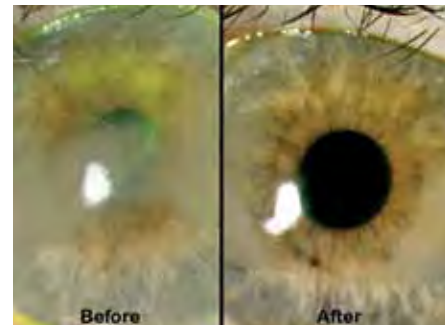
In therapeutic treatments, the abnormal shape

of the cornea is remodeled by the laser to the desired optical shape. The laser can also remove corneal opacities, such as scars in the superficial 1/3 of the cornea. The level of vision restoration is often remarkable (see Figure 1). Painful blistering corneal conditions such as recurrent erosion syndrome can be treated by minimal laser surface ablation to encourage epithelial adhesion.

Femtosecond laser and therapeutic use

Femtosecond lasers are precision non-mechanical cutting tools. These infrared lasers have ultra brief (10^{-15} sec) pulses that can cut three-dimensional shapes within the cornea by causing multiple adjacent minute spots of explosions in it. Currently, these lasers are mainly used to cut LASIK corneal flaps immediately before excimer laser ablation.

Therapeutic uses of femtosecond lasers include cutting both the corneal transplant and host into precise shapes that have complex edges (e.g. zig-zags) to improve wound strength and postoperative optical quality. The laser can also split corneas into lamellae for partial layer



■ Fig 1. This patient had moderate Band Keratopathy (a common calcific corneal degeneration) that had reduced his vision to 6/24. A light laser keratectomy cleared the deposits completely and returned vision to 6/6. The large circular clearing in the centre of the cornea (left image) was the treated area.

transplantation. Precision corneal tunnels can be created for plastic ring segments implantation in treatment of keratoconus. With these treatments, corneal transplantation may be delayed or even avoided.

Such treatments are more common in overseas public hospitals equipped to perform LASIK. In Australia, Medicare does partially fund these therapeutic treatments and some private clinics in WA offer them. ■



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Dr Ian Anderson
Tel: 6380 1855

Dr Malcolm Burvill
Tel: 9275 2522

Dr Ian Chan
Tel: 9388 1828

Dr Steve Colley
Tel: 9385 6665

Dr Dru Daniels
Tel: 9381 3409

Dr Blasco D'Souza
Tel: 9258 5999

Dr Graham Furness
Tel: 9440 4033

Dr Richard Gardner
Tel: 9382 9421

Dr Annette Gebauer
Tel: 9389 6666

Dr David Greer
Tel: 9481 1916

Dr Boon Ham
Tel: 9474 1411

Dr Philip House
Tel: 9316 2156

Dr Jane Khan
Tel: 9385 6665

Dr Ross Littlewood
Tel: 9374 0620

Dr Nigel Morlet
Tel: 9385 6665

Dr Stuart Ross
Tel: 9250 7702

Dr Andrew Stewart
Tel: 9381 5955

Contact: Matthew Whitfield Ph: 9481 6277 Email: info@eyesurgeryfoundation.com.au 42 Ord Street West Perth WA 6005