

Manual Correction of Myopia, Hypermetropia, Astigmatism, Presbyopia & Keratoconus.

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Abstract— A new method has been designed to correct myopia, hypermetropia, astigmatism and presbyopia of very high power. If 1mm of cornea is tucked, then it corrects **3.174 D** & If 1mm of horizontal diameter of cornea is reduced, then it corrects **+4.1D**. This procedure is reliable, safe, cheapest and simplest. Because of the use of simple procedure to split the cornea, adjustable nonabsorbable sutures, correction of very high myopia and hypermetropia along with astigmatism and presbyopia, the procedure is expected to be accepted.

Keywords— Arc of cornea, chord, angle of arc, myopia, hypermetropia, astigmatism, formula.

I. INTRODUCTION

LASIK (laser-assisted in situ keratomileusis) is a type of refractive surgery for the correction of myopia, hypermetropia and astigmatism. LASIK is most similar to another surgical corrective procedure, photorefractive keratectomy (PRK), and LASEK. All represent advances over radial keratectomy in the surgical treatment of refractive errors of vision. For patients with moderate to high myopia or thin corneas which cannot be treated with LASIK and PRK, the phakic intraocular lens is an alternative.^{1,2}

Some people with poor outcomes from LASIK surgical procedures report a significantly reduced quality of life because of vision problems or physical pain associated with surgery. However, 30% of post-LASIK referrals to tertiary ophthalmology care centers have been shown to be due to chronic dry eye.^{3,4}

A type of LASIK, known as presbyLASIK, may be used in presbyopia.⁵

Flap complications,^{6,7,8,9} slipped flap and flap interface particles are other complications.

Together with his colleagues, Charles Munnerlyn founded VISX USA inc.

SMILE is an acronym that stands for “Small Incision Lenticule Extraction” and is the latest advancement in laser vision correction. During a SMILE procedure, the femtosecond laser is used to cut a small corneal lenticule (precise lens shaped disc within cornea) and then it is removed via a small keyhole incision. The biggest difference and advancement between the two is the fact that SMILE laser eye surgery is a flapless procedure.

II. PRINCIPLE

If the curvature of cornea is responsible for myopia or hypermetropia, it can either be flattened or steepened to change the power of cornea. For example, if the cornea is made flatter, then the myopia is reduced. Whereas, if the cornea is made steeper, then the power of the cornea is increased, refractive index of the cornea and other factors responsible for ocular refractive power remaining unchanged. Assuming the refractive power of anterior surface of cornea is +49D, after deducting -6D power of posterior surface of cornea, the net power of cornea is +43D.

Structure of the Cornea

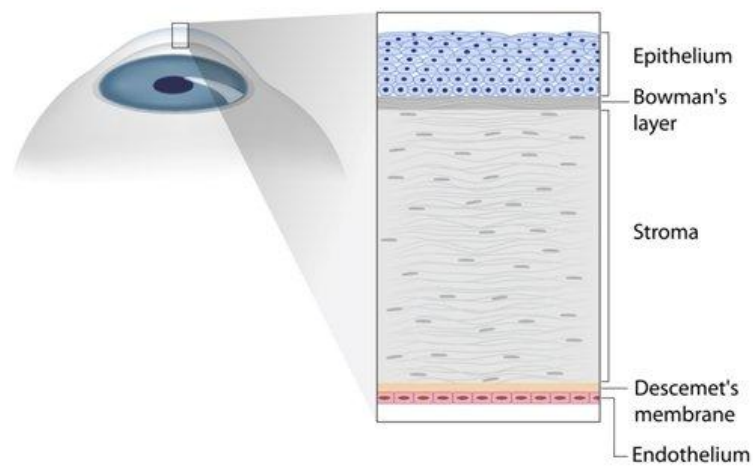


FIGURE 1

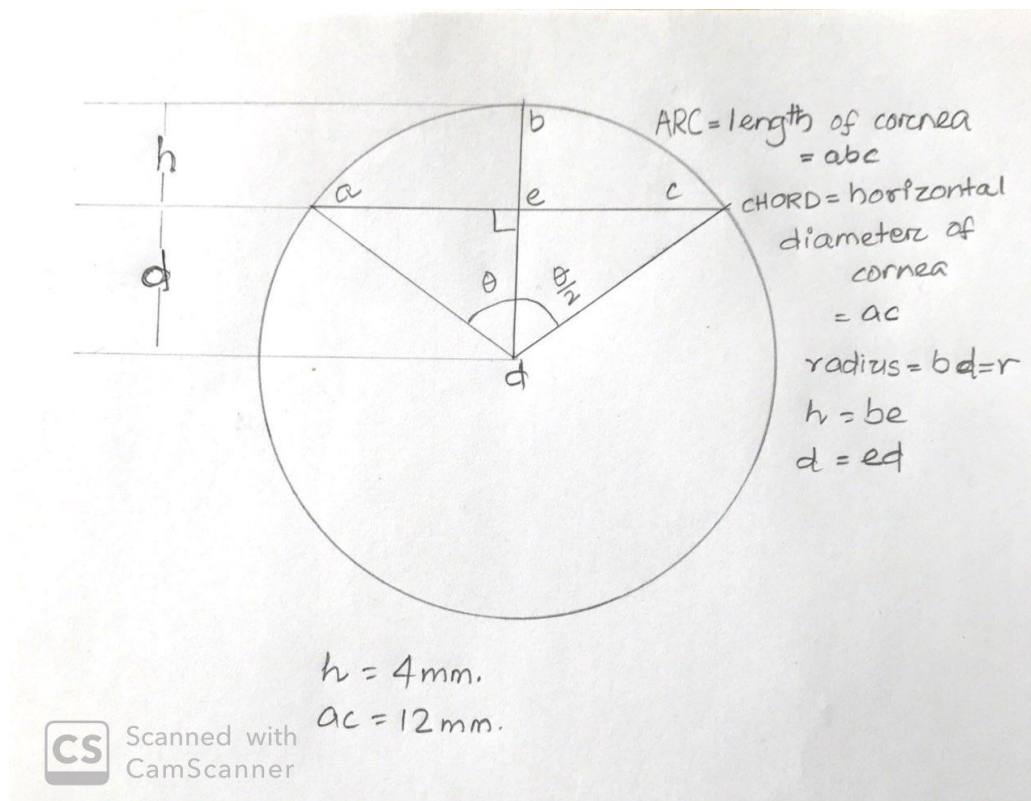


FIGURE 2

c = horizontal diameter of cornea = 12mm = chord of this circle,

h = 4mm, the distance between endothelium & iris plane.

radius = $\left[\frac{h}{2}\right] + \left[\frac{c^2}{8h}\right]$

In this case h = 4mm, c = 12mm

So $\frac{4}{2} + \frac{12 \times 12}{8 \times 4}$

$= \frac{13}{2} = 6.5\text{mm}$

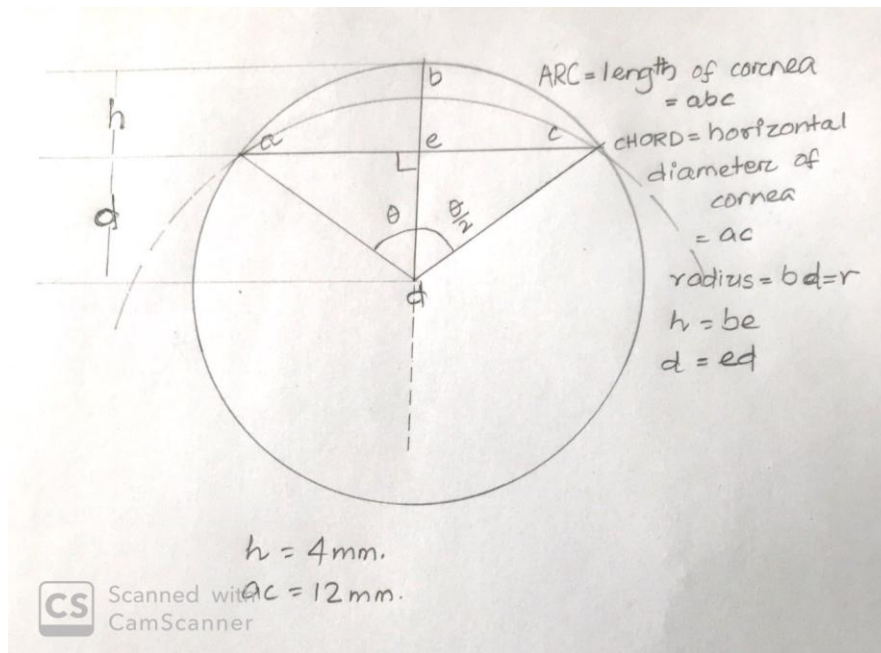


FIGURE 3

So $d = 6.5 - 4 = 2.5 \text{ mm}$

$\sin \theta = c/2 \div r = 12/2 \div 13/2 = 12/13 = 68^\circ$

Total angle of arc is 136°

II. Arc length = (angle of arc $\div 360^\circ$) $\times 2\pi r$

$= (136 \div 360) \div (2 \times 22/7 \times 13/2) = 15.4349215 \text{ mm} = \text{length of cornea}$

III. 15.4349215 OR 15.44 mm at arc angle at 136° , has power of +49D. As inner cornea has -6D power, the net power of cornea is +43D. So, keeping other factors constant, reduction of 1mm of cornea in length, shall reduce the power by 3.17357513 D ($49 \div 15.4349215$). This is approximately **3.174 D**.

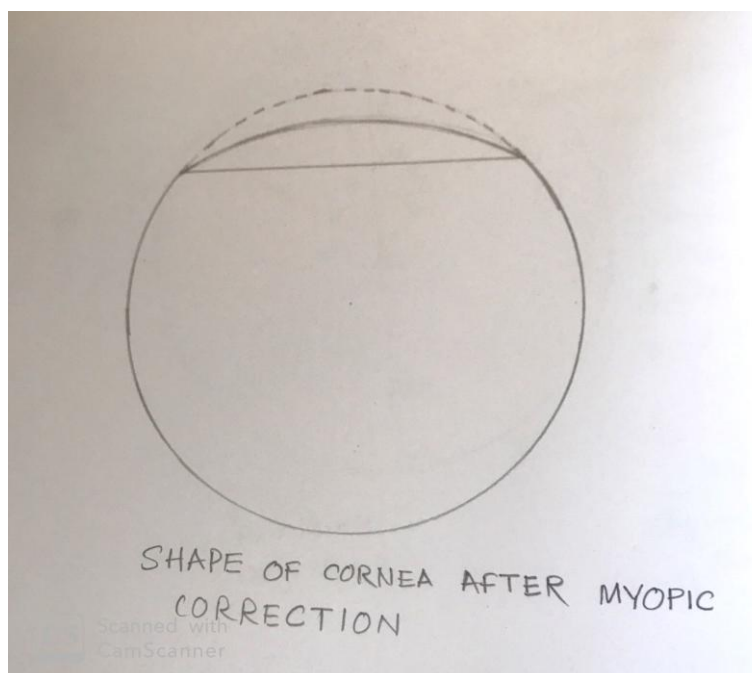


FIGURE 4

If 1mm of cornea is tucked on either sides that will flatten the cornea and correct $2 \times 3.174 = 6.348D$ of myopia. If 0.5 mm of cornea is tucked, then correction of $3.174 \div 2 = 1.587D$ of myopia.

2mm of cornea on either side (4mm) is tucked; 11 mm of cornea is left. If 3mm on either sides of cornea is tucked(=6mm in total), then 9mm is left to be flattened. If 4 mm on either sides is tucked (8mm), then 7 mm is left. If 5mm on either sides is tucked (10mm), then 5mm of clear cornea is left. Central cornea of 4 mm is essential to be clear.

Thus $(10 \times 3.174 =) -31.74D$ can be corrected, which is equal to $(31.74 - 6 =) 25.74D$.

FORMULA; $D2 = [(Pc \div Lc) \times (Lt)] - 6$

Pc = power of anterior surface of cornea.

Lc = length of cornea $= (\theta \div 360^\circ) \times 2\pi r$

Lt = length of cornea tucked.

$\sin \theta = \text{perpendicular} \div \text{hypotenuse} = p/h$

Example: myopia of **-20 D spherical & -6 cylindrical error at 90° .**

***7.179000858 = 7.18mm of cornea** has to be replicated. On either sides 3.59mm to be tucked.

***to correct -6 cylindrical, 2.15370257 mm (=2.154mm)** has to be plicated.

So 1.07685129 (= 1.1mm) on either sides of cornea at 180° to be tucked more at 180° . So at 180° , $3.6 + 1.1 = 4.7mm$ has to be tucked.

Except 1mm of peripheral cornea at periphery and 4 mm at center, rest of the cornea is available for the procedure.

VII. Similarly, 12mm of horizontal diameter of cornea, other conditions remaining constant is associated with +49D. **So 1mm of horizontal diameter is associated with +4.08333333(=+4.1D)**

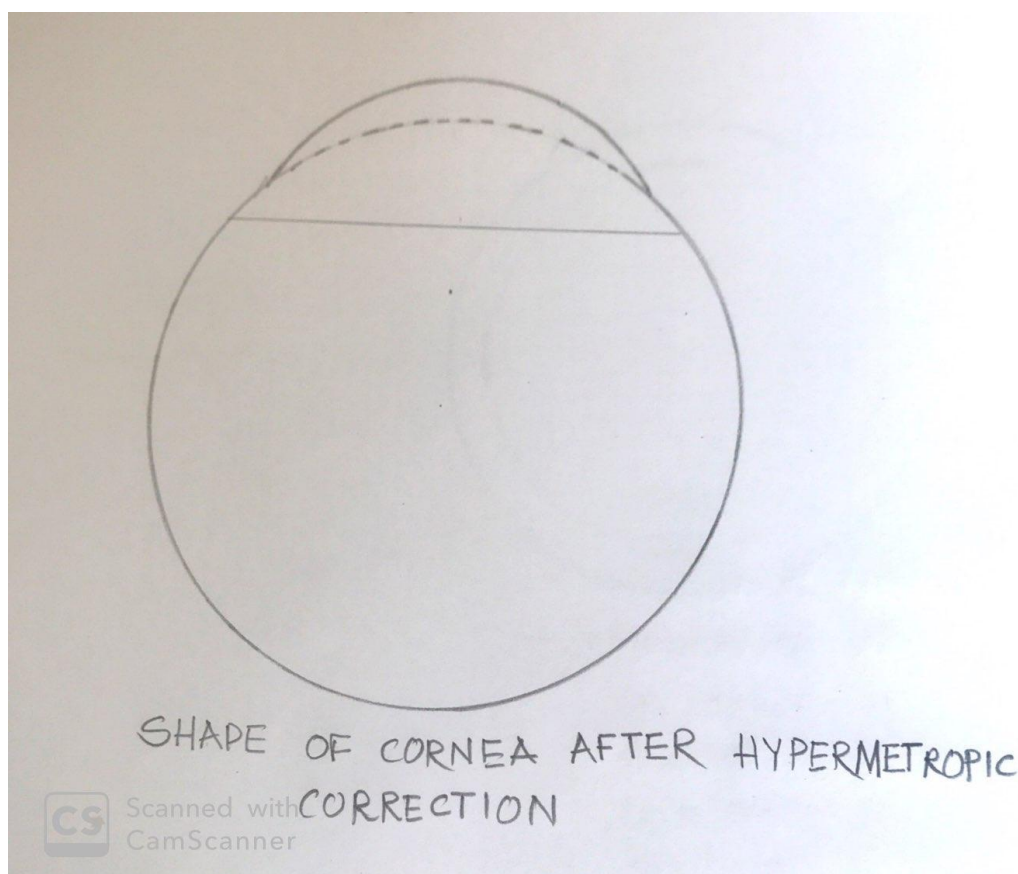


FIGURE 5

$h = 4\text{mm.}$
 $ac = 12\text{mm.}$

ARC = length of cornea
 $= abc$
 CHORD = horizontal
 diameter of
 cornea
 $= ac$
 radius = $bd = r$
 $h = be$
 $d_1 = ed$
 $d_1 = \text{center of}$
 1st circle (I)
 $d_2 = \text{center of}$
 2nd circle (II)
 $d_3 = \text{center of}$
 3rd circle (III)

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4. 2 types of caliper specially designed of measurement of curvature.
5. Fine tip marker pen
6. Gentian violet
7. 8-0 prolene sutures
8. Fine tooth forceps
9. Needle holder
10. Tie forceps

3.2 Procedure:

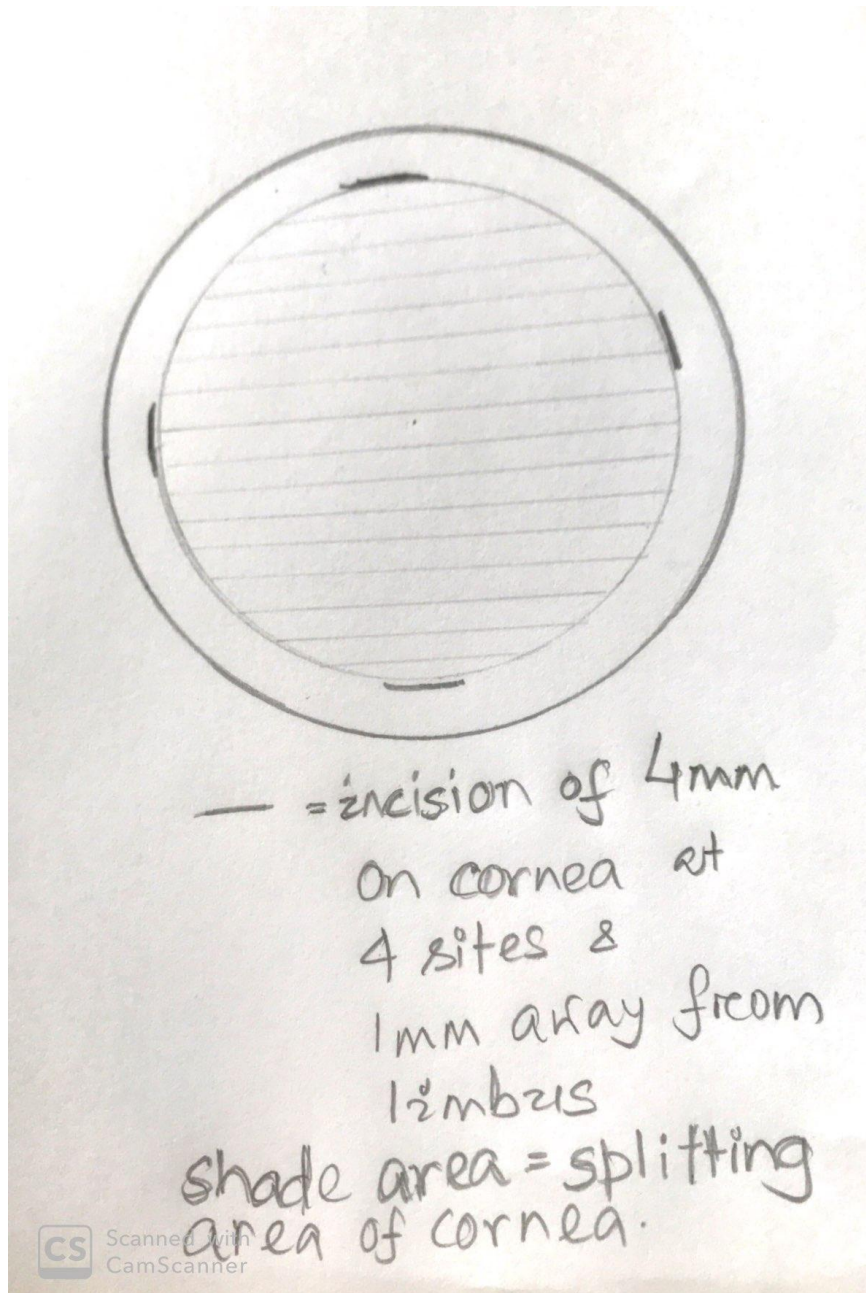


FIGURE 7

Myopia; firstly, 1mm away from limbus ,a 4mm wide incisions are made to a depth of 0.15mm. On this plane, a scleral tunnel blade can split cornea stroma into 2 parts, and the splitting is extended upto centre of cornea. Similarly, the cornea is

split from diagonally opposite site (if 1st one at 0° axis, then the 2nd one on 180° axis.) similarly, incision and splitting is done from 90° and 270° . The splitting of the cornea is completed in 360° to free the epithelial layer from stroma.

Method to plicate part of cornea is by running a suture through cornea at $3/4$ th depth & come out at desired end of the length. Then similarly run it from opposite side and exit near the point of entry, preferably 4 mm wide, to take adequate bite and tuck it as well as prevent cheese cutting.

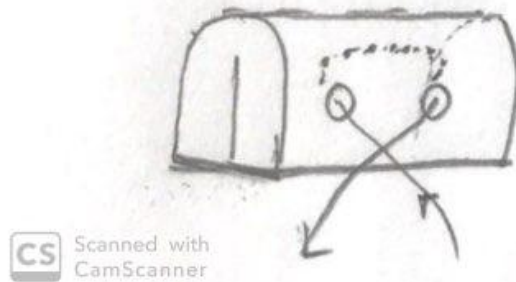
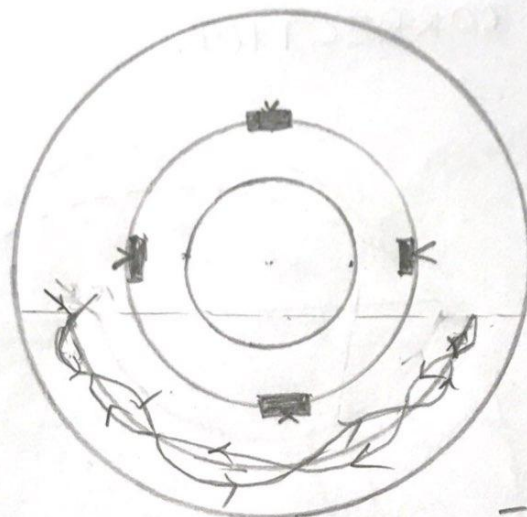


FIGURE 8

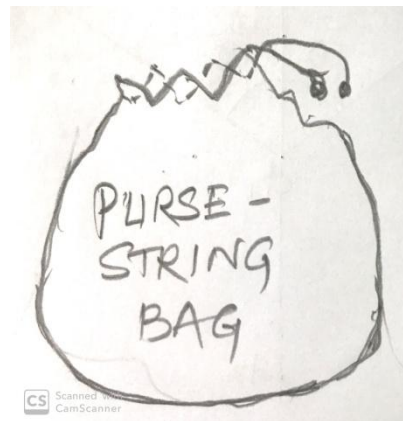


MYOPIC, ASTIGMATIC & PRESBYOPIC
CORRECTION.  TIE

EX: BEFORE CORRECTION POWER WAS
 $-20D / -6D / 90^\circ$
sph. cyl.

 PRESBYOPIA +1 to +3D.

FIGURE 9

Hypermetropia:**FIGURE 10**

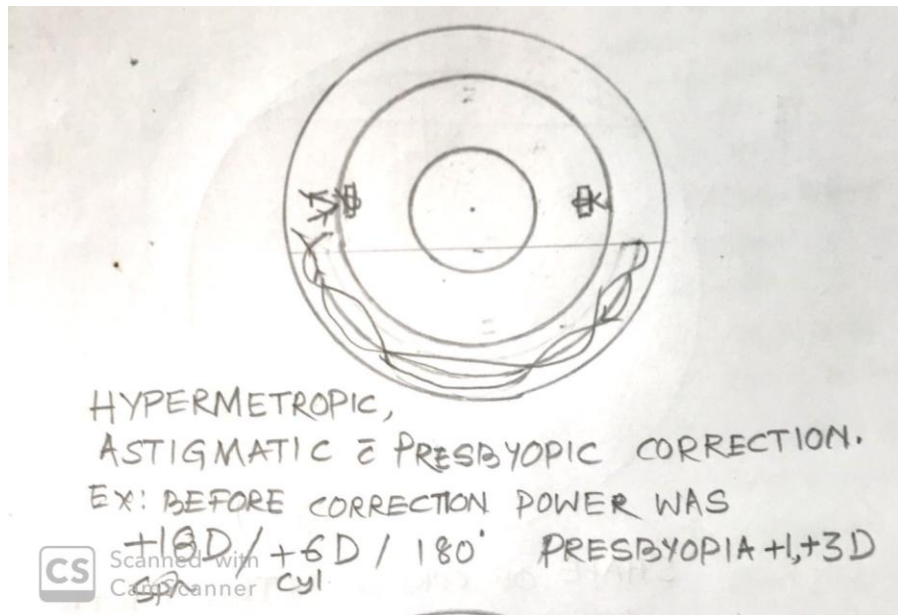
Incision on cornea is made on the site depending on the hypermetropia to be corrected. If 1mm of horizontal diameter of cornea to be reduced, then incision to be made 1mm away from limbus.

The cornea split as mentioned in correction of myopia.

In this case a prolene suture runs in purse-string fashion, so that when it is pulled, it narrows the horizontal diameter of the cornea in order to correct hypermetropia more than required, so that myopic shift can be corrected.

Adjustable sutures can be used to correct the errors according to portable keratometre measurement or verifying in operation theater by automatic keratometre or as found on 1st post op day.

Subsequently, astigmatism can be corrected above the purse string suture.

**FIGURE 11**

Presbyopia: (CORRECTION IS SHOWN IN ABOVE TWO DIAGRAMS ALONG WITH OTHER CORRECTIONS) By reducing the horizontal diameter of cornea to increase the power of the eye at lower 40% (2/5th) of cornea. A suture runs as in hypermetropic correction but only lower 40%. The running purse string suture passes through cornea at 0.75 mm from limbus as it adds +3D power to cornea at lower half only. This suture can be added to either myopic or hypermetropic or astigmatism corrections.

IV. ADVANTAGES

1. It does not require femtosecond or excimer laser which is exuberantly costly.
2. It does not require raising IOP to 60mm Hg for microkeratome.
3. This delicate procedure shall be cheapest and can be used by an expert hand.
4. Very high myopia, hypermetropia, astigmatism and presbyopia can be corrected.
5. It does not require a corneal flap to be raised.

V. DISADVANTAGES

1. It is time consuming.
2. Learning curve much higher than LASIK or SMILE procedure.

VI. CONCLUSION

Manual correction of myopia, hypermetropia, astigmatism and presbyopia is simplest, cheapest and reliable. If 1 mm of cornea is tucked, then it corrects **3.174 D** & If 1 mm of horizontal diameter of cornea is reduced, then it corrects **+4.1D**. Because of use of simple procedure to split the cornea, tie the sutures either to tuck it or use of purse string suture to squeeze the horizontal length of cornea, correction of very high myopia, hypermetropia, astigmatism and presbyopia, this procedure has lots of promises in future.

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