New Formula for Lasik Surgery on Myopic & Hypermetropic Eyes

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Abstract— *In this paper a new formula is derived for Lasik surgery on Myopic and Hypermetropic eyes. This article has given another formula to calculate the depth of cornea to be ablated, derived mathematically.*

Formula;

depth of cornea of myopic eye to be ablated in micron= $[r_1 \times D_1 \div D_2] - \sqrt{[r_2^2 - (d \div 2)^2]} \times 1000$

Formula;

depth of cornea in hypermetropic eye to be ablated on either sides in $\mu = \frac{d}{2} - \sqrt{r_2^2 - [r_2 - [r_1 - \sqrt{r_1^2 - \left(\frac{d}{2}\right)^2}\,]\,]^2} \times 1000$

Keyword: formula, LASIK, myopia, hypermetropia.

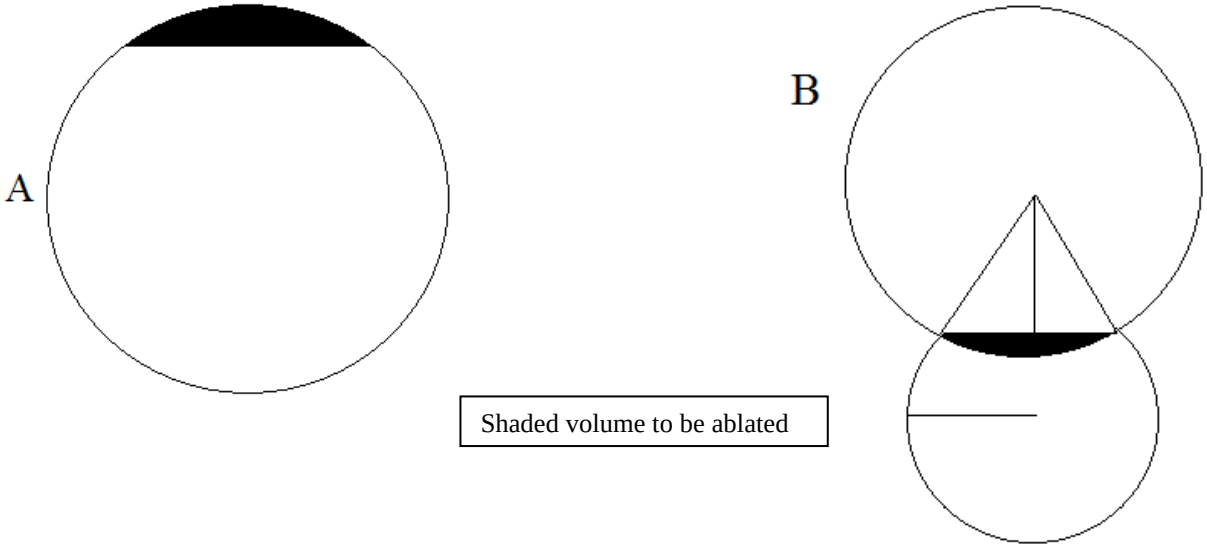
I. INTRODUCTION

LASIK is acronym of laser assisted in situ keratomileusis. LASIK has become the standard approach for (corneal) refractive surgery by most ophthalmologists. Time has taught the refractive surgeon the omnious importance of doing a good surgical plan. Cornea is molded by laser. It's diameter of refractive surface either increased or decreased in order to increase or decrease the power of entire cornea. Charles Munnerlyn's [1] [2] [3] formula is used by lasik machine.

This article has given another formula to calculate the depth of cornea to be ablated, derived mathematically.

II. OBSERVATION

Anterior surface of cornea



Anterior surface of cornea is responsible for refraction of ocular optical media, which is enormous, +49D[4] out of nearly total +60D of eye. LASIK has become the standard approach for corneal refractive surgery for most ophthalmologists. Its radius

of curvature is 7.45mm. So to reduce 4D of cornea, the power of anterior surface of cornea has to be 45D and radius has to be increased to (r1 × D1)÷ D2.

r1=radius of curvature of anterior surface of cornea.

r2=radius of curvature planned,

D1=power of anterior surface of cornea.

D2= power of anterior surface of cornea planned.

d=length of chord (diameter of cornea to be ablated)

$r_{2=} r_{1\times} D_{1\div} D_2$

chord= $\sqrt{r\,2\ -\ (d \div 2)^{\,2}}$

Formula;

depth of cornea of myopic eye to be ablated in micron= $[r_1 \times D_1 \div D_2]$-$[\sqrt{r_2^2 - (d \div 2)^2}] \times 1000$

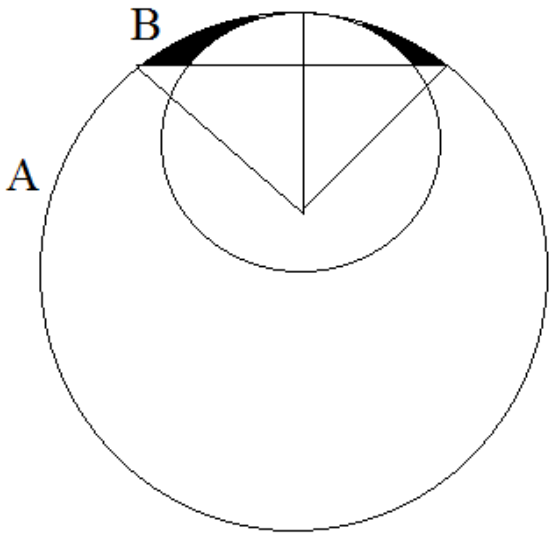
Example: r1=7.45 mm, r2=91.2625, d=4mm, D1=+49D, D2= - 4D

$[7.45\times49\div4] - [\sqrt{91.2625\ 2 - \ 4/2^2}] \times1000$=91.2625 – 91.2406 = 0.0219 × 1000 = Depth in μ=21.9

Munnerlyn's formula=depth to be ablated in micron=$(d^2 \times D) \div 3$ =21.33

Formula for Lasik Surgery on Hypermetropic Eyes:

Radius of curvature of cornea is 7.45mm.This power has to be increased by 4D .The power of anterior surface of cornea is 49D [4]. The new power shall be 53D on anterior surface of cornea and radius has to be decreased to (r1 × D1)÷ D2.



r1=radius of curvature of anterior surface of cornea .

r2=radius of curvature planned,

D1=power of anterior surface of cornea.

D2 =new power of the anterior surface of cornea

Circle A is outer circle. circle B is inner circle. shaded part to be ablated.

1. Circle A is having radius r1=7.45mm.

Diapteric power=+49D.

So r2=49×7.45÷53=6.8877mm

2. Diameter (d1) or chord of 4mm from which ablation of stroma shall be done.
3. r2=6.8877mm
4. distance from chord to perimeter of circle= r1- $\sqrt{r1^2 - (d1 \div 2)^2}$ or 7.45 - $\sqrt{7.45^2 - 2^2}$ = 0.2735 mm
5. distance between chord and center of circle B= 6.8877- 0.2735= 6.6142mm
6. 1/2 of chord = $\sqrt{6.8877^2 - 6.6142^2}$ = 1.9217 mm

Chord to be ablated on either sides as shaded area=2-1.9217=0.0783 × 1000=78.3 µ

FORMULA: depth of cornea in hypermetropic eye to be ablated on either side in

$$\mu = \frac{d}{2} - \sqrt{r_2^2 - \left[r_2 - [r_1 - \sqrt{r_1^2 - \left(\frac{d}{2}\right)^2}\,] \right]^2} \times 1000$$

Example

$$4/2 - \sqrt{6.8877^2 - [6.8877 - [7.45 - \sqrt{7.45^2 - \frac{4^2}{2}}\,]^2} \times 1000 = (2 - 1.9217)\,1000 = 78.3$$

III. DISCUSSION

Since 1949, Jose Barraquer Moner, described his Barraquer's thickness laws which states that whenever tissue is either added to the periphery of the cornea or removed from its central part, a corresponding flattening is obtained and vice versa, whenever tissue added to the center or removed from its periphery, a corresponding increase in curvature is obtained.[5] [6]

Charles Mnnerlyn in 1988 first published the article on formula for myopic eyes subjected to lasik surgery. [7][8]

Lasik surgery on hypermetropic eye is done by use of Gulani's triple lens. These are surgical acrylate polymer with marks of diameter 4.5mm, 4mm and 3.5 mm.[9]

The new formula written in this article exactly how much tissue in depth should be ablated on either sides of cornea with 120 micron flap.

If the chord is reduced to 3 mm, then 58.2 µ to be ablated. If flap size reduced to 100 µ, then the ablation is 40% of cornea at 540 µ.So 8D can be corrected which is safe and does not produce ectasia. The upper limit is 40%.

Formula is % of tissue to be ablated (PTA), flap thickness (FT),Ablation depth (AD), Central corneal thickness (CCT).

PTA= (FT+AD)/CCT.

For correction of 4D hyperopia, and diameter of cornea to be ablated is 4mm, 78.3µ of cornea to be ablated per 1D correction 78.3/4 =19.6 µ required.

If 3mm diameter of cornea is ablated, then 78.3 × 3 ÷ 4=58.8 µ ablation can correct 4D. With thickness of flap 75µ and thickness of cornea is 540 µ (40% of 540= 216), only 216-75=141 µ can be ablated. (141÷ 58.8) × 4=9.59 D can be corrected and nearby cornea can be reshaped to 8.5D and 7.5 D till 5mm of diameter of cornea to avoid night glare.

Similarly, if myopic eye is corrected after raising a corneal flap of 75 µ and diameter of cornea ablated is 3mm, then 141µ tissue can be ablated.(21.9×3)÷4=16.45µ ablation required to correct 4D.So (141÷16.45)4=34.285D can be corrected. Night glare can be eliminated by tapering slowly the power by 1 D up to 6mm diameter of central cornea.

This is significant for correction of 6D in hypermetropia & 16D in myopia is targeted.

IV. SUMMARY

Formula;

depth of cornea of myopic eye to be ablated in micron= $[r_1 \times D_1 \div D_2] - [\sqrt{r_2^2 - (d \div 2)^2}] \times 1000$

Formula;

depth of cornea in hypermetropic eye to be ablated on either sides in $\mu = \frac{d}{2} - \sqrt{r_2^2 - \left[r_2 - [r_1 - \sqrt{r_1^2 - \left(\frac{d}{2}\right)^2}\,]\,\right]^2} \times 1000$

V. CONCLUSION

New formulae for myopic and hypermetropic eyes for LASIK surgery are mathematically derived and shall definitely give better result if incorporated to lasik machine.

Correction of 1D myopia with 4mm diameter by ablating 5.475µ.

Correction of hypermetropia with 4mm diameter by ablating 19.575 µ on one side.

Maximum possible correction of hypermetropia is 9.59D and of myopia is 34.285D with diameter of ablation at 3mm and flap thickness 75µ.to avoid night glare the adjacent cornea must be gradually decreased in power of correction till diameter of 6mm of central cornea.

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