Efficacy of 500 Hz Excimer Laser Ablation in Compound Myopic Astigmatism With Cyclotorsion Alignment and Pupil Centroid Shift Compensation: An RCT

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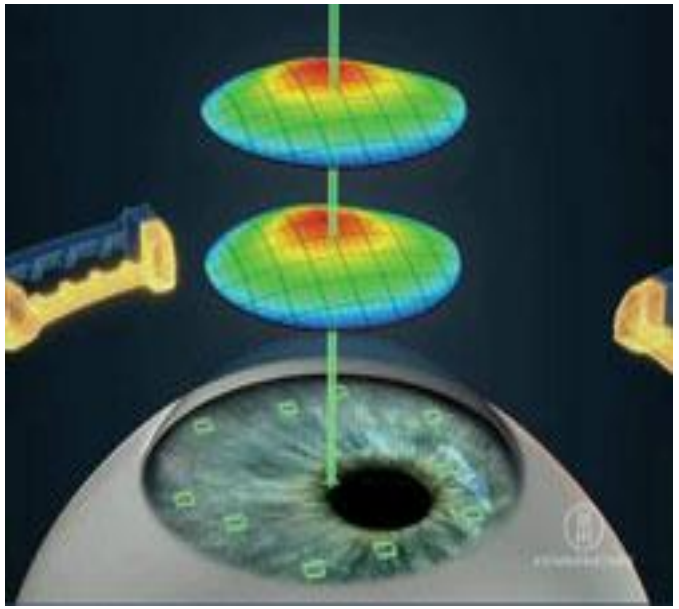
Pupil Centroid Shift

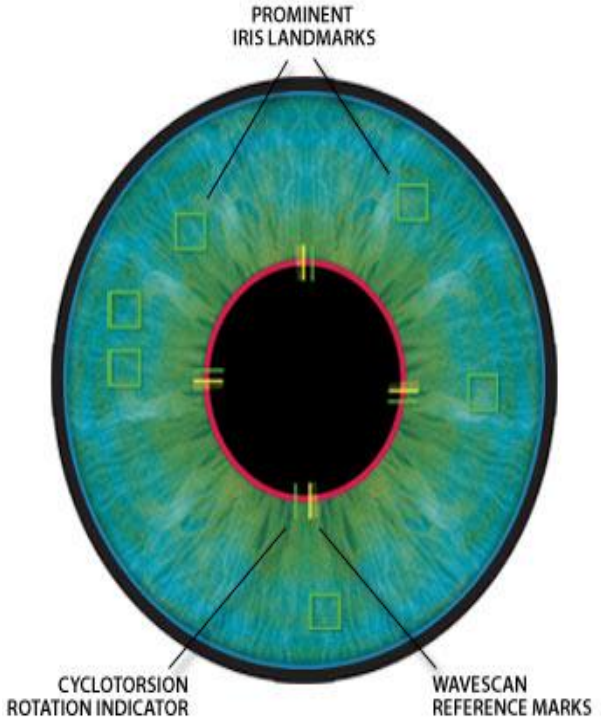
- Occurs with change in pupil diameter
- Aberrations measured over a dilated pupil /mesopic condition in a seated position are surgically corrected over an undilated pupil in supine position
- **Induced HOAs**



PCSC: Wavefront centred on preoperatively measured dilated pupil rather than intraoperative constricted pupil in supine position

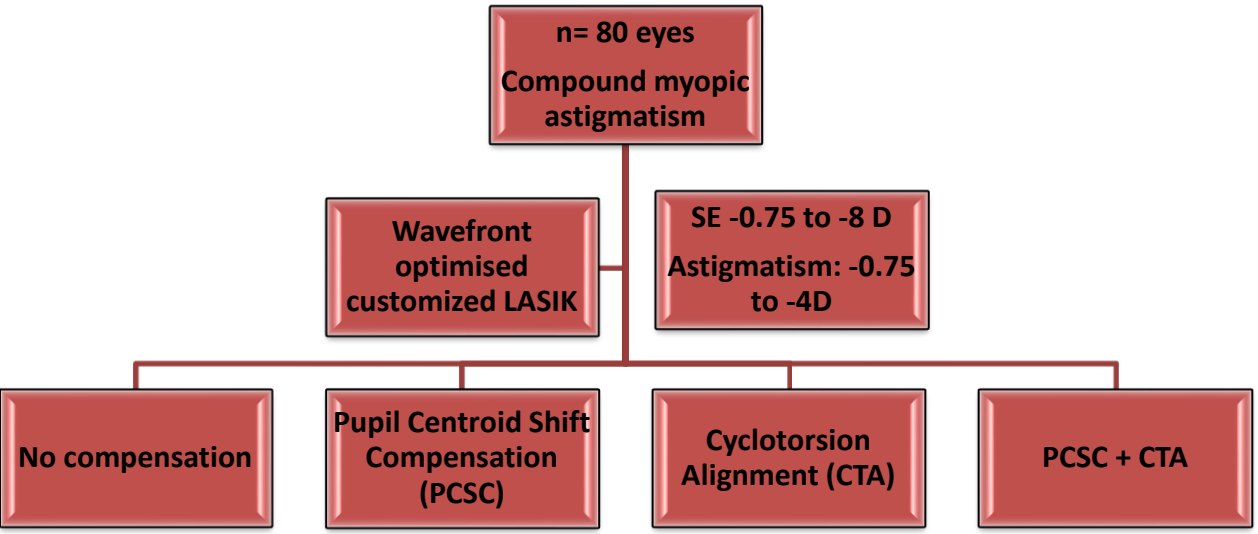
Cyclotorsion

- Cyclotorsion is a cause of under-correction and residual HOAs
- Factors causing cyclotorsion:
- Rotation of the head and body
- Position-induced cyclotorsion



CTA: Wavefront directed on preoperatively measured axis

Materials and Methods



- Pupil centre detection and Iris registration captured on Topolyzer™ (ALLEGRETTO Wavelight®, ALCON)
- Pre-requisites:
  - 4 consecutive readings (auto capture) taken
  - 65% accuracy in each reading
  - Based on limbus detection in all 4 readings

Prospective randomized clinical control trial
n= 80 (20 in each group)
Age: 20- 38 yrs

Materials and Methods: Inclusion and Exclusion Criteria

Inclusion Criteria

- Stable refractive history >1 year
- Myopia and astigmatism eligible for LASIK

  SE -0.75 to -8 D

  Astigmatism -0.75 to -4D
- More than 18 years of age
- Postoperative refractive target emmetropia
- Discontinuation of contact lens (2 weeks prior for soft CL, 4 weeks prior for RGP CL)

Exclusion Criteria

- Patients younger than 18 years
- CDVA worse than 6/24
- H/O previous ocular surgery/ ocular co-morbidities/ trauma/inflammation
- H/O corneal dystrophy, , irregular cornea on corneal topography
- Corneal thickness values that will result in residual bed less than 300µm

Results: Pre-operative Parameters

	Without PCSC/CTA	With PCSC	With CTA	With PCSC & CTA	p value
UCVA	1.02±0.42	1.18±0.47	0.95±0.39	0.95±0.43	0.2854
Spherical Equivalent	-3.72±2.13	-4.76±1.99	-3.54±1.74	-3.81±2.02	0.211
Contrast sensitivity	1.85±0.12	1.84±0.11	1.90±0.11	1.83±0.12	0.163
Glare acuity	0.2 (0-0.3)	0.25 (0-0.4)	0.2 (0-0.4)	0.2 (0-0.4)	0.121
HO TOTAL	0.07 (0.02-0.24)	0.08 (0.02-0.34)	0.07 (0.02-0.29)	0.10 (0.025-0.393)	0.428

Comparable preoperative BCVA, contrast sensitivity, glare acuity and higher order corneal aberrations

Results: Post-operative Parameters

	Without PCSC/CTA	With PCSC	With CTA	With PCSC & CTA	p value
UCVA	0 (-0.079-0.176)	0 (0-0.301)	0 (0-0.301)	0 (0-0.176)	0.8824
Refractive cylinder	-0.5 (-0.75-+1)	-0.5 (-0.75-+0.5)	-0.25 (-0.25-+0.5)	-0.25 (-0.75-+0.25)	0.2972
Spherical equivalent	0 (-1.25-+0.375)	-0.25 (-1.125-+0.625)	+0.125 (-1-+0.625)	+0.125 (-0.5-+0.5)	0.1445

No difference in UCVA and the mean post-operative residual cylinder between the groups at 6 month follow up

Results: Spherical Aberration

	Without PCSC/CTA	With PCSC	With CTA	With PCSC & CTA	p value
Pre-operative	0.018 (0-0.087)	0.024 (0.002-0.122)	0.023 (-0.05-0.13)	0.03 (0.007-0.19)	0.166
6 months	0.033 (-0.031-0.119)	0.039 (0.003-0.137)	0.026 (-0.059-0.134)	0.032 (-0.001-0.177)	0.569
p value	0.007	0.000	0.121	0.501	

The increase in spherical aberration in the group with CTA and both CTA and PCSC was not significant while it was significant in the other two groups

Results: Trefoil and Secondary Astigmatism

		Without PCSC/CTA	With PCSC	With CTA	With PCSC & CTA	p value
Secondary Astigmatism	Pre-operative	0.016 (0.001-0.36)	0.019 (0.004-0.078)	0.015 (0.03-0.134)	0.018 (0.001-0.131)	0.67
	6 months	0.027 (0.003-0.057)	0.025 (0.002-0.086)	0.03 (0.002-0.142)	0.015 (0.004-0.071)	0.263
	p value	0.01	0.04	0.000	0.501	
Trefoil	Pre-operative	0.04 (0.004-0.075)	0.038 (0.006-0.188)	0.04 (0.002-0.152)	0.034 (0.004-0.188)	0.994
	6 months	0.054	0.043	0.05	0.035	0.293
	p value	0.002	0.009	0.005	0.881	

The increase in secondary astigmatism and trefoil in the group with both CTA and PCSC was not significant while it was significant in the other three groups

Results: Contrast Sensitivity

	Without PCSC/CTA	With PCSC	With CTA	With PCSC & CTA	p value
Pre-operative	1.85±0.12	1.84±0.11	1.90±0.11	1.83±0.12	0.163
1 month	1.55±0.11	1.6±0.11	1.6±0.12	1.59±0.08	0.229
6 months	1.66±0.1	1.68±0.1	1.72±0.08	1.73±0.09	0.127
p value	0.00	0.00	0.00	0.00	

The reduction in contrast sensitivity in the group with CTA and both CTA and PCSC was the lesser as compared to other two groups

Results: Glare Acuity

	Without PCSC/CTA	With PCSC	With CTA	With PCSC & CTA	p value
Pre-operative	0.2 (0-0.3)	0.25 (0-0.4)	0.2 (0-0.4)	0.2 (0-0.4)	0.121
1 month	0.6 (0.4-0.8)	0.6 (0.5-0.8)	0.5 (0.2-07)	0.45 (0.2-0.7)	<0.05
6 months	0.5 (0.4-0.6)	0.5 (0.4-0.7)	0.46 (0.3-0.6)	0.4 (0.2-0.6)	<0.05
p value	<0.05	<0.05	<0.05	<0.05	

The drop in glare acuity was least in the group with both CTA and PCSC as compared to other three groups

Conclusions

- Wavefront-optimised LASIK is an effective modality for the correction of compound myopic astigmatism of -3.9±1.9D (-0.75 to -8)
- Glare acuity in all groups dropped after the procedure. The **decrease was the least in the group in which PCSC and CTA were compensated during the procedure.**
- All groups studied showed a significant drop in Contrast sensitivity at 1 month. The **groups in which PCSC and CTA was done showed the maximum improvement at 6 months.**
- All groups studied showed an increase in Higher Order Aberrations following the procedure. However the **induced aberrations were least in the group in which PCSC and CTA was done.**