Development of a nomogram for fs-Laser arcuate keratotomy

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Why a new nomogram?

- Arcuate keratotomies (AK) can be an effective means of correcting moderate amounts of corneal astigmatism.
- FS lasers are able to perform AK cuts more accurately (placement, length, depth) than manual cuts.
- Existing nomograms are not ideally suited.
  - Donnenfeld and Nichamin nomograms are derived from LRI procedures with an undefined optical zone and coarse steps.
  - Nomograms of Thornton, Lindstrom, etc. from the 1980s used small optical zones and were targeted at higher amounts of astigmatism.
- Oshika nomogram (1) was modified with age dependency (1% per year) as a starting point.
- The dose-effect-relationship was evaluated and a new nomogram derived with very fine steps (3 month data).

Patients & Methods

- Prospective study with n = 43 eyes (ethics committee University of Münster).
- Further retrospective data.
- Cataract patients, mean age 68.6 ± 10.3 years, 62% female.
  - 1 month: 72 complete data sets.
  - 3 months: 68 complete data sets.
  - 1 year: 38 complete data sets.
- Target astigmatism defined by vector mean of Tomey TMS-5 „real astigmatism“ (incl posterior surface) and Haag-Streit Lenstar autokeratometry (2).
- Residual astigmatism as defined by ... was evaluated.
  - Subjective refraction (SR).
  - Lenstar keratometry (LS).
  - TMS-5 „real astigmatism“ (TMSr).
- Arcuate cuts with Victus Femtosecond laser platform using the following parameters:
  - OZ = 8.5 mm.
  - 2 cuts of same arc length, 180° apart.
  - 80% of local depth as measured by the TMS-5 (SW 2.x) or online Pachy (SW 3.x).

New software 3.2 allows for online pachymetry
NEW OCT allows for better control during docking
Treatment parameters are indicated during surgery
with the rule
against the rule
preop
1 month
preop
3 months
preop
1 year
new nomogram @ 1 month
new nomogram @ 3 months
attempted
diopters
achieved (refraction)
overcorrection
undercorrection
\[ \text{effect}[D] = -2.4699 + 0.0610 \cdot \text{arclen}[\degree] + 0.0155 \cdot \text{age}[\text{yrs}] \]
Conclusion

- Moderate corneal astigmatism can be safely and predictably corrected with fs laser arcuate incisions
- ≥ 80% of eyes treated have ≤ 0.75 dpt of subjective residual astigmatism anytime of follow-up
- On average, only 1 Snellen line could be gained by spectacle correction – UCVA is comparable to toric IOL results (1)
- Cylindrical prediction error (vector difference between predicted and actual effect) slightly worse than toric IOLs (0.62 vs. 0.50 D) with outliers included
  - As good as TIOL when 7 outliers are excluded
  - measurement error (vector difference between objective measurement and manifest cylinder) = 0.4 D in comparison
- Much better predictability than intrastromal incisions (2)
- No systematic degradation of incisional effect observed at 3 month and 1 year follow-up
- Asymmetric cuts (length and placement) can deal with asymmetric astigmatism