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ROYAL MAXIM PALACE KEMPINSKI, CAIRO

**Optical Aberrations After SMILE,
FemtoLASIK, and SmartSurface TPRK
Role of Surgical Technique, Centration,
and Chord Mu**

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Background

- Higher-order aberrations (HOAs) affect postoperative visual quality
- Surgical technique and centration strategy influence aberration induction
- Chord mu is The linear distance on the corneal plane between the pupil center and the point where the visual axis intersects the cornea.
- Chord mu represents visual axis–pupil center offset and may modify

outcomes

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STUDY DESIGN & DEVICES

- Retrospective comparative study
- Single tertiary refractive center(Wenzhou Medical university eye hospital)
- Platforms used:
- **SMILE:** VisuMax[®] femtosecond laser (Carl Zeiss Meditec)
- **FemtoLASIK & SmartSurface TPRK:** SCHWIND AMARIS excimer laser
- Same aberrometry device and protocol
- Postoperative assessment $\geq$ **6 months**

Study Population

- **Total eyes:** 258 eyes of 258 patients with myopia >-8 SE
- Each eye had **preoperative and postoperative** measurements
- Stratified by **Chord Mu:**
 - < 0.15 mm
 - ≥ 0.15 mm
- Groups were preoperatively matched for:
 - Spherical equivalent
 - Chord mu
 - Baseline aberrations

OUTCOME MEASURES

- **Analyzed using absolute values**
- Spherical aberration
- RMS HOA
- Horizontal coma
- Vertical coma
- Horizontal trefoil
- Vertical trefoil

Statistical Analysis

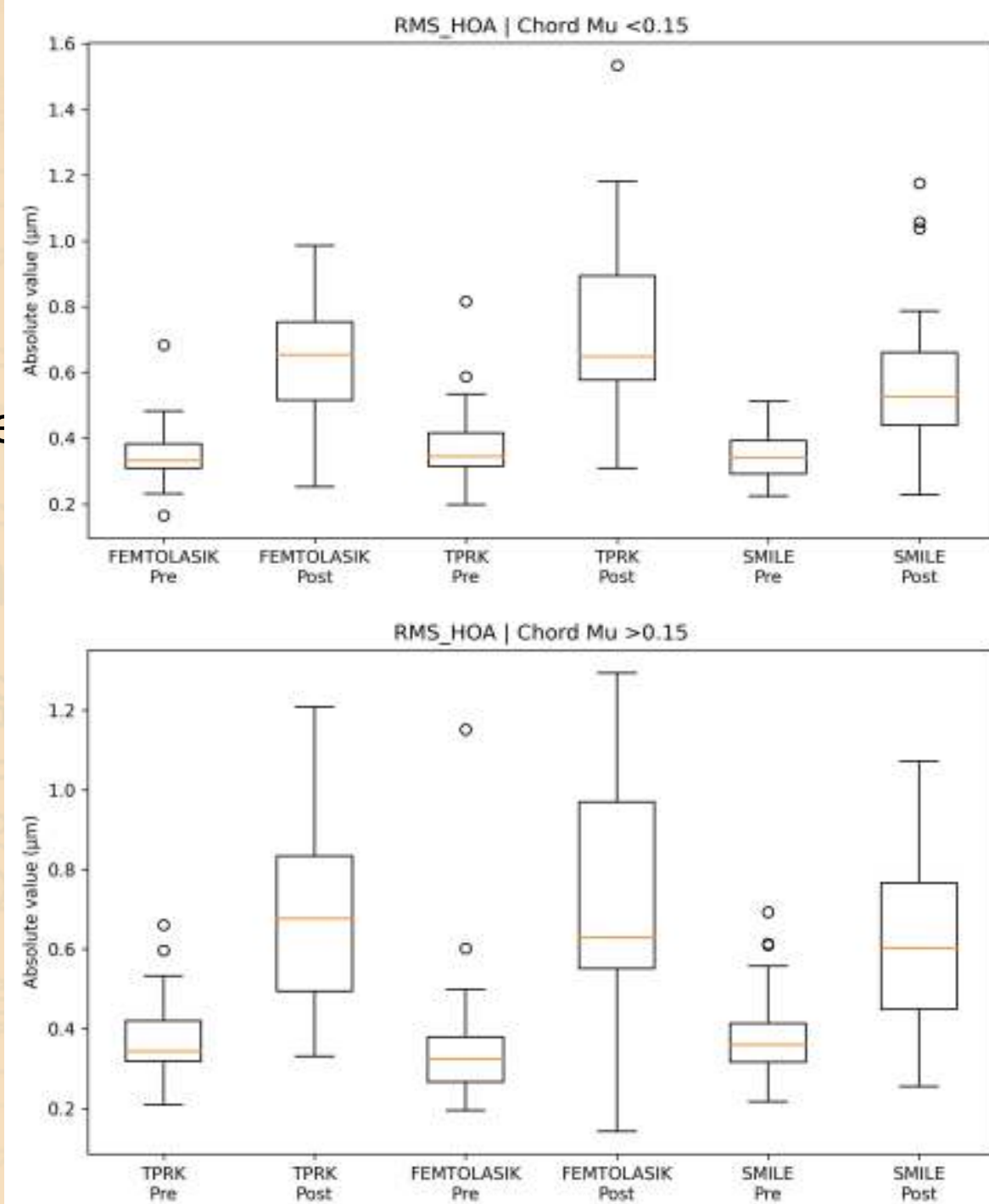
- Normality: Shapiro–Wilk
- **Pre vs Post:** paired t-test or Wilcoxon
- **Between procedures (within chord-mu group):**
- One-way ANOVA + Tukey post-hoc
- **Overall model:**
- Two-way ANOVA (Surgery × Chord Mu)
- Significance: **$p < 0.05$**

Preoperative Baseline Comparability

- No significant preoperative differences between procedures for:
 - Spherical equivalent
 - RMS HOA
 - RMS LOA
 - Spherical aberration
 - Coma and trefoil components

RMS HOA

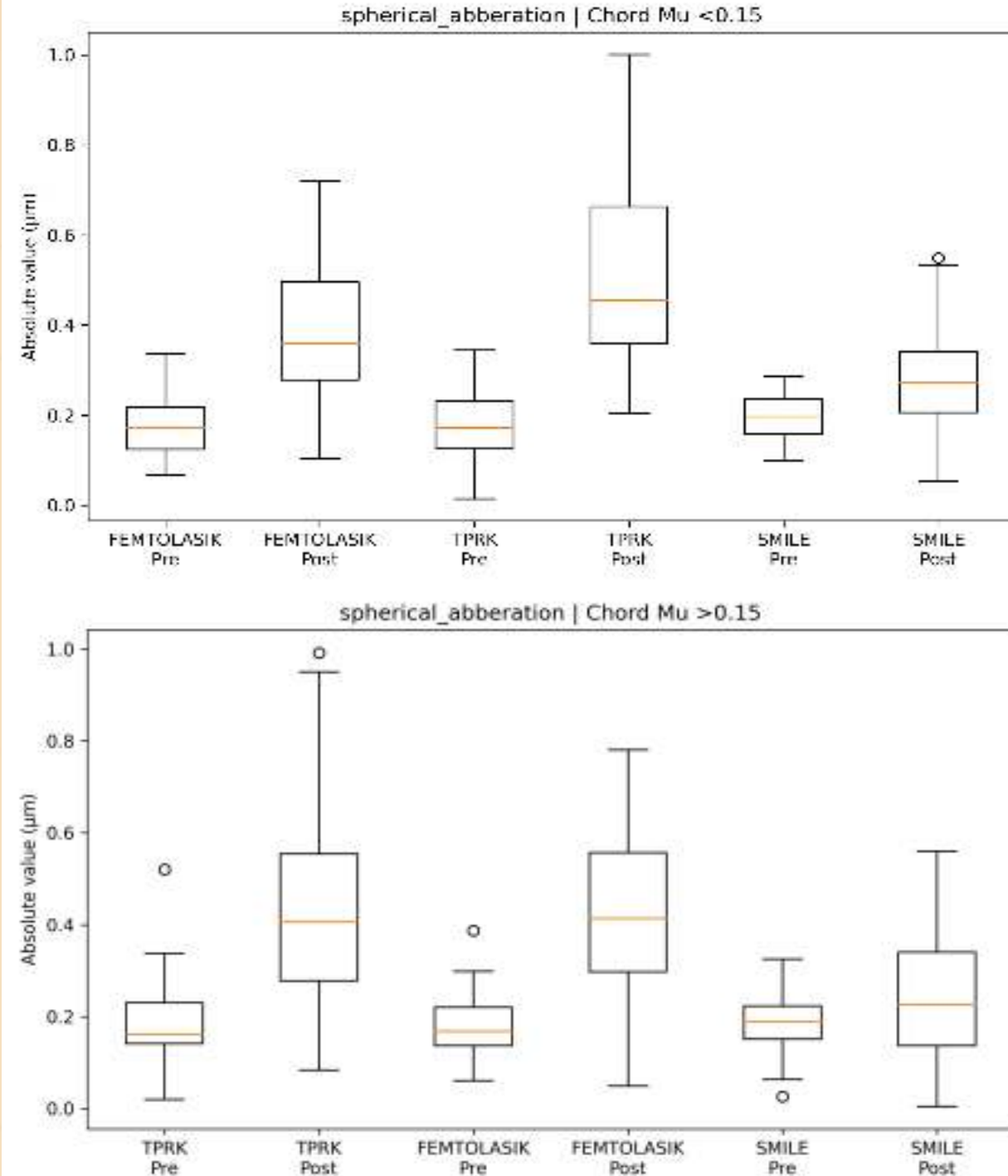
- RMS HOA increased after all procedures
- Magnitude differed significantly by surgery
- **Lowest:** SMILE
- Intermediate: FemtoLASIK
- **Highest:** TPRK
- **Statistics**
- One-way ANOVA: significant
- Tukey post-hoc:
 - SMILE < TPRK ($p < 0.01$)
- Two-way ANOVA:
 - Surgery effect significant
 - No surgery $\times$ chord-mu interaction



Spherical Aberration

- **Lowest:** SMILE
- Intermediate: FemtoLASIK
- **Highest:** TPRK
- **Statistics**
- One-way ANOVA: $p < 0.001$
- Tukey post-hoc:
 - SMILE < FemtoLASIK ($p < 0.01$)
 - SMILE < TPRK ($p < 0.001$)
- Two-way ANOVA:
 - Surgery type significant
 - Chord mu & interaction not significant
- **both chord-mu groups have shown same pattern**

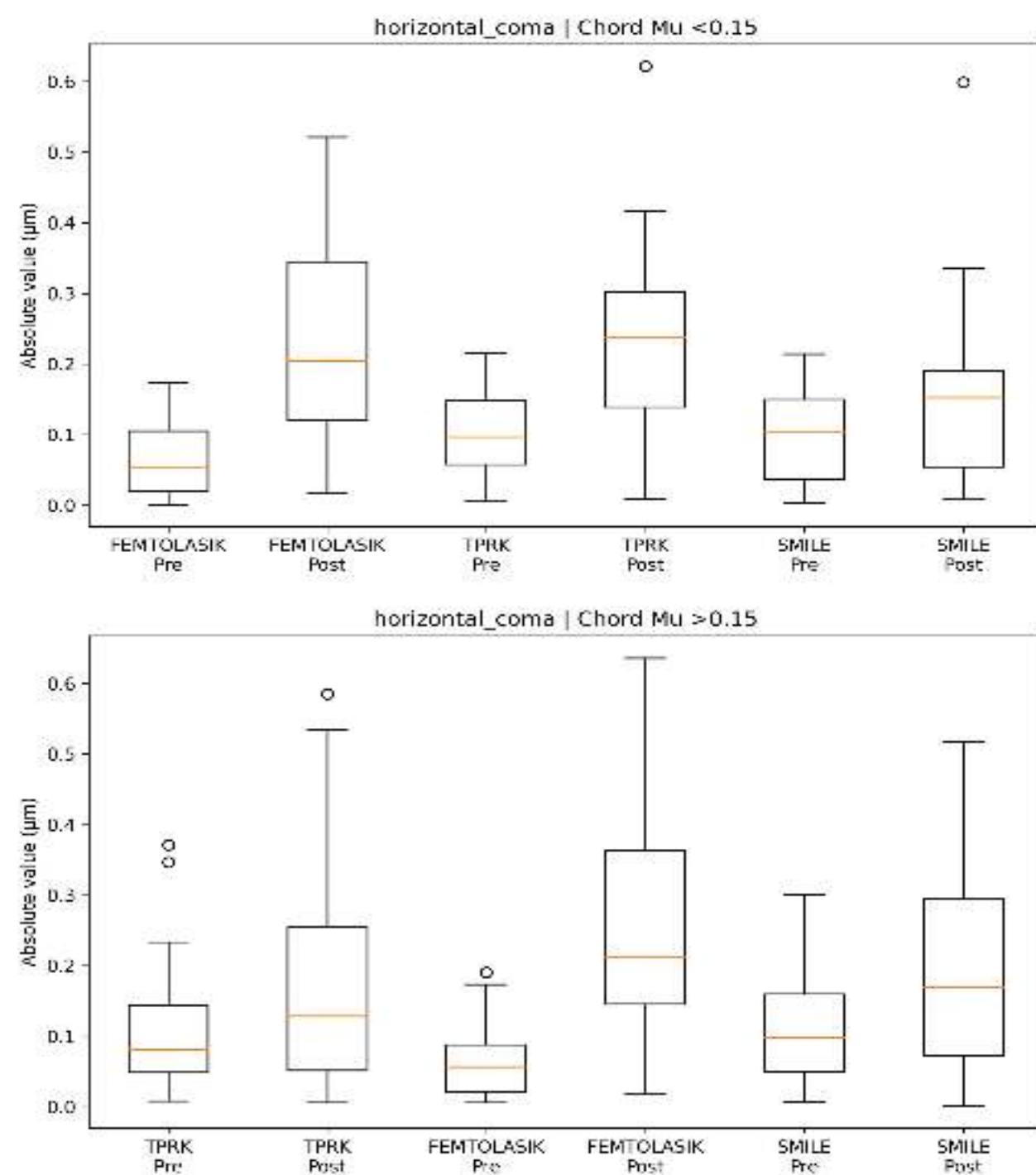
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Horizontal Coma

- Horizontal Coma
- Chord Mu < 0.15
 - Lowest: SMILE
 - Post-hoc: SMILE < FemtoLASIK, SMILE < TPRK
- Chord Mu ≥ 0.15
 - Lowest: TPRK
 - Post-hoc: TPRK < FemtoLASIK
- Coma behavior differs by **component and chord-mu level**

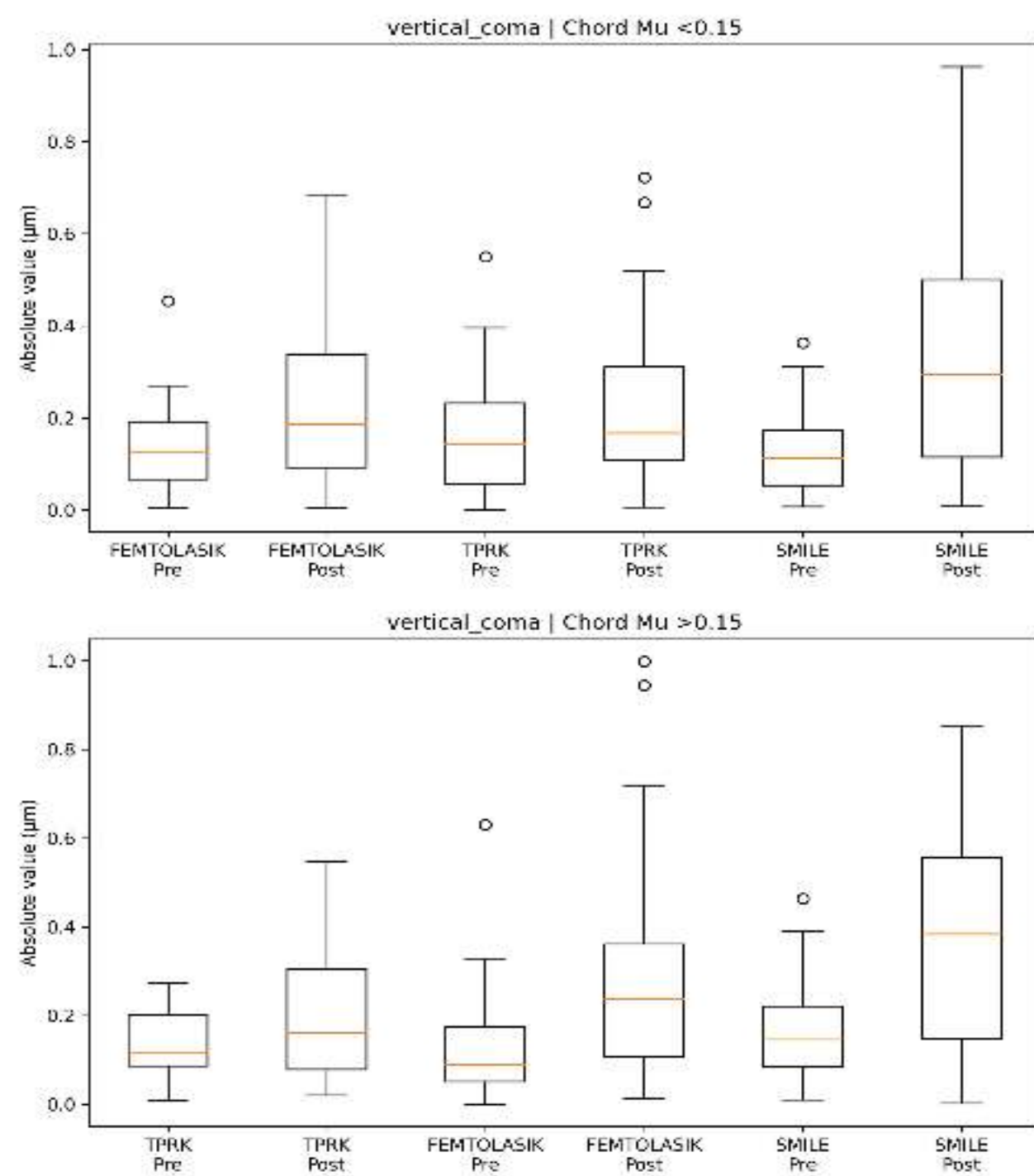
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Vertical Coma

- Vertical Coma
- Chord Mu < 0.15
 - FemtoLASIK $\approx$ TPRK < SMILE
- Chord Mu ≥ 0.15
 - Lowest: TPRK
 - Post-hoc: TPRK < SMILE

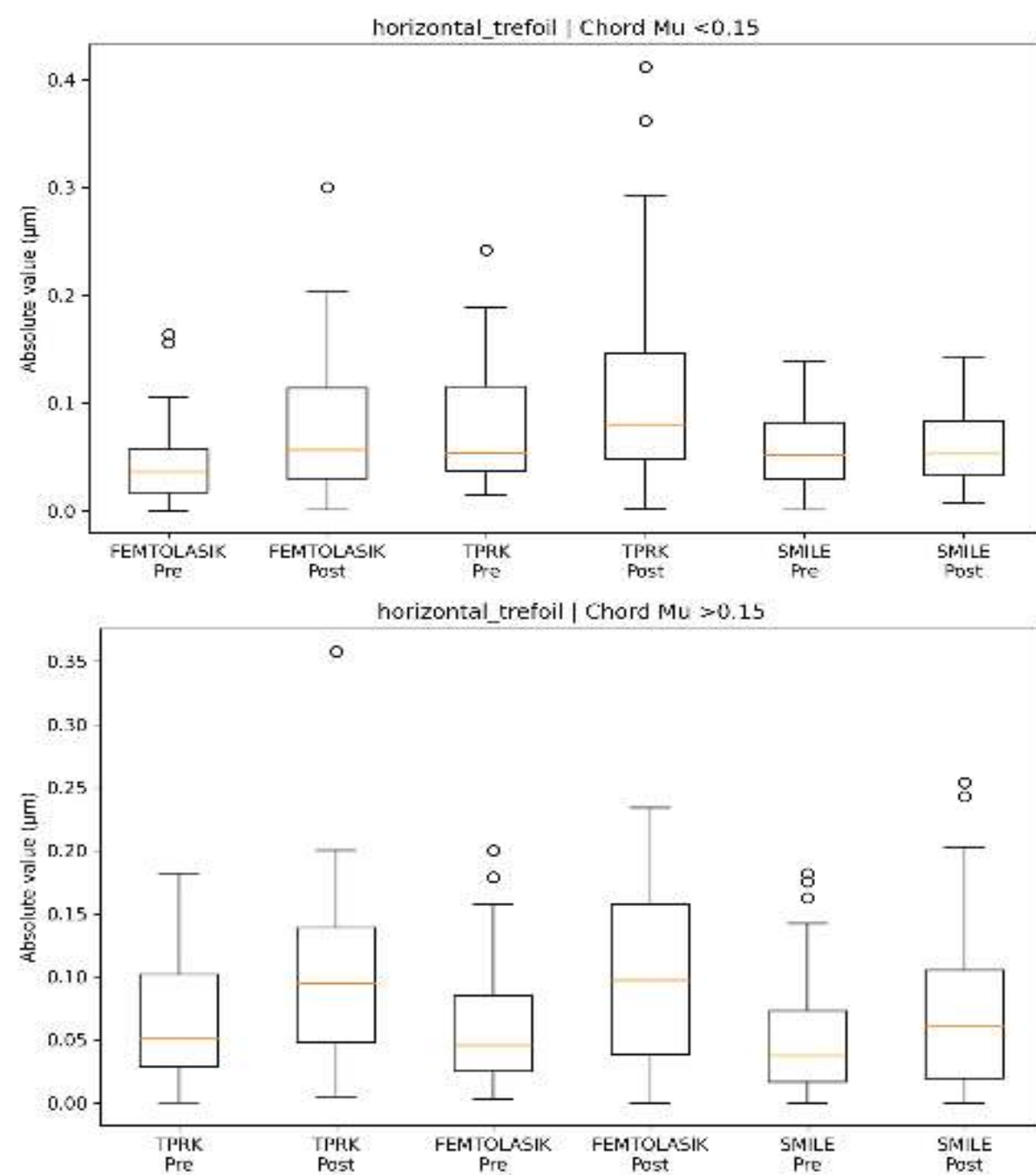
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Horizontal Trefoil

- Both chord-mu groups
 - **Lowest:** SMILE
 - **Highest:** TPRK
- Tukey post-hoc:
 - SMILE < TPRK ($p < 0.01$)

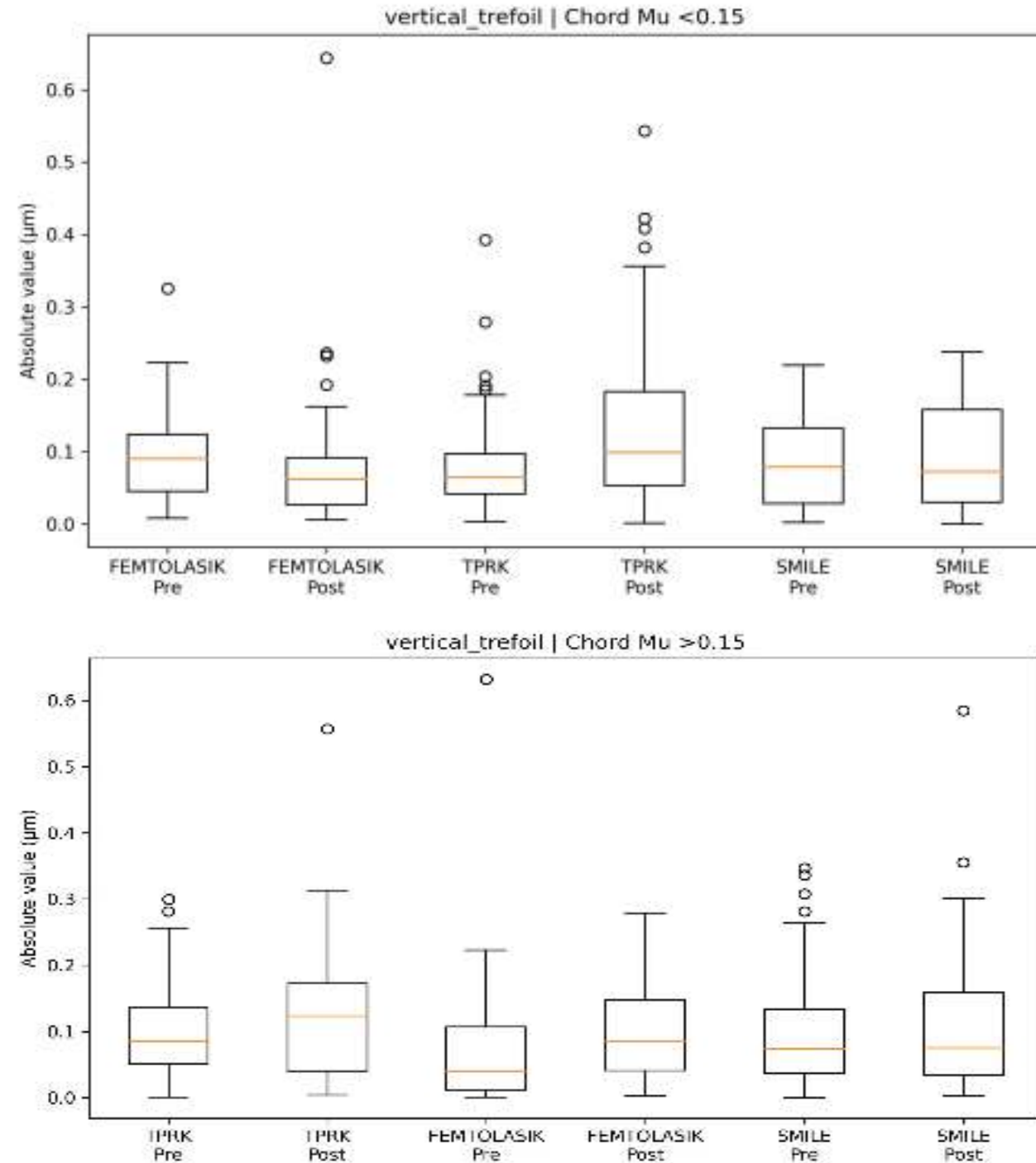
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Vertical Trefoil

- Vertical Trefoil
- Both chord-mu groups
 - **Lowest:** FemtoLASIK
 - **Highest:** TPRK
- Post-hoc:
 - FemtoLASIK < TPRK (significant)

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CENTRATION & CHORD MU (KEY INSIGHT)

- SMILE was performed with **manual centration**
- FemtoLASIK and SmartSurface used **automated eye-tracking centration**
- Despite this:
 - **SMILE achieved equal or better optical outcomes regardless of chord mu size**
 - Lower spherical aberration and RMS HOA
- Indicates:
 - Optical quality is achievable with **proper centration strategy**
 - Automated centration is not the sole determinant

Conclusions

- All procedures induce postoperative optical aberrations
- **SMILE (VisuMax®)**
- Lowest spherical aberration
- Lowest RMS HOA
- Lowest trefoil
- **TPRK (AMARIS)**
- Higher SA and trefoil
- Lowest coma in high chord-mu eyes
- Findings consistent across chord-mu groups
- **Centration quality is critical**
- Even manual SMILE centration can achieve excellent optical outcomes
- Comparable or superior to automated centration systems