LENS AND PERIPHERAL RETINAL RELATIONSHIPS DURING VITRECTOMY: COMPARISON OF 23, 25, AND 27-GAUGE VITRECTOMY AND CURVED ENDOLASER PROBES

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RELEVANT DISCLOSURES

- JS: Consultant for Alcon
- All other authors report no relevant financial disclosures
SUMMARY SLIDE

• Cadaver phakic eye study examining lens relationships with vitreoretinal instruments
• 23, 25, and 27 gauge cutter and laser utilized
• No difference in maneuverability relative to the lens between instruments of different gauge size
• The size of the eye matters more than the instrument gauge in accessing peripheral retina
INTRODUCTION

• Pars plana vitrectomy (PPV) popularized by Machemer et al. in 1971
• Since then, there have been advances in wide angle viewing systems
  • Improved visibility of peripheral vitreous base
  • Allowed surgeons to engage far peripheral retina without scleral depression
INTRODUCTION

• Wide angle view necessary for peripheral PPV
• Peripheral PPV is helpful for surgery for proliferative fibrovascular disease, proliferative vitreoretinopathy, and rhegmatogenous retinal detachment
• Adequate excision without damaging lens is challenging:
  • 1.2 to 9% of pars plana vitrectomy (PPV) has lens touch (Elhousseini et al. 2016, Jackson et al., 2013)
  • More difficult if lens is clear
  • Lens touch: increases chance of early cataract, posterior capsule rupture in subsequent surgery
SMIDDY ET AL (1991)

• Set out to describe relationships between vitrectomy probe and crystalline lens in phakic cadaver eyes

• Obtained three measurements as follows
SMIDDY ET AL. (1991) – 1ST MEASUREMENT

-Vitrectomy probe introduced to geometric center of globe
-Distance between vitrectomy shaft and proximal edge of crystalline lens
SMIDDY ET AL. (1991) – 2ND MEASUREMENT

- Probe positioned so that tip overlied ora serrata in same meridian as sclerotomy
  - Tip moved along ora until instrument touched lens
  - The chord length from sclerotomy to tip was measured
- Using trigonometry: circumferential arc of instrument access to ora on both sides of sclerotomy
- Vitrectomy probe directed toward the equatorial retina 180 degrees from sclerotomy
  - Tip advanced anteriorly until the instrument touched the crystalline lens
- Distance between instrument tip and ora serrata in the meridian opposite the sclerotomy site was measured with calipers
Conclusions:

- First to quantitate the intraocular relationships among the lens, the surgical instruments, and the location of the sclerotomy
- Sclerotomy sites 4mm posterior to limbus in phakic eyes are advantageous
  - Wider range of accessibility to anterior retina on opposite side of eye and the ora serrata extending circumferentially from meridian of sclerotomy
  - Basis for intravitreal injection and port placement technique
CURRENT STUDY: PURPOSE

• Since Smiddy et al. reported their findings in 1991, vitrectomy instruments have been modified to increase performance and safety
  • Curved instruments designed to avoid contact with posterior lens
  • Smaller gauge instruments developed (23, 25, 27-gauge)
• Re-examine the relationships between lens and vitrectomy instruments of different gauges
METHODS

- 8 fresh, fixed in formalin <24 hours, phakic eyes
- Each eye had 23, 25, 27-gauge valved trocar placed in superotemporal quadrant 4 mm from limbus
- Superior cap of globe removed
- Measurements of relationships taken for 23, 25, 27-gauge vitrectomy and curved endolaser probes (Alcon, Irvine, CA)

<table>
<thead>
<tr>
<th></th>
<th>Axial length (mm)</th>
<th>Ora serrata diameter (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>23.6</td>
<td>17.3</td>
</tr>
<tr>
<td>Median</td>
<td>23.5</td>
<td>17.5</td>
</tr>
<tr>
<td>SD</td>
<td>1.4</td>
<td>1.7</td>
</tr>
<tr>
<td>Range</td>
<td>21-26</td>
<td>14-20.5</td>
</tr>
</tbody>
</table>
METHODS

Distances measured with standard calipers to the nearest 1.0 mm:
1. Distance from lens to instrument in geometric center of globe
2. Chord length (arc length calculated)
3. Distance between ora and instrument when lens is touched
## RESULTS: DISTANCE TO LENS AT GEOMETRIC CENTER

<table>
<thead>
<tr>
<th></th>
<th>Cutter (mm)</th>
<th>Laser (mm)</th>
<th>Cutter vs Laser</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>P-Value*</td>
<td>Mean (SD)</td>
</tr>
<tr>
<td>23-Gauge</td>
<td>5.44 (0.77)</td>
<td>0.83</td>
<td>5.69 (0.86)</td>
</tr>
<tr>
<td>25-Gauge</td>
<td>5.56 (1.01)</td>
<td></td>
<td>5.50 (1.09)</td>
</tr>
<tr>
<td>27-Gauge</td>
<td>5.69 (0.43)</td>
<td></td>
<td>5.63 (0.60)</td>
</tr>
</tbody>
</table>

* Kruskal-Wallis Test  
** Wilcoxon Rank-Sum Test
## RESULTS: ARC LENGTH

<table>
<thead>
<tr>
<th>Cutter</th>
<th>Mean degrees (SD)</th>
<th>Mean clock hours</th>
<th>P-Value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>23-Gauge</td>
<td>111.91 (23.09)</td>
<td>3.73</td>
<td></td>
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<tr>
<td>25-Gauge</td>
<td>129.96 (19.96)</td>
<td>4.33</td>
<td>0.16</td>
</tr>
<tr>
<td>27-Gauge</td>
<td>126.79 (14.42)</td>
<td>4.23</td>
<td></td>
</tr>
</tbody>
</table>

* Kruskal-Wallis Test
# RESULTS: DISTANCE TO ORA AT LENS TOUCH

<table>
<thead>
<tr>
<th></th>
<th>Cutter (mm)</th>
<th>Laser (mm)</th>
<th>Cutter versus Laser</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>P-Value*</td>
<td>Mean (SD)</td>
</tr>
<tr>
<td>23-Gauge</td>
<td>1.81 (0.90)</td>
<td>0.27</td>
<td>1.00 (1.50)</td>
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<tr>
<td>25-Gauge</td>
<td>1.63 (0.89)</td>
<td>0.50 (0.83)</td>
<td>0.93</td>
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<tr>
<td>27-Gauge</td>
<td>1.00 (0.83)</td>
<td>0.75 (1.09)</td>
<td></td>
</tr>
</tbody>
</table>

* Kruskal-Wallis Test
** Wilcoxon Rank-Sum Test
CONCLUSIONS

• There were no significant differences between vitrectomy probe or endolaser gauges.
• The distance from lens to any instrument at geometric center of globe from a sclerotomy of 4 mm is 5.5 mm.
• The circumferential arc of the cutter’s access to ora on both sides of sclerotomy is 4 clock hours per side.
• Vitrectomy cutter could be advanced without lens touch to contact retina within 2 mm from ora insertion site.
• Curved endolaser probe could be advanced without lens touch to contact retina within 1 mm from ora insertion site.
• In eyes with axial length ≥25, vitrectomy cutter can cross to ora in same meridian as sclerotomy without touching lens.
LIMITATIONS

• Not *in vivo* study: Intraoperative conditions affect lens position
  • **Infusion pressure** -> displaces lens-iris diaphragm anteriorly
  • **Cycloplegics** -> tighten the lens zonules by relaxing the ciliary muscle -> lens-iris diaphragm pulled posteriorly
• Surgical technique:
  • Tilt: Eye is rolled superiorly or inferiorly to improve access to vitreous
  • Torque: Distortion of sclera from instruments
• Other surgical factors causing pressure changes: retrobulbar block, suprachoroidal hemorrhage, etc.
• 4 mm from limbus trocar insertion site
IMPLICATIONS

• No difference in maneuverability relative to the lens between instruments of different gauge size
• The size of the eye matters more than the instrument gauge in accessing peripheral retina
REFERENCES


