25G PPV WITHOUT SCLERAL BUCKLING FOR RRD, PVR, GIANT BREAKS

STEVE CHARLES
PREMISES

• Vitreoretinal Surgery Should Emulate the Patient Experience and Outcomes of Today’s Refractive Cataract Surgery

• 25/27G Vitrectomy is Better Than 20 or 23G for All Vitreoretinal Surgery, Not Just Macular Surgery

• Adding a Buckle to PPV Does Not Improve Outcomes But Does Increase Complications
PATIENT EXPECTATIONS DRIVEN BY MODERN CATARACT SURGERY

- White, Pain Free Eye, Without Sutures
- No Surgically Induced Refractive Error
- No Diploplia or Ptosis
- 30-45 min Procedure, Under Local

None of These Expectations Can Be Met By:
- Buckles, Especially Encircling Buckles
- Vit-Buckles
- Sutured 20G Vitrectomy
25/27G VITRECTOMY FOR RRD

- **Advantages of 25/27G**
  - Major Advantage: Less Pulsatile Vitreoretinal Traction Than 20G or 23G = Less iatrogenic Retinal Breaks & Retinal Movement
  - Additional Benefit: Trans-Conjunctival, Sutureless
    - Less Discomfort & Conjunctival Damage Than 20G or 23G
- **No Disadvantages of 25/27G**
  - Tool Flex Was A Perceived Issue, New Tools Such As 25 Plus, Contact-Based Wide Angle Viewing & Technique Modifications Such As Cannula Placement & Head Positioning Eliminate Flex Problem
• **Vitrectomy Complications**
  • ~90% Success Rate with Single Procedure
  • Progression of Pre-Existing Nuclear Sclerosis (*not* de novo cataract)
  • Iatrogenic Retinal Breaks
  • Endophthalmitis (3/37,000 in my series, none in RD cases only diabetics >25 years ago)

• **Buckle Complications**
  • Refractive Changes (~ 2.75 diopters with encircling buckle, cannot predict)
  • Ptosis (if superior rectus suture or encircling band damages levator aponeurosis)
  • Strabismus (especially w/ encircling bands or superior buckles because of superior oblique & superior rectus involvement)
  • Pain, Ocular Surge Disorder, Conjunctival Appearance
  • Persistent Subretinal Fluid (subfoveal is critical)
  • Buckle Extrusion, Intrusion, Infection
  • Retinal Incarceration and/or Bleeding at Drain Site
DISADVANTAGES OF VIT-BUCKLE

• No RCT Evidence That Vit-Buckles Produce Better Outcomes Than Vitrectomy Alone

• Significant Incidence of Hypotony & Phthisis (22% in Silicone Oil Study, none in my “primary” PPV for RD or PVR series)

• Much Longer Operating Times (patient discomfort, pain, cost)

• Higher Rates of General Anesthesia (increased medical complications, cost)
ENABLING TECHNOLOGIES & TECHNIQUES

• 25/27 Gauge Sutureless PPV
• High Cutting Rates (7,500-10,000 cuts/min)
• Advanced Fluidics
• Sutureless 25G Vitrectomy
• Wide-Angle Viewing
• PFO
• 25G Silicone Oil Tools & Techniques
• Understanding That PPV Doesn’t Cause Nuclear Sclerosis, Only Progression of Pre-Existing Nuclear Sclerosis

• The Declining Use of Scleral Buckling With Vitrectomy for Primary Retinal Detachments, Deborah Y. Chong, MD; Dwain G. Fuller, MD, JD, Arch Ophthalmol. 2010;128(9):1206-1207. doi:10.1001/archophthalmol.2010.190


• Siqueira RC, Gomes CV, Dalloul C, Jorge R. Vitrectomy with and without scleral buckling for retinal detachment. Arq Bras Oftalmol. 2007;70(2):298-302


• Oyagi T, Emi K. Vitrectomy without scleral buckling for proliferative vitreoretinopathy. Retina. 2004;24(2):215-218
- **Diplopia**
  - Sauer, et al. J Fr Ophth. 2007 Oct., 12 of 821 patients with scleral buckle had diploplia > 3 months, buckle was removed in all 12, of those 3 needed prisms, 3 needed strabismus surgery.
  - Fison, et al. BJO, 1987 Jul., 15 of 311 patients with sclera buckle had diploplia > 3 months, they were treated with prisms +/- buckle removal +/- strabismus surgery, only 80% of that 15 regained binocular vision with those measures.

- **Extrusion**
  - Roldan-Pallares et al. Arch Oph. 1999 Feb; 117(2), 0.6% rate of extrusion for silicone rubber buckles, 1.3% for MIRAgel, 757 patients included in the study.

- **Infection**
  - Hilton G.E. Arch Oph. 1978 Nov; 96, approximate infection of sclera buckles requiring explantation approximately 1%, 7 out of 600 patients.

- **Induced Myopia**
  - Smiddy, Michels, Arch Oph. 1987 Oct; 107(10), 75 eyes, encircling buckle yielded average of 0.99 mm increase in axial length and resulted in 2.75 D of myopic shift.
25/27G VITRECTOMY FOR RRD

- Alcon Constellation Vision System, Standard 78° Endoilluminator (not chandelier), Scleral Tunnel Sclerotomies
- Contact-Based Wide-Angle Visualization (Volk, AVI)
- Highest Cutting Rate (currently 7500 cuts/min)
- Proportional (linear) Vacuum, Not 3D or Dual Linear (50-650 mmHg)
- Never Pull Back While Cutting, Continuous Cutting Not Start-Stop
- Excise Flap of Horseshoe Tear & Remove Vitreous Anterior to Retinal Breaks
- Remove As Much Peripheral Vitreous as Possible, 360°, Not Just in Detached Area
Options to Reattach Retina Before Endolaser to Breaks

- FAX Plus Internal Drain SRF or PFO

2-3 Rows of Confluent Endolaser (not spots) Around All Tears
Plus Confluent Laser to Questionable Breaks, Lattice, Thin Areas

PFO-Gas or Air-Gas Exchange for Superior RD (SF$^6$ preferred over C$^3$F$^8$)

Consider Medium-Term PFO for Inferior RDs (off label in US)
Wide-Angle Illumination

- Wide Angle Illumination Reduces Visualization of Vitreous, ERM, & ILM Because of Diffuse Illumination: Chandelier, Bullet, Diffusion, Torpedo, Illuminated Infusion Port
  - Back Scatter Increases Glare from Cataract, IOL, Cloudy Vitreous, and Cornea, Especially During/After Fluid-Air Exchange
- Focal, Specular, or Retro (reflection from cutter & retina/choroid/RPE) Illumination Facilitates Visualization of Clear Vitreous, ERM, ILM
RETINECTOMY & THE REATTACHMENT SEQUENCE

STEVE CHARLES
WHEN SHOULD RETINETECTOMY BE DONE

• After the Reattachment Sequence Described on Upcoming Slides
• Not Under BSS
• “Under” Air Unless Oil is Already Present
• “Under” Oil if Recurrent Detachment with Oil in the Eye
• Not Under PFO if PVR (risk of subretinal PFO)
Resection of Anterior Loop Traction
(radial vitreous fibers contracted by PVR)
Punch-Thru Retinotomy & Removal of Subretinal Band with 25G DSP End-Grasping Forceps
Removal of Subretinal Band with 25G DSP End-Grasping Forceps
Drain SRF, then FAX

ERM Peel Under Air

Remove Subretinal Band Under Air

Retinectomy Under Air
REATTACHMENT SEQUENCE

1. **Removal of frontal plane vitreous traction (confluence of anterior & posterior vitreous cortex), anterior loop traction (contracted radial vitreous cortex fibers overlying the vitreous base)**

2. **Forceps ERM peeling with ILM forceps**

3. **Removal of significant subretinal bands, access using punch-thru retinotomy with closed forceps, no diathermy, no cutter retinotomy**

4. **Internal drainage of subretinal fluid through pre-existing retinal break with soft-tip cannula or vitreous cutter if potential for residual vitreous**

5. **Start fluid-air exchange only when SRF stops decreasing during internal drainage of SRF**
6. Continue internal drainage of SRF simultaneous with FAX
7. Search for residual vitreous traction if SRF stops decreasing before retina is attached, if present use vitrectomy “under” air (interface vitrectomy)
8. Search for ERM if SRF stops decreasing and peel with ILM forceps “under” air
9. Punch-thru retinotomy with end-grasping forceps to remove subretinal bands if they limit reattachment
10. If still not attached, incremental retinectomy “under” air (not relaxing retinotomy) until retina reattaches (extend to 360° if 270° or greater)
11. Confluent laser to retinectomy edge and severed large vessels
12. Air-silicone oil exchange
13. Eliminates need for buckle (induced myopia, longer OR time, more post-op pain, ocular surface disorder, increased phorias and tropias, extrusion, complicates trabeculectomy and tube shunts
ADVANTAGES OF RETINECTOMY UNDER AIR

- Retinectomy Under BSS Can Result in Excessive or Unnecessary Retinectomy
- Retinectomy Under BSS Results in Excessive Retinal Movement
- Retinectomy Under PFO Often Results in Subretinal PFO
- Retinectomy Under Air Reduces Need for Hemostasis and Confines Bleeding
Retinectomy (Charles)
Excise Retina/ERM
Anterior to Cut

Do Not Perform Relaxing Retinotomy (Machemer)
Retinectomy (Charles) is defined as removing all retina, epiretinal membrane, and vitreous anterior to a circumferential cut in the retina.

Relaxing Retinotomy (Machemer) consists only of a circumferential cut in the retina.

Disadvantages of Relaxing Retinotomy:

- More hypotony & epiciliary proliferation
- Always remove entire lens capsule with forceps if lensectomy
- More anterior segment neovascularization
- Greater PVR recurrence rates
INTERFACE VITRECTOMY BASIC CONCEPT

- Vitreous, BSS, ERM, SRF Removal, Retinectomy just outside Interface of BSS with Air, Oil, or PFO
- Ancillary Techniques Work “Under” Air, Oil, or PFO
  - Anterior Loop Removal
  - Forceps Membrane Peeling
  - Scissors Segmentation and Delamination
  - Punch Thru Retinotomy for Subretinal Surgery
  - Retinectomy
- Established Techniques “Under” Air, Oil, or PFO
  - Internal Drainage of Subretinal Fluid
  - Laser Endophotocoagulation
ADVANTAGES OF INTERFACE PPV

- Improved Visualization of Residual Vitreoretinal Traction
- Subretinal Fluid Remains Stable or Decreases as Vitreoretinal Traction Removed
- Dampening of Retinal Movement
- Bleeding Confined to Interface
**BASIC TECHNIQUE**

- Always Keep Cutter Port in Fluid or In Retina/ERM Complex, Just Outside Interface Between Fluid and Surface Tension Agent
  - Prevents Loss of PFO or Oil
  - Prevents Plugging With Oil
- 650 mmHg Vacuum for Silicone Oil, 25-100 mmHg Proportional Vacuum for PFO & Air
  - 25-27 Gauge for All Cases
Interface Vitrectomy

Agent Immiscible in $\text{H}_2\text{O}$, BSS, Vitreous, Retina, Blood

- Low Specific Gravity (agent floats)
  - Silicone Oil
    - Viscous Dampening
- High Specific Gravity (retina, vitreous, SRF, blood floats)
  - Air
    - Spring Dampening
  - PFO
    - ~2X Inertial Stabilization
    - ~2X Gravitational Force

Residual Vitreoretinal Traction Visible, Less Retinal Movement, SRF Decreases
CLINICAL SCENARIOS FOR INTERFACE PPV

- Residual VR Traction Noted During FAX and Internal Drain of SRF
- Residual VR Traction Noted After PFO Injected
- Excessive Retinal Movement During PPV With BSS in Eye
- Excessive Bleeding During Traction Removal (under air)
- Retinectomies (under air)
- Residual Traction Noted After PFO Injection
- All Silicone Re-ops for PVR or EMM
Interface Vitrectomy

Agent Immiscible in $\text{H}_2\text{O}$, BSS, Vitreous, Retina, Blood

- **Low Specific Gravity**
  - Silicone Oil
  - Viscous Dampening

- **High Specific Gravity**
  - Air
  - Spring Dampening
  - PFO
  - ~2X Inertial Stabilization
  - ~2X Gravitational Force

Residual Vitreoretinal Traction Visible, Less Retinal Movement, SRF Decreases
## INTERFACIAL TENSION AGENTS

<table>
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<tr>
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<th>Specific Gravity</th>
<th>Viscosity</th>
<th>Interfacial Tension</th>
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<tr>
<td>Air</td>
<td>1.00</td>
<td>1.00cs</td>
<td>air or gas-H$_2$O is 72 dynes/cm</td>
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<tr>
<td>Silicone Oil</td>
<td>0.963</td>
<td>1000 or 5000cs</td>
<td>silicone oil-H$_2$O is 44 dynes/cm</td>
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<tr>
<td>PFO</td>
<td>1.75</td>
<td>0.69cs</td>
<td>PFO-H$_2$O is 50 dynes/cm</td>
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AIR

**Advantages**
- No Cost
- Easy to Inject & Remove
- Highest Interfacial Tension
- Spring Dampening
- Confines Bleeding

**Disadvantages**
- Striate Keratopathy If Aphakic Eye
- IOL Fogging (if capsule not intact & disrupted anterior vitreous cortex)
F = -kY

F is Force
k is Spring Constant
Y is Displacement
<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
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</thead>
<tbody>
<tr>
<td>• ~2X Inertial Dampening</td>
<td>• Residual Droplets</td>
</tr>
<tr>
<td>• ~2X Gravitational Down Force</td>
<td>• Moderate Cost</td>
</tr>
<tr>
<td>• Easy to Inject &amp; Remove, Less Viscous Than BSS</td>
<td></td>
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<tr>
<td>• Moderate Interfacial Tension</td>
<td></td>
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<tr>
<td>• Intra-Op or Medium Term Use (~ 2 weeks)</td>
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Removing Residual Vitreous Traction “Under” PFO
SILICONE OIL

**Advantages**
- Realistic Intraoperative Assessment of Residual Traction
- No Need to Remove Oil If Already Present
- Intra-Operative & Long Term Use
- Shorter Operating Times

**Disadvantages**
- Moderate Cost
- 1000-5000X More Time to Inject & Remove Than Air or PFO (1000cs 5X faster than 5000 cs)
- ~5% Emulsification Glaucoma with Long Term Use
F=bv
B is viscosity constant
V is velocity
CLINICAL SCENARIOS FOR INTERFACE PPV

- Residual VR Traction Noted During FAX and IDS
- Residual VR Traction Noted After PFO Injected
- Excessive Retinal Movement During PPV With BSS in Eye
- Excessive Bleeding During Traction Removal (under air)
- Retinectomies (under air)
- Residual Traction noted During PFO Injection
- All Silicone Re-ops for PVR or EMM
TWO-PORT 25G SILICONE OIL RE-OPE TECHNIQUE

• 25G Cannula Superotemporal for Tools, Place Plug Rapidly to Prevent Oil Loss
• 25G Cannula Superonasal for Endoilluminator, Insert Endoilluminator
• Alcon VFC Loaded with 1000cs Oil, 25G Alcon Silicone Oil Cannula, If RD/PVR
  • EMM/ILM Peeled Without Adding Oil
  • PVR: Retinectomy, SRF Removal with Cutter Require Adding Oil
EMM Forceps Membrane Peeling, Two-Port “Under“ Oil
MEDIUM TERM PFO WITHOUT SCLERAL BUCKLING FOR INFERIOR RRD, PVR, GIANT BREAKS

steve charles
MEDIUM TERM PFO FOR INFERIOR RD

- Meticulous Peripheral Vitrectomy, Don’t Force PVD, PVD Will Evolve Over 14 Days
- Inject PFO with MedOne Dual Bore Cannula
- Apply Laser to Breaks & Any Suspicious Areas After Retina Attached With PFO, Laser Can Be Applied Post-Op with LIO If Intra-Op Endolaser Found to Be Insufficient
- Drainage of SRF If Needed (insert soft-tip cannula into break)
- Patient Positioned Seated, Standing, or Semi-Reclining
- Remove PFO After 14+ Days When Laser Marks Pigmented
- Ideal for All Inferior RDs, Failed Inferior Buckles, Giant Breaks, Very Thin Sclera, Giant Breaks (Marfan’s, selected myopes)
- 2nd Procedure to Remove PFO Necessary
- Residual Droplets Common, Must Remove to Reduce Glaucoma (if A/C: office, slitlamp, 30g at 6 o/c, bevel up)
Medium Term PFO for Inferior RDs cont.

- Author’s Prospective, Consecutive Series, Currently >900 Eyes, No Toxicity
- Sub-Conj Decadron and Topical Difluprednate
- Requires 2nd brief 25/27G Procedure to Remove PFO
- Removal of Droplets from A/C, Space Between Iris and Lens/IOL, and Capsular Bag Essential to Prevent Glaucoma
- Office Removal of Droplets Using 30G Bevel Up Needle at 6 o/c Limbus Using Slitlamp
360° Peripheral Vitreous Removal
Laser Around Breaks, Consider Laser for Extent of RD or 360°
Drain SRF If SRF Persists After PFO Injection
Alternative: Retinotomy At Ora
Extend Break to Ora
To Remove SRF
Anterior To Breaks