ILM Peeling: Technique, Outcomes and Complications

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Overview

• The Retinal Surgeon’s Toolbox (Dyes, Forceps)
• Techniques of Membrane Peeling
  • Naked Peel
  • ICG
  • Triamcinolone
  • The Blue Dyes
• Indications
  • ERM
  • Macular Hole
  • Diabetic Macular Edema
  • Retinal Detachment?Macular Hole
  • VMT
• Complications
Anatomy of the ILM

• Structural boundary between retina and vitreous
• Thickest posteriorly (2.5 microns)
• Close association with Muller cells
Function of ILM

- Involved in early embryogenesis
- Does not regenerate
- Stretching and flattening of neighboring Muller cell processes occurs
Good Vision without ILM

• Credit goes to Morris, Kuhn and Witherspoon of Birmingham, Alabama who reported on eyes with “hemorrhagic macular cysts” due to Tersons syndrome – documenting stable good vision after removing the macular ILM
ILM Removal in MHS

- Credit also goes to Dr Logan Brooks for stressing the need for ILM peeling in MHS to achieve anatomic success
Membrane Peeling

- Epiretinal Membrane (ERM)
- Internal Limiting Membrane (ILM)
  - Macular Hole
  - Diabetic Macular Edema (DME)
  - Vitreomacular Traction Syndrome (VMT)
    - ILM is usually thickened in these cases
- Terson Syndrome
  - Sub-ILM blood can be present
- Optic Pit Maculopathy
  - Case reports of improvement with ILM peeling and gas tamponade
Membrane Peeling: Adjuvants

- Staining can make it easier to see!
Preferred Adjuvant to Aid in Epiretinal and/or ILM Peeling

- Indocyanine Green: 51.27%
- Triamcinolone acetonide: 19.29%
- Trypan Blue: 5.84%
- Brilliant Blue G: 9.64%
- None: 13.71%
- Other: 0.25%

N=394
The “Naked” Peel

let’s get naked!
ILM Peeling without Dyes

- Simple technique for complete removal
- Magnifying contact lens
  - Axial magnification
- Barbed MVR
- Peeled areas show whitish reflex
- Staining simply not required
- No need to worry about toxicity of the agent or extra step in administration
ICG Staining

- ICG Staining
  - Stains Type 4 collagen
  - Improves visualization of ILM
  - Decreases surgical time
  - Decreases risk of phototoxicity
  - Decreases learning curve
ICG: Cell Culture Studies

- ICG has been tested using
  - Retinal pigment epithelium
  - Choroidal endothelial cells
  - Muller cells
  - Retinal ganglion cells

- Toxicity increases with increasing concentration and exposure time
- Few studies show toxicity at or below 0.05 mg/ml
- Hypo-osmolarity and concurrent light exposure may increase toxicity
Adverse Events with ICG

- Reduced VA
- Visual field defects
- Retinal pigment epithelium changes
- Reduced rate of macular hole closure
- Persistence of ICG in the retina and optic nerve
- Optic atrophy
- Altered surgical cleavage plane with ILM peeling
ICG Assisted Peel
ICG Recommendations

• If you REALLY have to use it….
  • Use concentrations \( \leq 0.05 \text{ mg/ml} \)
  • Use ICG in fluid-filled eyes
  • Keep exposure times short (10s or less)
  • Avoid proximal or prolonged endoillumination of stained tissue
  • Thoroughly rinse the ICG from the eye
ICG Summary

- Good contrast
- Peeling is easier
- Toxicity concerns
Triamcinolone
Triamcinolone
Triamcinolone

- Undiluted or diluted triamcinolone dispersed lightly over the macula
- Intraocular forceps used to tear the ILM in a tangential fashion
- Flap grasped and regrasped to ensure ILM is peeled in one large sheet in a tangential fashion around the fovea
- Free floating ILM pieces and triamcinolone removed with the vitrector
Triamcinolone Pearls

- Start edge by grasping ILM (picks and MVR blades do not work with this technique)
- Once peeling has begun, grab as close to the surface as possible and regrab often and in tangential fashion rather than perpendicular
- ILM in contrast to cortical vitreous will always scroll
- If cortical vitreous has been peeled, reinject kenalog for the ILM
- ILM peeled area will have a dull reflex. If there is no dull reflex ILM has not been peeled.
Does Triamcinolone Impact Macular Hole Closure?
Triamcinolone Study

- 37 consecutive patients
- Single Surgeon (GS)
- All Stage 2, 3, or 4 (confirmed by OCT)
- Minimum 3 month f/u
- Excluded:
  - Traumatic holes
  - Previous vitreous surgery
  - Patients with previous RD
Technique

• Triamcinolone acetonide to elevate posterior hyaloid and peel ILM
• Steroid particles removed from vitreous cavity but remained at edge of hole
• 25% SF6 gas for 3 days/8 hours
## Results

<table>
<thead>
<tr>
<th>Total Patients</th>
<th>37</th>
<th>10</th>
<th>27</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>27</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Mean Follow-up (months)</th>
<th>11</th>
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<table>
<thead>
<tr>
<th>Lens Status</th>
<th>26</th>
<th>11</th>
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<tbody>
<tr>
<td>Phakic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pseudophakic</td>
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</table>

<table>
<thead>
<tr>
<th>Stage of Macular Hole</th>
<th>10 (27%)</th>
<th>25 (68%)</th>
<th>2 (5%)</th>
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<tbody>
<tr>
<td>Stage 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stage 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stage 4</td>
<td></td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Gauge of Vitrectomy</th>
<th>27 (73%)</th>
<th>10 (27%)</th>
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</thead>
<tbody>
<tr>
<td>23 gauge</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20 gauge</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mean Visual Acuity (best corrected)</th>
<th>20/150</th>
<th>20/63</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preoperative</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Postoperative</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

p < 0.0001
Results

- Anatomic hole closure 97% (36/37 eyes)
- No postoperative RD or endophthalmitis
- 5 patients required glaucoma medication
  - 3 were using prior to surgery/2 stopped after 4 weeks
- No patients needed glaucoma surgery
- 26 phakic eyes, 18 (70%) had cataract
  - progression and 12 underwent cataract surgery
Triamcinolone vs. ICG

- **Advantages:**
  - Triamcinolone can be reinjected once ILM peeling has begun
  - No special preparation
  - No photosensitizing properties like ICG
  - Useful for patients with iodine allergy
  - Cost: Triamcinolone=$15   ICG=$120

- **Disadvantages:**
  - ICG stains for Type 4 collagen; Triamcinolone does not stain
  - Triamcinolone tends to stick to the forceps platform
The BLUE Dyes…
Trypan Blue

- Binds to ERM; ILM staining is subtle (less than ICG)
- No toxicity noted in clinical studies of ERM and MH
- Two percentages available
  - 0.06% (Vision Blue) – good for cataract surgery
  - 0.15% (Membrane Blue) – good for retina surgery
Brilliant Blue G 0.025%

- Brilliant Peel (Europe) or compounded in US
- Dosage 0.25 mg/ml
- Non-toxic to retina
- Can use in fluid-filled eye
- Improved staining of ILM
- Combination Trypan and Brilliant Blue available in Europe now and likely entering US in 2013
Blue Dye Summary

- Trypan Blue and Brilliant Blue appear safer than ICG
- Trypan blue better for ERM
- Brilliant Blue better for ILM
- Look for more in 2014
ILM Peeling Studies
How often you peel ILM during routine vitrectomy for epiretinal membrane

- Never: 10.86%
- 1-25%: 23.36%
- 26-50%: 11.18%
- 51-75%: 10.53%
- 76-99%: 25.00%
- 100%: 19.08%

N=304
Triamcinolone: ERM and ILM Peeling Combined

- Source of controversy in the literature
- Largest retrospective series (GS) (n = 38 consecutive patients with longest follow-up) (mean: 589 days)
- After peeling ERM, every case had ILM peeled
- Average pre-operative acuity: 20/90
- Average acuity at 3 months: 20/55
- Average acuity at final visit: 20/67
- Average improvement in visual acuity: 2.2 lines
- Recurrence rate zero
DME: Intraoperative

- Anything different for a DME ILM peel?
- “Sponge” retina

Pre-op 20/400
Post-op 20/100
<table>
<thead>
<tr>
<th>Author / Date</th>
<th>Study Type</th>
<th>Surgical Adjuvent</th>
<th>n</th>
<th>f/up</th>
<th>ILM Peel?</th>
<th>VA Base</th>
<th>OCT Base</th>
<th>VA Change</th>
<th>OCT Change</th>
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<tbody>
<tr>
<td>Flaxel, et. al., 2010</td>
<td>P, I</td>
<td>V</td>
<td>241</td>
<td>6m</td>
<td></td>
<td>20/80</td>
<td>-412</td>
<td>Unch</td>
<td>- 134 u</td>
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<tr>
<td>Jahn, et. al., 2004</td>
<td>P, I</td>
<td>NS</td>
<td>30</td>
<td>24m</td>
<td></td>
<td>20/30</td>
<td>NS</td>
<td>Unch</td>
<td>NS</td>
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<td>Avci, et. al., 2005</td>
<td>P, I</td>
<td>TA</td>
<td>13</td>
<td>7.4m</td>
<td></td>
<td>20/32</td>
<td>NS</td>
<td>0.1 logMAR</td>
<td>NS</td>
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<td>P, I</td>
<td>ICG</td>
<td>21</td>
<td>17.8m</td>
<td></td>
<td>NS</td>
<td>553</td>
<td>NS</td>
<td>- 396</td>
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<tr>
<td>Recchia, et. al., 2005</td>
<td>P, I</td>
<td>ICG</td>
<td>11</td>
<td>11m</td>
<td></td>
<td>20/352</td>
<td>445</td>
<td>N/A</td>
<td>- 193</td>
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<tr>
<td>Shah, et. al., 2005</td>
<td>R</td>
<td>TA</td>
<td>26</td>
<td>8m</td>
<td></td>
<td>20/190</td>
<td>575</td>
<td>0.23 logMAR</td>
<td>- 260</td>
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<tr>
<td>Stolba, et. al., 2005</td>
<td>P, RCT</td>
<td>ICG</td>
<td>56</td>
<td>6m</td>
<td></td>
<td>20/38</td>
<td>544</td>
<td>Unch</td>
<td>-60 u</td>
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P = Prospective, O=Observational, I=Interventional, R=Retrospective, RCT=Randomized Clinical Trial, V=Variable, ICG = Indocyanine Green, TA = Triamcinolone Acetonide, NS = Not Specified, N = None, Y=Yes, N=No, SP = Surgeon Preference, Unch = Unchanged., N/A=Data Not Available
<table>
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<th>OCT Base</th>
<th>VA Change</th>
<th>OCT Change</th>
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</thead>
<tbody>
<tr>
<td>Yanyali, et. al., 2006</td>
<td>RCT</td>
<td>N/A</td>
<td>20</td>
<td>12m</td>
<td>Y</td>
<td>20/102</td>
<td>391</td>
<td>0.17 logMAR</td>
<td>- 166</td>
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<tr>
<td>Song, et. al., 2007</td>
<td>R</td>
<td>NS</td>
<td>55</td>
<td>8.3m</td>
<td>SP</td>
<td>20/162</td>
<td>440</td>
<td>0.19 logMAR</td>
<td>- 134</td>
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<tr>
<td>Yanyali, et. al., 2007</td>
<td>R</td>
<td>N/A</td>
<td>27</td>
<td>27.6m</td>
<td>Y</td>
<td>20/112</td>
<td>408</td>
<td>0.12 logMAR</td>
<td>- 178</td>
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</table>

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• Prospective interventional study
• Inclusion: Center involving DME, VA > 20/800, and presence of VMT.
• 241 eyes underwent PPV for DME
• Investigators choice for surgical technique, adjuvents, or ILM Peeling.
• 61% had ERM Peeled; 64% ILM Peeled

• Multivariate analysis: VA and OCT outcome

• Results:
  • Median CST improvement 412 → 278
  • Median VA unchanged 20/80 → 20/80
    • Greater VA improvement if:
      • Worse initial VA or retinal thickness
      • ERM present or ILM Peeled
      • OCT evidence of VR abnormalities

Complications
ILM Peeling: Complications
Complications

• Subretinal hemorrhage
• Intraoperative bleeding
• Postoperative persistent edema
• Postoperative eccentric macular holes
Eccentric Macular Holes after ILM Peeling

- Rubenstein, Bates, Benjamin, Shaikh, 2005 retrospective analysis of 232 eyes undergoing ILM peeling for idiopathic macular hole
- 4 patients had postoperative iatrogenic holes
- All patients were asymptomatic and felt to be at low risk for detachment and were observed without additional intervention
Eccentric Macular Holes after ILM Peeling

- Mason, Feist, Albert, 2007
- Retrospective analysis of 631 eyes undergoing ERM removal with ILM peeling
- 6 patients developed an eccentric macular hole

<table>
<thead>
<tr>
<th>Patient</th>
<th>Age (y)</th>
<th>VA When Eccentric MH Diagnosed</th>
<th>Postoperative Visit When Eccentric MH Diagnosed</th>
<th>Interval to Diagnosis</th>
<th>Final VA</th>
<th>Follow-up</th>
<th>Management</th>
<th>Eccentric MH Location</th>
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<tbody>
<tr>
<td>1</td>
<td>77</td>
<td>2/300</td>
<td>4</td>
<td>6 wk</td>
<td>5/200</td>
<td>9 wk</td>
<td>None</td>
<td>Nasal</td>
</tr>
<tr>
<td>2</td>
<td>54</td>
<td>20/100</td>
<td>2</td>
<td>9 d</td>
<td>20/40</td>
<td>12 mo</td>
<td>Laser</td>
<td>Temporal</td>
</tr>
<tr>
<td>3</td>
<td>73</td>
<td>20/20</td>
<td>4</td>
<td>2 mo</td>
<td>20/20</td>
<td>37 mo</td>
<td>Laser</td>
<td>Temporal</td>
</tr>
<tr>
<td>4</td>
<td>75</td>
<td>20/50</td>
<td>5</td>
<td>4 mo</td>
<td>20/40</td>
<td>26 mo</td>
<td>None</td>
<td>Temporal</td>
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<tr>
<td>5</td>
<td>64</td>
<td>20/25</td>
<td>6</td>
<td>8 mo</td>
<td>20/25</td>
<td>24 mo</td>
<td>None</td>
<td>Temporal</td>
</tr>
<tr>
<td>6</td>
<td>34</td>
<td>20/20</td>
<td>4</td>
<td>2.5 mo</td>
<td>20/20</td>
<td>3 mo</td>
<td>None</td>
<td>Superior</td>
</tr>
</tbody>
</table>

MH, macular hole; VA, best-corrected Snellen visual acuity.
Eccentric Macular Holes after ILM Peeling

- Mason, Feist, Albert, 2007
- Most cases were observed without intervention
- No cases enlargement of holes over time
Eccentric Macular Holes after ILM Peeling

Mechanisms:

1. Glial cell migration along outer retinal surface and simultaneous inner retinal layer degeneration, causing dehiscence of layers
2. Direct surgical trauma to the retina during the procedure (i.e. multiple grasps)
3. Possible toxicity of staining solutions (authors in both studies used ICG)
4. Contracture at edge of remaining ILM
Final Thoughts….

- Have a plan and always **BE PREPARED**
- Visualization: “You can’t fix what you can’t see”
- It is not a race…Speed vs. efficiency
- Know when to say “when”
- It is always about the patient
Thank You
Discussion
ERM: Preoperative

- Which factors are important to you?
  - Retinal Thickening on OCT?
  - Cystic Edema?
  - IS/OS Junction?
  - Visual Acuity?
  - Patient’s Complaints?
  - Patients Level of Sanity?
ERM: Intraoperative

- Complete vitrectomy or not?
- Gauge, vitreector, forcep and adjuvant choice?
- Where do you start peeling?
- How far do you peel?
- Do you peel ILM too?
- Strips left on fovea?
- Subtenon’s kenalog or intravitreal kenalog or nothing at end?
- Leave fluid or air/gas?
Persistent Macular Edema after peeling for ERM (ILM Intact)

  - 26 eyes with persistent macular edema (minimal f/u > 24 weeks), mean 32.1 weeks (25-54 weeks) after PPV *without* ILM peeling
  - 12 eyes received one injection of bevacizumab vs 14 eyes with no treatment
  - F/u at 1, 4, 8, and 12 weeks
  - No significant change in CMT and BCVA at all timepoints with one injection of bevacizumab.
Lamellar Holes

TO Vitx....

Or Not....