Assessment of Refractive Error

Typical kids less than 5yrs of age don’t do subjective but assess RE by RETINOSCOPY
Dry retinoscopy and/or Wet retinoscopy

What about Autorefraction?
Difficult under 4 unless hand held
Hand held maybe 2 to 2.5yrs and above if you are good and quick - BUT
  Limited ranges on sphere and cyl
  Difficult in strabismus, nystagmus
  Must be cyclopeged
  More useful for cyl than sphere
  Are you going to have 2 different autorefractors in your practice?
Can do everyone with retinoscope and cheaper than another autorefractor, you already have the equipment

Loose Lens Retinoscopy
Advantages: Keep child’s attention; Less Freighting for child; Most don’t fit or stay behind phoropter

How to do it (things to discuss)
Technique/mechanics
Get and stay on axis for strabismus
Get axis correct

Dry Retinoscopy - Technique
MUST CONTROL ACCOMMODATION
1. Fixation at Distance
   Possible at 2 to 2.5 years and older there are other techniques for less than 2 to 2.5 yrs
2. Fog the other eye by using + lenses
   If myopia, may need to use some minus, but less than full correction

Attention at distance to control accommodation
   Must be large enough to see through the fog
   Must be interesting and meaningful to the child
     The red/green E just isn't it
Better if target is dynamic and changing

Options to get attention at distance
Movie – DVD/TV combo at distance; Ask the child questions about what is going on at end of room;
Mechanical toys; Sibs/parents/Fellow student/tech; Look out for someone who might come into room if 3 to 5yrs and no movie; Chicken and hole story

Dry Retinoscopy - Fogging
Control Accommodation by Fogging other eye
Trial frame for scoping - NO
Heavy and don’t fit well; Not practical for infants and those less than about 3 yrs
Lens paddles vs loose lens
If use single paddle, then cant fog other eye
If paddle like flipper, awkward, need lots of powers
Duplication of trial lenses
If use flipper and insert trial lens, time consuming

Dry Retinoscopy - Fogging
Quick look at reflex without lenses to estimate fog needed
Example - pretty slow with
   Take 2 lenses separated by about 1 D
   Example + 4 and + 5
   Hold in front of child one in front of each eye and check reflex
   if still with and using +4, switch lenses
   If against use +4 to fog other eye and then get +3
   Bracket first in 1D steps then 0.50D steps

Must be efficient and entertaining
Return lenses to trial case in proper place; Don’t spread out on counter
10 to 15 lenses out of trial case is not efficient

What if kid wont look at Distance?
Dynamic techniques
1. Scope while child looking at light
   Sing, animal sounds, noises to get and keep attention
   No working lens subtracted, note dynamic and it is the gross lens in chart
   Reasonable estimate of astigmatism
   If kid looses it after drops, and high cly, at least you have some info and could Rx something if needed

Mohindra or Near Retinoscopy
Not a Dynamic retinoscopy technique
Dynamic techniques – accommodation active
Principle behind Mohindra or Near retinoscopy is accommodation is NOT active
Dark room with retinoscope target as light; Look at light – not accommodative stimulus
If distance is 50 cm or greater – WATCH your working distance

Done in completely dark room
Examiner is at 50cm from the patient
Original technique – monocular, with other eye occluded, eliminate vergence but most
don’t use occlusion now
-1.25 working distance
Wait for with motion
Must use sound effects or sing

If at 50cm why -1.25 working distance for Mohindra?
   Empirically derived to get best agreement with cycloplegic retinoscopy
   Claimed as adjustment for dark focus
Comparison to cycloplegic Refraction
Sphere r = 0.88
Cylinder $r = 0.85$

The Dim Reflex
Really dim and no motion or fat and slow reflex
If dim reflex almost always NOT NEUTRAL but high RE
Try -8 and +8 to see if you see something
At least once a semester a -10 or so gets scoped as plano, DON’T LET THAT BE YOU

Getting the Axis Right
Find and neutralize the most plus meridian
Rotate beam 90deg and neutralize other meridian
The axis of the cyl correction will be at the same orientation of the retinoscope beam
Review, optical crosses, responsible for knowing this

Checking the Balance
1. MEM – discussed by Dr Anderson
   Over distance Rx or proposed distance correction
   If neturalizing lens differs between the eyes recheck distance retinoscopy or subjective
   (in older patient)
2. Look at near CT
   Unequal movement in the two eyes suggests imbalance
3. Limited Subjective
   Older 5 and 6 year olds may be able to do a limited subject
   This subjective is typically a confirmation of retinoscopy
   Two endpoints may be possible to determine by subjective
      Endpoint sphere if you do it correctly
      Axis of astigmatism – but not power

Techniques for Sphere Endpoint
Blur out the threshold line
Start with sphere retinoscopy in phoropter
+1.00 over BVA should blur out the threshold line
To make sure I sometimes say, if I had $100, but I don’t, could you read if for $100? – to try to make sure they are motivated

Techniques for Sphere Endpoint
Could also try red/green technique
Some kids works great, others really bad

Does NOT work to refine in 0.25 D steps
More minus or less plus almost always looks better so don’t give them these choices

Modified Subjective Techniques for Astigmatism
Subjective for power typically DOES NOT work well in kids under 7
They usually do one of 2 things
Throw out cyl you scope but VA is bad without it
When you give them 2 choices they always pick the same, 1 because its always better to be first or 2 because 2 is more than 1 so that is better
DO IT MONOCULAR behind the phoropter with cyl power from retinoscopy
Modified subjective for AXIS of astigmatism
Target =Letter above threshold around 20/30 or perhaps 20/40 if refractive amblyopia
due to uncorrected cyl
Isolate a letter with sharp angles “L”, “Z,” “T”, “E”
Ask what the letter is, if they cant see it, need to select bigger letter, or recheck retinoscopy

Ask if the letter looks straight
Rotate axis 45 degrees from what you scoped
Ask if the letter is crooked, ugly, if they can see it
Tell the child to say STOP with the letter is straight and clear
Slowly rotate axis
Try not to look at it as you rotate; Try not to slow down as you approach where you scoped
When child says stop, note the axis
Repeat 3 or 4 times coming from opposite directions to see if consistent response

Astigmatism Axis
The higher the cyl, the more important it is to get the axis correct
Additional techniques
Put trial frame on kid to align your retinoscope beam with axis
After determine axis, put beam on trial fame or phoropter to read off axis

Keratometry
The higher the cyl power, the better the correlation between refraction and corneal cyl
Several hand held keratometers available that can be useful in cases of high astigmatism
to estimate amount and axis and compare to retinoscopy

Cycloplegic Retinoscopy
Preschooler first time visit
1% Cyclopentolate &1% tropicamide
Child under 6 mos or medically fragile consider
0.5% cyclo & 0.5% tropicamide
Repeat visits and not moderately hyperopic
Consider tropicamide and phenylephrine

Comparison of Drops
Tropicamide (1%) and Cyclopentolate (1%) vs Tropicamide (1%) and Phenylephrine (2.5%)
45 Subjects age 4 to 32 years
All with Dark Iris
Masked assessment of pupil size & reaction to light
6mm pupil - 98% with either combination
7mm pupil – 80% TP and 50% with TC
Reactivity to Light
For Tropicamide and Phenylephrine
At 20 min, no reaction to light in > 90%
For Cyclopentolate and Tropicamide
At 20 min about 20% still reacting to light

What Should I Use??
To Maximize dilation – Trop and Phenylephrine
To Maximize cycloplegia – Trop and Cyclo
Types of Reactions to the drugs
Most often reported with 2%, but have seen psychological disturbances in clinic twice over 25 years
Schizophrenic like behavior
Ataxia, Confusion, Disorientation, Restlessness, Apprehension, Drowsiness

Getting drops in
Explain to parent what you want to do and why
Explain that pupils will be dilated and blur up close
Clear with attending, get parental permission and get drops and tonopen in the room
Then tell child time for eye drops and avoid discussion

Anesthetic?
If think going to be able to do tonopen then anesthetic first before dilating drops
Icare without anesthetic is another option for IOP
If RE determination is highest priority (eg IET, poor VA, dry scope significant RE) Then
go for what you need most, which is cyclo and tropicamide
Decision to use anesthetic is driven by what is needed most

Don’t Lie to the child
It child asks if hurt don’t say no
Say stings a little like opening eyes while swimming
If old enough - by time you count to 10 it will be over

IDEAL Case
If restraint is needed; best to have parent help
OK for BIO but not putting in drops; Need head back

Wrapped up – typically only if doing CL; Head in lap
Other Options
Child sits in parents lap facing parent with child’s legs around parents waist
Child lies down with head in your lap and assistant to hold hands

Older stronger child, on the floor

You should never:
Put weight on the young person’s neck, torso or hips, because of the dangers of affecting their breathing; Use choke or strangle neck holds; Restrict airways, for example, by obstructing the nose or mouth.
Photorefraction
Also term photoretinoscopy
Based on analyzing the luminance profile in the pupil

Hyperopia    Myopia

Most Common Photoscreeners
Photoscreener (formerly MTI) now called iscreen
  Digital images replaced film
  Ethernet connection to send images to central site for analysis
  3 ft test dist, 4.3 lbs, 3 hour battery life before charge

Photoscreener
Digital Photos
Takes 2 picture for 2 different meridians
Sent to central location via Ethernet to interpret the photographs
Marketed as refractive error screener for infants and preschoolers
SureSight vision screener  
Welch Allyn

From Welch Allyn  
Positioned at 35 cm  
Align cross hairs in center of child’s pupil  
5 to 8 readings/eye  
Weighs about 2 lbs  
6.5” x 7.75” x 2”  
Target is red light in middle of green blinking lights

Marketed as refractive error screener for infants and preschoolers  
Marketed as screening device for infants and preschoolers  
Has child mode that is suppose to correct for close distance  
Outputs sphere and cylinder, but only measures refraction in H and V, so does not supply axis information
Pediavision is distributor
Handheld vision screener
Laptop computer, printer and cables
Automated vision assessment software
Software upgrades

Screening for RE
In large vision screening research project (VIP) compared ability to ID refractive error in children 3 to 5 years of age
Gold standard was cycloplegic refraction
Set cut points for RE for different techniques to get specificity of 94%
False positive rate is 6%
No significant RE, but screening indicates significant RE an over referral

Set Specificity to 94% and then Determined Sensitivity
If Sensitivity is 70%
The 30% are false negative, under referral
Have significant RE by cycloplegic but missed by screening

What is Sensitivity with 94% Specificity
Non-cycloplegic retinoscopy = 74%
Sure Sight vision screener = 66%
Retinomax autorefractor = 63%
MTI vision screener = 43%
Cut Points for different tests

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Hyperopia</th>
<th>Myopia</th>
<th>Astigmatism</th>
<th>Anisometropia*</th>
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<tbody>
<tr>
<td>Non-cycloplegic retinoscopy</td>
<td>≥ 2.50 D</td>
<td>≥ 2.75 D</td>
<td>≥ 2.00 D</td>
<td>≥ 1.50 D</td>
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<td>Power Refractor II</td>
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<td>≥ 3.75 D</td>
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<td>SureSight Vision Screener**</td>
<td>≥ 4.25 D</td>
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<td>Retinormax autorefractor</td>
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</tbody>
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* The maximum of inter-eye differences in the power of the most positive meridian, the most negative meridian, and the magnitude of cylinder was used to determine presence of anisometropia for all tests.

** Used in child mode, which adds a correction for accommodation.