Adjustable Sutures in Children
Workshop Outline
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GOALS

- To demonstrate the advantages of adjustable sutures in children
- To learn adjustable surgery techniques developed by the presenters specifically for use in children
- To help participants incorporate adjustable sutures in children at their own institutions

INTRODUCTION

Although adjustable sutures are frequently used in adults, only a few strabismus surgeons use them routinely in children.

Many reasons are given for this:
- “Adjustable sutures do not help. Post-operative drift is too variable in children for early post-operative measurements to be helpful.”
- “Children are too difficult to evaluate post-operatively.”
- “A second anesthetic adds too much risk.”
- “Adjustment is too difficult in children.”
- “It adds too much time and stress to warrant the possible improvement in outcomes.”
- “I don’t have experience with adjustable sutures.”

Results of adjustable suture approach in children

A brief review of the literature (see (4) for a comprehensive review)

David Guyton’s study (1) is the only study that compared results by the same surgeon using adjustable sutures in children with a control of surgery without adjustable sutures.
Study design

- Retrospective review
- Horizontal muscle surgery in patients ≤ 10 years of age
  - Non-adjustable: 98 (1990-1993)
- Consecutive eligible patients to reduce bias
- Satisfactory alignment defined as: ≤ 8 PD of strabismus @ 3 months follow-up
- All surgeries by Dr. Guyton

Results

- 79% in the adjustable group achieved satisfactory alignment
- 64.5% in the non-adjustable control group achieved satisfactory alignment
- Significant at the P < 0.01 level

Other studies have also shown a high rate of success. Engel (2) reported an 88% success rate with a median follow-up of 19 weeks (range of 6 to 54 weeks). Hunter (2) reported similar success rates.

THREE TECHNIQUES FOR ADJUSTABLE SUTURES IN CHILDREN

Primary surgery

Guyton

- Use general anesthesia, using zofran (Ondansetron), toradol (Ketorolac), +/- dexamethazone (Decadron) and religiously avoid midazolam (Versed).
- Radial cul-de-sac incision straight through conjunctiva and Tenon's, centered 8 to 10 mm posterior to limbus; heals better than circumferential incision.
- Use Guyton Small Incision Muscle Hook from Katena Products (no financial interest) to maintain small incision without tearing.
- Use 6-0 Vicryl suture with S-28 needle, except for large hang-backs especially inferiorly and nasally, then use non-absorbable 6-0 Surgidac suture with SS-28 needle, anchored 4 mm posterior to the insertion to prevent late erosion of suture through conjunctiva.
- Use hang-back technique for both recessions and resections, resecting 2 mm more than targeted for resections and hanging muscle back 2 mm, to allow adjustment either way.
• Use special sliding Vicryl noose, basically a clove hitch with three slip knots, which is totally removed after knot is tied, to minimize remaining suture material.
• Place traction suture of 6-0 Surgidac to gain access to adjustable knot post-op.
• Conjunctival closure rarely needed when using small-incision muscle hook.
• Examine child in recovery room with proparacaine drops after next case; sit child forward with head turned down to facilitate initial opening of eyes; hold up in air and feign dropping if still will not open eyes.
• Anesthesiologist puts child to sleep with IV propofol using existing IV, with average dose 2-3 mg/kg, supplementing as necessary. Use oxygen mask.
• Adjustment is made if indicated, knot is tied, and noose is removed. If non-absorbable suture, suture ends are left 8 mm long and buried straight backward to avoid later erosion through conjunctiva.
• Rarely put back to sleep twice if noose has slipped or large adjustment is made with first post-op anesthesia.

Hunter
• **Anesthesia:** As above
• **Incision:** As above
• **Suture:** 6-0 Vicryl S-29 needle except for use of semi-adjustable procedure rather than non-absorbable suture for inferior rectus recession
• **Slip knot:** Short tag noose described in references below
• **Traction suture:** NONE
• **Post-op exam and sedation:** As above
• **Second sedation:** If required, done on post-op day 1-7 (return to OR)

Engel
• Anesthesia: as above
• Incision: as above
• Suture: 6-0 Vicryl S-29 needle. Do not use nonabsorbable sutures except for SO. Will place additional “anchoring suture” for IR muscles, re-ops, Duane’s retraction syndrome, Grave’s, or other “tight” muscle.
• For MR, IR, and SR hang-back with noose.
• Additional 6 to 8 mm Vicryl anterior to the noose is buried on either side of muscle with shallow scleral pass. If noose is “not tight” then additional scleral pass to prevent slippage of muscle.
• LR semi-hang back with two additional scleral passes, with knot tied at the original insertion (no noose is used). This done to prevent vertical drift of the muscle and to lesson amount of subconjunctival suture that needs to be re-absorbed.
• Conjunctiva is closed with 7-0 Chromic or 8-0 Vicryl with knots buried to avoid irritation
• Lidocaine 1% with epinephrine 0.2 cc subconjunctival at incision
• If adjustment is needed, incision is opened, buried Vicryl suture exposed, and muscle is adjusted with the noose (SR, MR, IR) or without the noose (LR)
• Second sedation, if required, done in the OR 4 hours after primary surgery

**Evaluation for possible adjustment**

Guyton
• Examine child in recovery room with proparacaine drops after next case (~90 minutes post-op). Sit up over edge of bed for assessment when possible, with head turned down initially to facilitate opening eyes. Hold up in air and feign dropping if will not open eyes.
• Use cover test at both distance and near to estimate deviation when possible, with glasses, using accommodative target for near.

Hunter
• **Timing**: Minimum wait 1 hour; adjust between cases; prefer early evaluation to allow child to leave hospital sooner
• **Setting**: In recovery room. Child must be able to sit up on own, not with head of bed elevated and not on mommy's lap
• **Avoid** return to operating room – complicates the logistics of adjustment
• **Anesthetic**: Topical proparacaine (stings considerably less than tetracaine)
• **Cooperation**: As above for infants. For older children, talk directly to the child. Whispering sometimes helps. Learning how to gain the cooperation of a frightened 4-year-old child may be the most difficult part of adopting this technique.
• **Measurements**: Full assessment of ductions with prism-and-cover testing at distance in diagnostic positions of gaze and at near when possible

Engel
• Allow 4 hours if possible between primary surgery and evaluation for possible adjustment
• Best if patient sleeps before the evaluation
• Child can drink clear fluids up to 2 hours before the adjustment
• Since using lidocaine 1 percent with epinephrine subconjunctivally, tetracaine rarely needed
• Bring lots of moveable toys, make a game of guessing which finger puppet, etc etc.
• Measure for both distance and near
**Anesthesia choice if adjustment under anesthesia is needed**

Guyton:
- Adjustment with child awake in the recovery room is usually possible after age 8, occasionally down to age 5, but takes extra time.
  - Least cooperative patients are high-school football players!
- IV propofol anesthesia, not just sedation.

Hunter:
- **Patient selection:** Can often attempt awake adjustment before calling for anesthesia
  - **Teddy bear sign:** If an older child or young adult is observed clutching a teddy bear in the pre-op holding area, sedated adjustment will probably be required
- **Sedation:** IV propofol sedation
- **Dosage:** Anesthesiologist often underestimates dosage required, has to call for more propofol
- **Lid speculum test:** If child does not move when lid speculum inserted, you have 5 minutes
- **Technique:** Confirm that muscle is seated in new position after sliding slip knot
- **Completion:** with short tag noose, no need to tie knot at end of adjustment, but suture ends must be tucked under conjunctiva

Engel:
- Many anesthesiologists more comfortable with LMA
- If only intravenous sedation used
  - Child has to be fairly deep; can be judged by absent blink reflex when brushing lashes.
  - “Tetracaine test” - if child moves when tetracaine is first applied, not deep enough

**How much to adjust**

Guyton:
- For ET: Aim for exact alignment; do not overcorrect.
- For XT: For bilateral lateral rectus recessions, aim for straight at near with ET 4-5 in the distance and double vision beyond 6-8 feet. For recess-resect procedures, overcorrect less.
• For HT: Do not overcorrect except in field of action of recessed muscle, which will usually recover. Small undercorrection straight ahead is often best.
• We do not always know exactly where to leave the muscle, but we definitely know where we do NOT want to leave it.

Hunter
• Basically same as above for ET, XT, HT
  o I will overcorrect some XT patients by 12-15Δ at distance if single vision up to 1/3 m away.
  o These rules are broken routinely for re-operations, muscle fibrosis, ARC diplopia
• Higher threshold for adjustment in kids
• Sources of error
  o Beware angle kappa
  o Check for prism in “prism-free” glasses
  o Watch ductions to avoid overcorrection
• Measure amount of adjustment precisely against pre-measured pole suture extension
  o Allows final position of muscle to be properly reported in patient record

Engel:
• Large XT should have a greater overcorrection than small X(T). For X(T) under 25 PD, E(T) up to 8, straight for near. For X(T) 25 PD or more, E(T) 8 to 15 PD, and E(T)' ≤ 6 PD
• BMR for ET should not even have a hint of exophoria
• How much to move the muscle if an adjustment is needed depends on post-op measurements, move the muscle “a lot, medium, or a little”
• Helpful to be close to the desired post-operative position of the eyes after the primary surgery, as a large adjustment of the muscle will not on average be as predictable as a smaller adjustment of the muscle.
MAKING ADJUSTABLE SUTURES WORK FOR YOUR PATIENTS AND INSTITUTION

How to present the benefits and limitations of adjustable sutures to parents

- The main difficulty in strabismus surgery is the significant chance of over- and under-corrections, which frequently lead to additional surgeries being necessary.
- This is primarily due, in the hands of experienced surgeons, to the fact that we are not fixing the problem, which is how the brain is using the muscle, but instead are “tricking” the brain by moving the muscle to a new position.
- Adjustable sutures allow the surgeon “a second chance” to realign the eyes.
- Since the muscle has not healed to the sclera, the adjustment tends to be more predictable than if the muscle has to be moved again with another surgery once it has healed to the eye.
- The child already has an intravenous line.
- Some studies have shown a statistical advantage in success rate in using adjustable sutures.
- Even with adjustable sutures, however, the eyes can still drift, and another procedure may be necessary.

Preparing parents and child

Hunter
- Adjustment required in about 20%, remainder go home without any suture manipulation
- This gives us a chance in very rare cases to re-adjust up to a week after surgery if the alignment suddenly changes after the child goes home
- Total time in hospital is 1-2 hours for surgery, 2 hours to wake up, and 1 hour more if adjustment is required

Engel
- Parents and, if appropriate, child need to know that an adjustment is likely, to get the best result.
- They will stay most of the day.
- Parents should bring toys, game boys, video games, etc., etc., to keep child occupied.
- Adjustment is required approximately 1/3 of the time. 2/3 go back home without an adjustment.
Guyton

- Low threshold for adjustment, because always have the opportunity because sutures have to be tied off. Adjust in ~60% of cases; just tie off in other 40%.
- Total time in recovery room, with both parents present as soon as child stirs, averages 2.0 to 2.5 hours.

Operating facility considerations:

Possible objections:

- Extra time in recovery room (Guyton, Hunter)
- Additional use of OR (Engel)
- Child must remain NPO and not allowed sedating narcotic for pain relief (short-acting fentanyl is OK up to 30 minutes before adjustment – Guyton)
- Patient safety
- Added parental anxiety

Responses

- Extra up-front cost gives better outcome, guards against unwanted surprises, reduces reoperation rate by (probably) 10%
- Re-operations technically more difficult
- Actual adjustment takes just minutes
- 20 year safety record in Baltimore – NO untoward mishaps
- Pain management (Hunter): Allow nurses to administer topical proparacaine q15 min in recover room if patient is in pain
- Anesthesiologists may bill for second procedure
  - Suddenly recovery room propofol anesthesia will seem safe after all!
- If we can’t offer it here, patients will go to where it is offered for surgery

Specific logistics

Hunter technique

- Share CHB OR nursing policy (attached)
- Anesthesia may request “buffer” time at end of day (30 minutes per adjustable case posted) in case turnover time between cases is extended by need for adjustment
  - In practice this is not required, and rule is not enforced
- Case must be posted by surgical coordinator as “sedated adjustment” to alert team
- Suture adjustment kits purchased separately, enough to allow for 1 day worth of adjustments, kept at bedside
Engel technique
- Book each surgery twice for each patient, as if they were having two surgeries, once for the primary, and once for the secondary (easier when adjustment is done in the recovery room - Guyton).
- If possible, give yourself a “full day” of surgery, so that you have the OR for the whole day. Place non-strabismus or non-adjustable cases after the adjustable cases.

Suggestions for the first case
- Meet with nursing, anesthesia leadership in advance of procedure to discuss concerns
- Pre-select anesthesiologist who is comfortable with the concept
- Select emotionally mature child (5 or older)
- Allow plenty of time for the child to awaken. Cannot judge whether an adjustment is needed if child is not fully awake.

Engel suggestion:
- Plan for LMA for adjustment rather than IV sedation.
  - (Guyton, Hunter do not use LMA or return to OR for adjustment unless IV access is lost and cannot be restored)

REFERENCES:
Guideline for Anesthesia Care for Suture Adjustment Following Strabismus Surgery

Purpose:
The following recommendations were developed collaboratively by Anesthesia and Nursing Department representatives and reviewed with the Ophthalmologist-in-Chief. These recommendations will help support the ophthalmologist’s practice of adjusting sutures postoperatively in the PACU. These recommendations also help to ensure an optimal surgical experience and patient outcome while minimizing the impact on surgical volume and flow.

Policy

- **Booking the case:**
  - An extra half hour will be added to the room block time for each case requiring suture adjustment in Waltham and Lexington.
  - Cases should be booked early enough to allow for no later than a 5:00 p.m. discharge time including recovery from suture adjustment.
  - Cases should be designated “adjustable awake” or “adjustable sedated” to optimize planning for privacy for eye exam and possible sedation.

- **Consent**
  - Surgical consent will indicate possibility of suture adjustment and additional sedation in the post anesthesia care unit.

- **Initial recovery phase:**
  - Patients who will have suture adjustments will require orders to remain NPO (this information will be communicated to the family by the ophthalmologist prior to surgery).

- **Team preparation for suture adjustment:**
  - **Children’s Hospital Boston:**
    - Nursing: 20 minute lead time will be given to the PACU Day Surgery Charge Nurse (5-9188 or 5-7922) in order to make arrangements to move the patient to a more private location if necessary and adjust staffing to arrange for 1:1 nursing.
    - Anesthesiology: 20 minute lead time will be given to the PACU Anesthesiologist (5-9122) in order to be able to determine coverage for the PACU and to notify the OR Board Runner of the need to be temporarily available for PACU patient requirements.
  - **Children’s Hospital Boston at Lexington/Waltham:**
    - Nursing: 20 minute lead time will be given to the PACU Day Surgery Charge Nurse (Lexington: 2310, 2311; Waltham: 6-1279) in order to optimize privacy and 1:1 nursing coverage.
    - Anesthesiology: In most cases, the anesthesia provider who performed the initial anesthesia will be responsible for the anesthesia for the suture adjustment as well. The time for the adjustment will be agreed upon by the surgeon and anesthesia provider.
Suture adjustment:
- Patient identification will be performed by the nurse and anesthesia provider just prior to administration of medication and the start of the procedure.¹,²,⁴
- Medication for the procedure will be administered by the anesthesia provider and documented on the existing anesthesia record along with vital signs.¹
- The PACU nurse will document the procedure in PowerChart.
- The anesthesia provider will remain at the bedside 1:1 until the patient is back to baseline and care is transferred to the PACU nurse.¹

References