Surgical management of strabismus in Duane retraction syndrome

Ramesh Kekunnaya, MD, FRCS,a Stephen Kraft, MD, FRCSC, b Venkateshwar B. Rao, MD, c Federico G. Velez, MD, d,e,f Virender Sachdeva, MS, g and David G. Hunter, MD, PhDh,i

SUMMARY

While Duane retraction syndrome (DRS) is relatively common, surgical management of the associated strabismus can be challenging because of the lack of abduction/adduction, the variable severity of muscle contracture, and the variety of clinical presentations. In this workshop a panel of experienced surgeons provide their perspective and practical tips on the management of strabismus in patients with DRS.

Duane retraction syndrome (DRS) is a spectrum of innervational and mechanical anomalies whose underlying pathophysiology is a congenital misinnervation of the lateral rectus muscle. Most cases have a variable degree of globe retraction on attempted adduction due to co-contraction of the lateral and medial rectus muscles. DRS is one of several innervational conditions known collectively as the congenital cranial disinnervation disorders (CCDDs).

Although many clinicians rely upon Huber’s classification of DRS into types 1, 2, and 3,1 we have found that classifying patients as esotropic, exotropic, or orthotropic2 is more useful in terms of surgical planning and treatment. DRS is usually unilateral, but it can be bilateral in up to 15% cases. DRS patients may rarely have concurrent vertical heterotropia in primary gaze.

There are many schools of thought on the management of strabismus in DRS. Surgeons should take into account the amount of deviation in primary gaze, the severity of the head turn or tilt, the extent of adduction and abduction limitations, the degree of retraction the presence of up- and downshoots, and the results of forced duction testing (FDT). A variety of treatment strategies—some newly introduced—are available to strabismus surgeons treating patients with DRS. While these procedures are not applicable to all patients, ophthalmologists should be aware of the strengths, weaknesses, and potential complications of all currently available procedures. In this workshop, these are addressed in the context of the most common clinical presentations of DRS.

Unilateral, Esotropic DRS

The most common form of unilateral DRS presents with a limitation of abduction, most commonly with esotropia in primary gaze <30°, although the angle can be larger. There is often a compensatory head turn to the side of the affected eye. The left eye is more frequently involved than the right eye.

The optimal surgical plan for a case of unilateral DRS with esotropia and limited abduction depends on the following: (1) magnitude of esotropia in primary position; (2) degree of limitation of abduction; (3) severity of retraction on adduction; (4) severity of upshoot and/or downshoot in adduction; and (5) the extent of the field of binocular single vision.1 Different surgical approaches address the variable presentations of these five features. This section addresses the roles of unilateral and bilateral medial rectus recessions as well as the indications for a combined medial rectus recession and lateral rectus resection of the DRS eye. Alternative surgical options will be covered below.

Unilateral Medial Rectus Recession

Unilateral recession of the medial rectus muscle of the DRS eye remains an effective treatment for esotropic DRS.4,5 It can successfully align the eye in primary gaze if the deviation is ≤20°.4,5 Recession of the medial rectus muscle should be considered when the muscle is contractured as determined by FDT. If the eye already has some lateral movement beyond the midline, medial rectus recession may allow for some improvement in abduction, which can expand the field of binocular single vision into the ipsilateral field.

Medial rectus recession of the DRS eye should be limited to ≤6 mm, with some workshop participants recommending...
recession of no more than 5 mm. Limiting the medial rectus recession reduces the likelihood of an iatrogenic adduction limitation, which compromises the field of binocular single vision by causing an esotropia in contralateral gaze. If the improvement in abduction comes at the cost of an even more severe limitation of adduction, the total field of binocular single vision will be reduced. In addition, when recession is limited to a significant degree, the esotropia in contralateral gaze can cause disabling diplopia.

Recession of the medial rectus muscle can also be the first stage of a planned two-stage procedure, in which the second step is a vertical rectus muscle transposition procedure. Medial rectus recession may also be performed in conjunction with a superior rectus transposition (SRT), as described below.

A large recession of the contralateral medial rectus has been suggested as a means to expand the field of binocular single vision by “matching” the abduction deficit of the DRS eye. However, when abduction deficits are −3 or worse (on a scale of 0 to −4, with 0 being normal and −4 representing inability to move beyond the midline into the field of gaze), the approach is not likely to be successful because no amount of innervation to the affected lateral rectus muscle will improve abduction. This approach may be most useful in DRS patients with good abduction (−2 or better).

**Bilateral Medial Rectus Recession**

There are three situations in which bilateral medial rectus recession may be helpful: (1) large-angle esotropia, (2) severe globe retraction, and (3) contracture of the affected medial rectus muscle.

If esotropia in primary gaze is larger than 20°, a unilateral medial rectus recession of <6 mm in the DRS eye is not likely to be effective, and adding recession of the contralateral medial rectus muscle is required to eliminate the primary position esotropia. In patients with severe globe retraction, recession of a tight lateral rectus muscle will reduce the retraction but may also increase the angle of esotropia. Recessing the contralateral medial rectus muscle helps compensate for the increase in angle. In the third scenario, the medial rectus muscle of the affected eye is contractured, and recessing the contralateral medial rectus muscle creates a “fixation duress” in that eye. That is, the increased amount of the innervation that is required in the fixing eye while taking up the fixation either against a contractured agonist or following the weakening of the antagonist, namely, the medial rectus in this case. After surgery, the medial rectus muscle of the unaffected eye receives increased innervational tone to maintain fixation in primary position, with a concomitant reduction of innervational input to the ipsilateral lateral rectus muscle and a simultaneous lessening of innervational drive to the medial rectus muscle of the affected eye. The reduced innervation to the medial rectus muscle of the Duane eye is believed to reduce the likelihood of repeat contracture postoperatively. It should be emphasized that this approach is not meant to try to match duction deficits in the two eyes.

The amount of recession of the medial rectus muscle in the fellow eye is different in the above three situations. In the first two scenarios (large-angle esotropia and/or severe globe retraction), the recession dosage is determined by the degree of residual esotropia anticipated as a result of the surgery on the DRS eye, with a maximum recession of 5–6 mm. In the third scenario, to reduce the risk of contracture of the medial rectus muscle of the DRS eye, the medial rectus muscle of the fellow eye has to be recessed more than “usual” amounts, at least 7–8 mm to create the requisite fixation duress.

**Unilateral Recession and Resection**

Recessing the medial rectus muscle and resecting the lateral rectus muscle of the DRS eye can treat esotropia and limited abduction in selected cases. Favorable patient characteristics for such a procedure include the following: (1) esotropia in primary gaze of at least 25°; (2) mild globe retraction in addition (<33% narrowing of the palpebral fissure on shifting gaze from primary position into adduction); (3) clinically normal adduction; (4) substantial limitation of abduction, at least −3.5; and (5) minimal or no upshoot or downshoot phenomena.

In the past, strabismus surgeons have raised serious cautions about resecting the lateral rectus muscle of an eye with DRS, out of concern that a resection would worsen globe retraction and produce an adduction limitation. This may indeed occur if the resection performed is comparable to the 5–8 mm resections typically used for patients with comitant strabismus. In appropriately selected cases of DRS, the lateral rectus resection must be limited to no more than 3–3.5 mm, and the medial rectus recession should be limited to no more than 5 mm.

Kraft reviewed 15 cases of bilateral medial rectus resections and 12 cases of recession and resection for DRS with esotropia and limited abduction. Mean preoperative misalignment in primary gaze and mean abduction deficits (−3.5 vs −3.9) were slightly greater in the resection group. The mean esotropia in primary position was reduced from 19° to 2° in the bilateral medial rectus recession group compared to from 27° to 0.3° in the recession/resection group. Mean abduction improved on average from −3.5 to −2.5 in the bilateral medial rectus recession group vs from −3.9 to −1.6 in the recession/resection group. Adduction limitation changed from 0.2 to 1.4 in the bilateral medial rectus recession group versus from 0 to −0.9 in the recession/resection group. Therefore, both strategies led to clinically significant improvements in the esotropia and abduction in the eye with DRS, although the addition in the eye with DRS was compromised less with the recession and resection procedure than with bilateral medial rectus recessions.

**Unilateral, Exotropic DRS**

Exotropic DRS is reported to occur in about 10%-15% of cases and is usually associated with type 2 DRS. In a series of 441 patients, Kekunnaya and colleagues reported a 32%
incidence of exotropic DRS, of which a majority (67%) had type 3 DRS. Helveston suggested that the tendency of the eye to develop heterotropias may depend on the degree of the tightness of the lateral rectus muscle. In our experience, patients with exotropic DRS invariably have a tight lateral rectus muscle. These patients may also have associated globe retraction and overshoots (defined as overelevation or overdepression in adduction, most often caused by co-contraction of the horizontal rectus muscles). Hence the surgical management of these patients depends on the laterality, presence and degree of globe retraction/overshoots, and the angle of deviation in primary gaze.

In patients with isolated, unilateral, exotropic DRS, the classical teaching has been to perform an ipsilateral lateral rectus recession for deviations ≤20° and a bilateral lateral rectus recession for deviations >20°. Tibrewal and Kekunnaya treated a series of 31 exotropic DRS patients with unilateral or bilateral lateral rectus recession and found that the primary position exotropia decreased from 19.7° to 4.8° (Surgical outcomes of exotropic Duane’s syndrome. Poster: Annual Meeting of the AAO, November 2013, New Orleans). The success rate (alignment within 8° of orthotropia and/or correction of abnormal head position to <5°) was 71%, and 23% of patients were undercorrected. The abnormal head position was corrected in 89.7% of patients. The authors concluded that the surgical dosage should be increased compared with standard surgical tables when treating exotropic DRS.

Recession of the lateral rectus muscle in exotropic DRS may worsen the abduction limitation, if present. Therefore, when bilateral lateral rectus recession is required, it should be asymmetric, with the larger recession on the contralateral eye (except when the contracture of the ipsilateral lateral rectus muscle is severe). Patients with exotropic DRS tend to have associated overshoots, which may be managed by the addition of Y-splitting of the lateral rectus muscle (Figure 1).

In patients with type 2 exotropic DRS, globe retraction may be moderate to severe, and lateral rectus recession alone may not be beneficial. Approaches for the management of these patients include differential recession of the lateral and medial rectus muscles, supramaximal recession of the lateral rectus muscle, and periosteal fixation of the lateral rectus muscle to redirect the anomalous action of the lateral rectus muscle away from the globe. Periosteal fixation may be performed alone or in combination with vertical rectus transposition toward the lateral rectus muscle insertion to restore abduction. Sharma and colleagues compared the success rate of periosteal fixation alone and periosteal fixation with partial tendon vertical rectus transposition in 13 patients. They reported a reduction in exotropia in approximately 70% of patients in both groups with improvements in globe retraction, overshoots, and abnormal head position. The vertical rectus transposition group had a marginal improvement in abduction limitation in addition to improved adduction.

Bilateral DRS

Bilateral esotropic DRS must be distinguished from similar conditions, including infantile esotropia with pseudo-abduction limitation secondary to alternating fixation, Ciancia syndrome, and Moebius syndrome. Abduction limitation should be confirmed by occluding each eye and then performing a doll’s head maneuver while the eye is fixing on a target. Globe retraction in adduction and the lack of facial palsy are the key features differentiating bilateral esotropic DRS from Moebius syndrome. Bilateral involvement is seen in 15% of DRS patients, most commonly in males. Esotropia is most common (56%), followed by orthotropia (34%) and exotropia (10%). The deviation in primary gaze in bilateral, esotropic DRS can vary from 14° to 70°. Head position is determined by the resting location of the fixing eye. Some patients may exhibit an A pattern.

The preferred surgical option in most cases is bilateral medial rectus recessions (Figure 2). The surgical dose depends on the preoperative measurements in primary gaze, clinical limitation of ductions, and the degree of restriction on FDT. There is a risk of reduced horizontal ocular motility after bilateral medial rectus recession in bilateral DRS, especially if co-contraction is present. In a series of 14 patients with bilateral esotropic DRS reported by Sachdeva and colleagues, mean preoperative deviation was 38°. All patients underwent bilateral medial rectus...
recession, with a mean surgical dose of 5.6 mm (range, 5–7 mm) for each eye. The success rate was 86%, and no patient developed substantial limitation of adduction (−1 or more) or consecutive exotropia of >8Δ. Some workshop coauthors believe that the amount of medial rectus recession required to treat bilateral, esotropic DRS is greater than would be expected from standard surgical tables.

Bilateral exotropic DRS is the rarest form of DRS. It can be associated with type 1, 2, or 3, and even with a combination of different types in each eye. Surgical decision making must be individualized with such combinations. Theodorou and colleagues treated 11 patients with bilateral exotropic DRS (range, 12Δ–60Δ) over a decade. In most cases they performed unilateral lateral rectus recession (range, 3–18 mm) along with conjunctival recession. A small medial rectus recession was added when co-contraction was present. The success rate was 70%. Stereopsis (measured by Frisby near test) was demonstrated in 55% preoperatively and 73% postoperatively. Preexisting stereopsis improved in 83% of the patients by an average of 39 arcsec.

In one coauthor’s experience (RK), symmetrical or asymmetrical bilateral lateral rectus recessions are more effective than unilateral surgery for bilateral, exotropic DRS. Bilateral Y-splitting may be necessary in some patients.

Synergistic divergence is a severe exotropic form of DRS where there is striking, simultaneous abduction in attempted side gaze in either direction. To date, no surgical procedure leads to satisfactory results for all characteristics of synergistic divergence.

Role of Superior Rectus Transposition

A variety of transposition procedures have been used to improve abduction in DRS, including full transposition of both vertical rectus muscles laterally along the spiral of Tillaux (with or without the use of augmentation sutures). This procedure has been associated with new-onset vertical deviations in some patients and is not generally performed in combination with weakening of the medial rectus muscle out of concern for causing anterior segment ischemia. In 2006, Johnston and colleagues proposed a novel technique of transposing only the superior rectus muscle laterally in esotropic DRS, leaving the inferior rectus muscle untouched (An innovative approach to transposition surgery is effective in treatment of Duane’s syndrome with esotropia. Invest Ophthalmol Vis Sci 2006;47:ARVO E-Abstract 2475). They reported good results in 32 patients without any consecutive hypo- or hypertropias. Mehendale and colleagues combined SRT with adjustable medial rectus recession in 10 patients with esotropic DRS and achieved good alignment with improved abduction without inducing vertical deviations or significant torsion. The procedure involved transposition of the superior rectus muscle to the lateral rectus muscle insertion (Video 1, available at jaapos.org) with an augmentation suture placed 8–12 mm behind its insertion. SRT with or without medial rectus recession improves alignment in primary gaze while also enhancing abduction in most cases (Figure 3).

Recently one coauthor (DGH) reported the outcomes of medial rectus recession alone (unilateral or bilateral) in 18 patients with that of SRT (with or without simultaneous medial rectus recession) in 19 patients. Although both groups showed similar improvement in esodeviation and head turn, the average medial rectus recession was smaller in the SRT group. Abduction improved by ≥1 unit (as defined earlier) in 79% of patients in the SRT group versus 28% in the non-SRT group. In the 24 patients with more than 6 months’ follow-up, esotropia decreased from 8.2Δ to 6.1Δ in the SRT group but increased from 7.2Δ to 10.9Δ in the medial rectus recession group. The combination of SRT and adjustable medial rectus recession thus appears to be more effective than unilateral or bilateral medial rectus recession in improving abduction while allowing for a smaller recession to align the eyes and eliminate a compensatory head posture. In patients with esotropia of 12Δ–14Δ, SRT alone may be sufficient, or one of the other approaches described above may also be used. When the esotropia is >15Δ, SRT should be combined with an adjustable medial rectus recession of up to 5 mm.
based on the esotropia in primary position and the tightness of the medial rectus muscle on FDT. For larger deviations, SRT may be combined with bilateral adjustable medial rectus recessions. Although SRT improves esotropia and abduction, surgeons and patients should be aware that whenever the vertical rectus muscles are manipulated surgically, especially with transposition, there is a risk of creating torsional or vertical strabismus.

**Globe Retraction and Overshoots**

Globe retraction in primary gaze can respond favorably to large recessions of antagonist co-contracting muscles. Medial rectus recessions of 5–6.5 mm and lateral rectus recessions of 7–9 mm are required. Patients with severe globe retraction may benefit from profound weakening of the lateral rectus muscle via periosteal fixation.

When esotropia is present, the medial rectus muscle should be recessed more than the lateral rectus muscle. If no esotropia is present in primary gaze, the lateral rectus muscle should be recessed about 1 mm more than the medial rectus muscle.

In one coauthor’s (BVR) experience, adult patients need larger recessions to obtain results comparable to those in pediatric patients. We believe that in many adults, the orbital soft tissues and fat have been molded by decades of globe retraction such that even large recessions of both horizontal rectus muscles will have minimal effect on the globe retraction. Given sufficient time and with continued co-contraction of the muscles, globe retraction may recur despite large recessions.

The overshoots that occur in adduction in DRS, including overelevation (“upshoot”) and overdepression (“downshoot,”) are believed to be the result of a bridle or leash phenomenon caused by a tight lateral rectus muscle that slips over or under the globe as the eye adducts. Dysinnervation of the vertical rectus muscles may also contribute to these abnormal vertical movements. Previously described surgical approaches include recession of the ipsilateral lateral and medial rectus muscles, posterior fixation suture of the ipsilateral lateral rectus muscle alone or both the lateral and medial rectus muscles, vertical rectus muscle recession, and inferior oblique myectomy (for upshoot only). These approaches will not be described further here. Jampolsky has described Y-splitting of the lateral rectus muscle with or without recession for treatment of overshoots (Discussion of Eisenbaum AM, Parks MM. A study of various surgical approach to the leash effect in Duane’s syndrome. Presented at joint session of AAO and AAOH, Chicago, IL, November 5, 1980). Although some authorities believe that a sufficiently large lateral rectus recession by itself should be adequate to control overshoots without Y-splitting, here we will elaborate on the preference of one coauthor (BVR) for the including latter procedure.

The effectiveness of Y-splitting depends on the restriction created by each of the two arms of the Y. As the eye looks above the midline in adducted position, the upper arm of Y rotates over the globe and lower arm of Y, placed under further tension, contracts and prevents the eye from slipping upward. Similarly, when the eye looks below the midline in adducted position, the lower arm of the Y rotates over the globe and the upper arm of the Y, placed under further tension, contracts and prevents the eye from slipping downward. Any procedure that would stabilize the lateral rectus muscle on the globe would eliminate or prevent the overshoots.

We believe that with Y-splitting, the bifurcation of the muscle halves balances their positioning as the eye adducts. When globe retraction is present and the lateral rectus muscle is tight (as is common when upshoot/downshoot is present), it is prudent to recess the lateral rectus muscle in addition to Y-splitting (Figure 1; Video 2, available at jaapos.org). Rao and colleagues published a series of 10 DRS patients treated with Y-splitting and a lateral rectus...
recession of 5–9 mm. In 6 of those patients, the globe retraction was severe enough to warrant simultaneous medial rectus recession of 3–6 mm. All patients showed elimination of overshoots with improvements in head turn, primary gaze deviation, and globe retraction (when present).

Reoperations Following Vertical Rectus Muscle Transposition

Residual Esotropia

Residual esotropia following vertical rectus transposition for esotropic DRS may result from either a lack of abducting vector force generated by the transposition and/or excess tonus or contracture of the ipsilateral medial rectus muscle. Rosenbaum determined that the most important factor affecting the efficacy of transposition is the tension of the ipsilateral antagonist medial rectus muscle. That is, if the length-tension curve of the abnormally stiff or contracted muscle creates excess resistance to the newly created abducting force, some patients fail to respond to augmented vertical rectus transposition or require subsequent recession of the medial rectus muscle.\(^{14,22,24}\)

On FDT the point in abduction where restriction begins will approximately indicate the amount of abduction that may be gained from the transposition. Pineles and colleagues\(^ {23}\) found that patients left with a residual esotropia requiring ipsilateral medial rectus recession after vertical rectus transposition had a greater restriction to abduction on intraoperative FDT. Other risk factors included larger angle of esotropia in primary gaze and in adduction.

Two variables are important when reoperating on patients with DRS: (1) the ability to maintain the head straight when fixing with the DRS eye and (2) intraoperative FDT. If an abnormal head position is observed or measured when the patient is fixing with the DRS eye, that eye should have surgery. If FDT demonstrates significant restriction to abduction, the medial rectus muscle should be recessed. It is important to rule out the presence of fibrotic or accessory bands explaining a positive FDT after the medial rectus muscle is disinserted.

If FDT is negative, the previously performed transposition should be explored. Findings in those patients may include migration of the muscle insertion or belly toward its original insertion or muscle path, muscle recession or slippage, weak tension, or temporal dragging of the transposed muscle by the previously placed augmentation suture.

Exotropia

Secondary exotropia following vertical rectus transposition may result from excess tension or restriction caused by the transposition, a weak ipsilateral medial rectus muscle, enhancement of lateral rectus muscle co-contraction, or ipsilateral lateral rectus muscle stiffness. Postoperative exotropia usually results in diplopia, reversal of torticollis, and often narrowing of the field of binocular single vision.

Risk factors for postoperative exotropia in patients treated with vertical rectus transposition followed by medial rectus recession include the presence of a large exotropia (or less esotropia) in adduction preoperatively. This suggests that these patients may have had more severe co-contraction that was then further exacerbated by the medial rectus recession. Other factors that may predispose to overcorrection following medial rectus recession include an unrecognized accommodative component, a slipped medial rectus muscle, or a stretched scar. A contralateral medial rectus recession may cause sufficient fixation duress in the DRS eye to create an exodeviation. Early overcorrections tend to be associated with over-recession of the medial rectus muscle, whereas late overcorrections are associated with a stretched scar, a slipped ipsilateral medial rectus muscle, or secondary tightness of the ipsilateral lateral rectus muscle. Both early and late overcorrections may be associated with a tight vertical rectus transposition.

FDT can guide management of overcorrections. If the FDT is negative, management includes ipsilateral medial rectus advancement, scar tissue removal or removal of the slipped capsule with muscle recovery and advancement. A positive FDT may be caused by VRT alone or by tension of the ipsilateral lateral rectus muscle. The mechanism for the lateral rectus muscle tightness could be a passive shortening of the fibers caused by the exotropic position of the eye, enhanced co-contraction as a result of the medial rectus recession, or scar tissue formation from VRT. Repeating the FDT with a muscle hook under the lateral rectus muscle helps determine the degree of muscle stiffness. When FDT is positive, management includes reposi- tioning of the transposed muscles and/or maximal ipsilateral lateral rectus recession. When repositioning the transposition, the surgeon must first release the augmentation suture and/or remove any scar tissue between the muscle and the sclera and then repeat the FDT. If the restriction persists, muscle recession following the path of the transposition is recommended.\(^ {56,27}\)

Induced Vertical Deviation

Vertical deviations may occur in 13%–30% of cases following full-tendon vertical rectus transposition involving both the superior and inferior rectus muscles. The mechanisms include restrictive imbalance between the transposed muscles, unexpected recession or slippage of one of the transposed muscles, or less commonly a weakening vertical effect that results when a large portion of the muscle tendon belly is transposed laterally, increasing the loss of vertical torque.\(^ {14,22,24}\)

Rosenbaum recommended an intraoperative FDT prior to completing any transposition procedure.\(^ {15,23}\) Ruth and colleagues\(^ {26}\) found a restriction in all patients who had a vertical deviation and a positive FDT in the opposite direction. The treatment of choice involved three steps: (1) removal of the augmentation suture, (2) recession of...
the restricted vertical rectus muscle 1.5–3 mm, and (3) replacement of the augmentation suture in a manner that further released any restriction. Although most patients with new vertical deviations have positive FDT, if the test is negative, exploration of the transposed vertical muscles and partial reversal of the transposition is recommended.

Most patients with induced vertical complications following vertical rectus transposition have a hypotropia secondary to muscle restriction. Surgical dissection of the attachments between the inferior rectus muscle, the capsulopalpebral fascia and Lockwood’s ligament may help to prevent this complication. It is also important to dissect the attachments between the superior rectus muscle, the frenulum, and the superior oblique tendon to prevent undesirable torsional and vertical complications caused by changing the tension and path of the superior oblique tendon. Exploration of the superior oblique tendon is important in patients with hypertropia and significant limitation to downward rotation. Scar tissue formation between the superior oblique tendon and the superior rectus muscle insertion changes the path of the superior oblique tendon and converts the superior oblique muscle into a mechanical antidepressor. Repositioning of the superior oblique muscle may be necessary to release all restrictions.

Intraoperative monitoring of torsion helps to identify patients who may develop vertical or torsional deviations following superior and inferior rectus muscle transposition. Another way to prevent the onset of new vertical deviations is to eliminate the inferior rectus transposition entirely. It was the high prevalence of induced hypotropia that inspired introduction of the SRT procedure detailed in an earlier section.

Recommendations

The surgical approach to a patient with DRS must be individualized based on the amount of ocular deviation, abnormal head position, associated globe retraction, and overshoots. The individualized strategy is summarized in the flow chart presented in e-Supplement 1 (available at jaapos.org).

Acknowledgments

The authors are grateful to Dr. Shekhar Sanghi, Mr. Kartbeek, and Mr. Praveen, and the audiovisual team for technical assistance.

References