Exaggerated Traction Test for the Oblique Muscles

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Abstract: Retroplacement and torsional manipulation of the globe during forced duction testing provide an exaggerated traction test of the oblique muscles, allowing graded evaluation of superior oblique and inferior oblique tightness. On a scale from 0 to 4 +, normal superior oblique tightness averages 1.5 +, and normal inferior oblique tightness averages about 1 +. The degree of superior oblique or inferior oblique tightness correlates well with clinical overaction of these muscles, allowing better distinction between oblique overaction and dissociated vertical deviation. Also, the effect of partial superior oblique tenotomy can be monitored, and a complete tenotomy can be confirmed with certainty. [Key words: forced ductions, oblique muscles, overaction, strabismus surgery, traction test.] Ophthalmology 88:1035-1040, 1981

The traction test in strabismus ("forced" ductions, or "passive" ductions of the globe), has only rarely been described with respect to the oblique muscles of the eye. In reference to the superior obliques, Scott and Knapp in 1972 described retroplacement of the globe as helpful when performing the traction test on patients with suspected Brown's syndrome. In 1975 Scott described a "knife edge" feeling with the traction test in Brown's syndrome. He stated further that superior oblique contracture secondary to inferior oblique paresis usually shows only mild resistance to elevation in adduction. In reference to the inferior obliques, Toosi and von Noorden stated in 1979 that the traction test in cases of overacting inferior obliques is usually negative.

This paper presents a new technique for exaggerated traction testing of the oblique muscles. The procedure is designed to test the tightness of the oblique muscles by placing them on maximum stretch. The technique includes traction of the globe into the oblique quadrants, plus retroplacement, plus torsional manipulation. With this technique, even normal superior and inferior obliques can be "felt" with certainty. The technique allows a graded evaluation of oblique tightness, subject to each surgeon's interpretation, on a scale from 0 to 4 +.

TECHNIQUE

Ordinary traction testing of the rectus muscles is performed without anterior or posterior displacement of the globe. In particular, as pointed out by Knapp, it is important to avoid retroplacement of the globe in performing traction testing of the rectus muscles. Retroplacement slackens the rectus muscles, and a true restriction can be missed. Retroplacement is essential, however, in performing effective traction testing on the oblique muscles.

In Figure 1A, under retrobulbar or general anesthesia, the globe is grasped at 3 and 9 o'clock positions near the limbus using two pairs of 0.5 mm
Fig 1. Components and step-by-step technique in performing the exaggerated traction test of the left superior oblique muscle, illustrated by the surgeon's view and corresponding horizontal section. A, grasping the globe with toothed forceps; B, retroplacement of the globe; C, extorsion of the globe; D, rotation of the globe superonasally; E, combined maneuver accomplishing retroplacement, extorsion, and rotation superonasally; F, traction of the globe temporally; G, beginning rotation of the globe temporally over the taut superior oblique tendon; and H, the globe seems by feel to "jump" over the taut tendon as the tendon suddenly slips nasally.
Castroviejo toothed forceps, biting into episclera. If an abnormal torsional position of the fundus is noted prior to surgery, the points of grasping may be altered accordingly to correspond to the true horizontal meridian. Vigorous manipulation will be required, and secure forceps bites must be achieved, especially nasally. The only complication thus far observed with the procedure to be described has been ripping of the conjunctiva from inadequate forceps placement.
Figure 1B illustrates retroplacement of the globe, placing the superior oblique muscle and tendon on stretch. The globe may ordinarily be retroplaced 5 to 10 mm without difficulty. Figures 1C and 1D illustrate other maneuvers that stretch the superior oblique. The globe is forcibly extorted in Fig 1C and is rotated superonasally in Fig 1D. Neither retroplacement, extorsion, nor rotation superonasally is sufficient alone to produce maximum stretch of the superior oblique; these maneuvers must be combined.

Figure 1E illustrates the combination of the above maneuvers, representing the first step in the exaggerated traction test. The nasal forceps, grasping the globe at 9 o’clock as in Fig 1A, is plunged superonasally, with the cornea diving out of sight, and the temporal forceps following passively. Both the nasal and temporal forceps are then moved temporally as in Fig 1F, with the temporal forceps almost vertically in line with the nasal forceps, tightening the superior oblique muscle and tendon maximally. In Fig 1G the temporal forceps begin to rock the globe temporally, and a tight “band” is immediately apparent. As the globe approaches the crest of the band, the nasal forceps must be allowed to move anteriorly, as in Fig 1G. Suddenly the globe seems to “jump” over the band as the superior oblique tendon slips nasally over the surface of the globe to a less stressed position. The magnitude of the jump provides a tactile measure of superior oblique tightness. Even normal superior obliques can be “felt” with certainty after the technique is mastered.

Exaggerated traction testing of the inferior oblique is not illustrated but is the mirror image of the technique for the superior oblique. The nasal forceps are plunged into the inferonasal quadrant of the orbit, and the globe is then rocked temporally. Temporal movement of the globe prior to rocking, analogous to Fig 1F, is especially important with the inferior oblique. The inferior oblique is less easily felt than the superior oblique, probably because of the interposed tissues between the inferior oblique and the globe. These tissues, primarily the inferior rectus muscle, would be expected to cause a more gradual rocking of the globe over the taut inferior oblique—more gradual than in the case of the superior oblique tendon, which can slip easily over the surface of the globe.

How tight do normal obliques “feel” with this technique? In the author’s grading system from 0 to 4+, normal superior oblique tightness averages about 1.5+, and normal inferior oblique tightness averages about 1+ tight.

**CORRELATION WITH OTHER OBSERVATIONS**

How can one be sure that it is the oblique muscles that cause the taut band felt with the exaggerated forced duction maneuver? All doubt disappears when the respective oblique is disinserted or otherwise divided, for the band disappears entirely. The globe rolls smoothly temporally, without encountering the restriction previously felt. Of interest is an observation in three cases that required subsequent horizontal muscle surgery months after superior oblique tenotomy or large inferior oblique myectomy. The oblique overaction had been cured entirely in each case, but the exaggerated traction test at the second procedure revealed essentially “normal” tightness of these muscles in spite of the fact that no tightness could be felt whatsoever immediately after the original procedure. Presumably the superior oblique tendon or inferior oblique muscle stump had re-established effective connection with intermuscular septum, Tenon’s capsule, or the sclera itself. This observation may help to explain why complete muscle palsy is rarely seen after weakening procedures of the obliques.

A correlation between oblique “tightness” and
oblique clinical overaction has been observed over a two-year period. Retrospective tabulation of exaggerated traction test results on 119 eyes provided the data in Tables 1 and 2. There is no obvious correlation of tightness with underaction of either inferior obliques or superior obliques, but there appears to be a reasonably good correlation with overaction. In general, the more overaction, the more tightness.

To investigate the extent of bias in the author's grading of oblique tightness, a surgical assistant was trained to perform the exaggerated traction test. This second-year ophthalmology resident appeared comfortable with the maneuver after experience with approximately 20 oblique muscles. Sixty-eight oblique muscles were then tested by the author and the assistant individually at the time of surgery, with the assistant having no knowledge of the patient or of the surgery to be performed. The results are shown in Table 3. Correlation between the two sets of observations is not perfect but is reasonably good.

Increased tightness of the obliques does not appear to be present in pure dissociated vertical deviation. Further experience is necessary, but the exaggerated traction test may indeed prove useful in cases of hyperdeviation by providing a measure of the relative contributions of oblique overaction and dissociated vertical deviation to the vertical misalignment.

APPLICATIONS

Knowledge of oblique tightness has proven useful both in diagnosis and in confirmation of surgical results, e.g., a frequent diagnostic problem is a residual hyperdeviation after surgical weakening of an oblique muscle. Is the hyperdeviation due to residual overaction, dissociated vertical deviation, or contracture of a rectus muscle? Exaggerated traction testing of the obliques can often help decide.

DISCUSSION

The exaggerated traction test for the oblique muscles cannot be easily quantified. It may be difficult to learn, and if only partially learned, the test may serve to obscure the "art" of strabismus even further. If one cannot learn to feel every normal oblique muscle, the maneuver is being performed incorrectly. Once the technique is learned, however, and seasoned with experience, it can become a valuable adjunct to strabismus surgery. In the author's management of cyclovertical strabismus, exaggerated traction testing of the obliques has become far more useful, and far more used, than any other operative test.

REFERENCES


Discussion

by

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Dr. Guyton has described a totally new maneuver to assess superior and inferior oblique tightness at surgery, which he feels is correlated with the degree of clinical overaction observed in the awake patient.

The maneuver is based on sound anatomic understanding of the obliques. In essence, he is moving the globe posteriorly, horizontally, vertically, and torsionally to place each oblique muscle on extreme stretch. There is no question in my mind that these passive movements of the globe are additive in placing the oblique muscle being tested in the most extreme position of mechanical elongation or stress. Retroposition of the globe during forced duction testing to exaggerate mechanical restriction caused by the superior oblique was originally described by Scott.1

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This maneuver is really more than a "forced duction" of the oblique muscles. The classic forced duction test is based on the principle of carefully rotating the globe in the normal physiologic field of rotation of the eye in an attempt to judge restriction to this normal rotational movement. Dr. Guyton’s maneuver is more analogous to a stress test of the oblique muscles rather than a forced duction test. I have attempted the maneuver several times and find it difficult to master. It is certainly easier to “strum” the superior oblique than the inferior oblique. In the developing family of clinical quantitative tests, Dr. Guyton’s test falls into the group of those assessing mechanical resistance as opposed to those measuring muscle function.

In training a resident to perform this test independently, without prior knowledge of the patient’s condition, Dr. Guyton has shown that there is some inter-observer correlation regarding the relative degrees of tightness. The role of this unbiased observer could be expanded so that we can have more objective information about whether the correlation between the increased tightness of the oblique muscles and the observed clinical overaction is valid.

If Dr. Guyton’s observation of correlation between oblique tightness and overaction is substantiated in some type of double-masked fashion, it raises the interesting possibility that, at least, some oblique overactions may be on the basis of either primary or secondary mechanical changes in the muscle as opposed to increased innervation. During the past few years, there has been much interest in attempting to separate out and quantify the mechanical and innervational factors operating in various strabismic conditions. I feel that one of the next phases of advancement in the field of strabismus will be the ferreting out of this mechanical versus innervational story. Dr. Guyton’s maneuver may assist all of us in understanding one chapter of this story. It may be that some cases of oblique overaction are on a mechanical basis and show either a primary or secondary contracture of the oblique muscle as the basis for the overaction, while others, which may appear clinically similar, are based on innervational excess. In the future, this may result in different modes of treatment for the same clinical problem based on mechanical weakening or selective denervation.

In another respect it is somewhat surprising that Dr. Guyton has found this very high percentage of mechanical tightness of the oblique muscles because the classical forced duction test has been found to be usually negative in cases of inferior oblique overaction by Toosi and Von Noorden as mentioned by Dr. Guyton in his presentation. Also, investigation by Gonzales has demonstrated that denervation of the oblique muscle alone results in prompt and effective reduction of the inferior oblique overaction. While this surgical technique has not become practical because of the problems of reinnervation, it is a piece of evidence to suggest that innervational factors are operating in oblique overaction.

Whether this maneuver may indeed be helpful in confirming that complete tenotomies or myectomies have been performed. It is still best to substantiate a complete transection by direct visualization combined with a repeated attempt to hook any posterior fibers remaining. Modern surgical techniques have stressed the importance of direct visualization of the obliques for isolation and tenotomy or myectomy. I do not feel this attempt at direct visualization should be abandoned in favor of Dr. Guyton’s test. However, it could be a helpful confirmatory sign.

This new test may also be helpful in the future as a guide for the amount of inferior oblique recession that is necessary on a specific patient. In other words, the inferior oblique could be recessed to a point where the normal amount of “tightness” was felt. Currently, we do not have objective methods at the time of surgery to determine how much inferior oblique recession to perform. This new test may provide some additional assistance in more objectively determining the desired amount of inferior oblique recession.

Whether this maneuver is really helpful in evaluating the contribution of the inferior oblique in dissociated vertical divergence must await independent observation. The change in magnitude of the dissociated vertical divergence in abduction and adduction has been a very useful guide in determining the contribution of the inferior oblique to the DVD. If the DVD is greater in adduction than in abduction, the inferior oblique should be implicated as a contributor to the problem. An inferior oblique alone almost never accounts for a dissociated vertical divergence. Therefore, the usual clinical dilemma is whether to add an inferior oblique weakening procedure to the basic rectus muscle surgery for DVD. Whether to add inferior oblique surgery to rectus muscle surgery, should be based on the difference in magnitude of the vertical deviation in abduction and adduction.

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