

Although denervation alone did not provide the expected results, its introduction was the basis for increased attention paid to the neurovascular<sup>86</sup> or neurofibrovascular bundle<sup>81,82</sup>—a formation comprised of the nerve and artery of the inferior oblique muscle and abundant fibrous tissue.

### Marginal Myotomies and Elongation of Inferior Oblique Muscle

Marginal myotomy of the inferior oblique muscle, a procedure that provides little correction, has poor results. It is rarely indicated. In 1949, Lloyd<sup>59</sup> already had discarded it because of unsatisfactory results. Some variants were proposed to improve its effectiveness. Martinez-Oropeza<sup>99</sup> and other Mexican ophthalmologists<sup>16</sup> performed an enlarged technique of marginal myotomy that they termed *triple marginal myotomy*. Basically, the procedure consists in making three marginal myotomies, two at the inferior margin, for instance, and the other at the superior margin, in the middle of the anterior myotomies. The muscle fibers were cut with thermocautery to ensure hemostasis.

We have performed this procedure only a few times; therefore, we do not have a great deal of experience with it, but we consider it fairly interesting because it weakens the inferior oblique muscle by elongating it without modifying its insertions or altering its line of action. Conversely, although the sections are achieved by cautery, the multiple incisions of the muscle capsule lead us to suspect that the operation may produce undesirable restrictive scarring. The same results would occur with the inferior oblique muscle elongation proposed by Almeida (1990).<sup>100</sup> Superior oblique muscle elongation is performed at the tendon, whereas Almeida's method takes place in muscle tissue. Although we have no experience with this procedure, we find it is prone to undesirable scarring.

### Selection of Technique

To evaluate the weakening procedures of the inferior oblique, we use the measurement of the V-pattern deviation in prism diopters before and after the operation and

observation of the muscle dysfunction. We classify it into 4 degrees of overaction (1+ to 4+) and 4 degrees of underaction (1- to 4-).

In slight (1+), bilateral, symmetric overactions of the inferior oblique, we opt not to operate, as a mild bilateral overaction is preferable to a postoperative vertical deviation, which cannot be discarded when the oblique muscles of both eyes are operated on. We operate for slight overactions only when the other eye must be operated on for a greater overaction (3+ or 4+), or in certain superior oblique pareses. In such cases, recession according to the Fink technique (i.e., a recession of 8 mm) is adequate.

When the overaction is moderate (2+), bilateral, and symmetric, with a moderate V-pattern deviation (10–12<sup>Δ</sup>), surgery may be avoided, especially in the absence of significant vertical deviation in the primary position. If operating is necessary because the V pattern is larger or because a greater overaction in one eye requires a more aggressive procedure, recessions of 10–12 mm are adequate.

In severe overactions of the inferior oblique muscle (3+ or 4+), recessions following the muscle line of action are insufficient; other techniques must be planned. Generally, we perform 4- to 6-mm myectomy with cauterization of the stumps (especially for contracture). In very severe overactions, we perform a distal myectomy,<sup>76</sup> extirpating the entire portion of the inferior oblique muscle that lies between the scleral insertion and Lockwood's ligament and cauterizing the proximal stump.

We have abandoned recession with anterior transposition in simple overactions except in cases of inferior oblique muscle overaction associated with DVD. Recommended procedures<sup>101</sup> are shown in Table 12-4.

## Superior Oblique Muscle

During the first quarter of the twentieth century, the skepticism that existed about surgery of the oblique muscles primarily concerned the superior oblique muscle. Von Graefe's idea<sup>38</sup> that oblique muscle surgery was a *noli me tangere* (i.e., better not to touch) predominated. Jackson<sup>102</sup> was even blunt when he said that surgery on the superior oblique muscle was impracticable. Banister<sup>103</sup> commented that, because of the superior oblique muscle's complex relationships and its scleral insertion at the equator, any operation on it was "out of the question." Many myths retarded the development of superior oblique muscle surgery.

According to Fink,<sup>36</sup> the first person to carry out a weakening procedure on the superior oblique muscle was Axenfeld who, in 1921, did an extirpation of the trochlea. Fink also quoted statements about superior oblique tenotomy that were made by van der Hoeve, Czermak, and Elschnig, but the absence of publications leads us to doubt that they

**TABLE 12-4**  
*Procedures for Different Degrees of Inferior Oblique Overaction*

Inferior Oblique Overaction	Recommended Procedure
Slight	8-mm recession
Moderate	10- to 12-mm recession
Severe	Myectomy with cauterization Distal myectomy Denervation plus myectomy Recession plus anterior transposition

ever really performed this procedure on any patients. In 1940, Meesmann<sup>104</sup> described section of the trochlea. At the same time, Malbrán,<sup>105</sup> Hughes and Bogart<sup>106</sup> (1942), and Hughes<sup>107</sup> reported success with similar procedures on the trochlea. In these operations, the trochlea was approached through a cutaneous incision at the superomedial angle of the orbit. In 1946, Berke<sup>108</sup> reported his paper "Tenotomy of the Superior Oblique for Hypertropia," establishing one of the most important landmarks in the development of surgery of the superior oblique muscle.

Weakening of the superior oblique tendon can be approached from the medial side of the superior rectus muscle, in the superomedial quadrant; generally, this approach is called the *nasal approach*. The weakening may be approached also from the lateral side of the superior rectus muscle, in the superolateral quadrant; generally, this is called the *temporal approach*. Although the terms *nasal* and *temporal* are not the most appropriate, we use this terminology because it is widely accepted.

The nasal approach allows tucking, recession, tenotomy, tenectomy, split-lengthening of the tendon, and recession with posterior transposition. The temporal approach permits tenotomy, tenectomy at the insertion, posterior tenectomy, posterior tenotomy, anterior tenectomy, scleral disinsertion, recession with posterior transposition, and recession by hang-loose suture. Weakening procedures (e.g., tenotomy or tenectomy, tendon split-lengthening, recession with posterior transposition) performed via the nasal approach provide larger effects than when performed via the temporal approach, because the nearer a tenotomy is to the trochlea, the greater is its weakening effect. If tenotomy is performed close to the trochlea, the weakening is so marked as to appear to be a total superior oblique muscle paralysis.

The approach, dissection, and management of tendon are more complex when done via the nasal approach. The operations performed via the nasal approach are more prone to cause complications than are those performed via the temporal approach. Sometimes, as in recession with posterior transposition, we can use a combined approach, beginning via the temporal approach and later via the nasal approach.

### Procedures via the Nasal Approach

For cases with moderate superior oblique muscle overaction and a small A-pattern deviation, Jampolsky<sup>18,109</sup> proposed a simple marginal Z tenotomy executed via the medial approach. Although effective, this procedure yields unpredictable results<sup>110</sup> (see Table 6-7).

**Berke's Tenotomy and Tenectomy** The superior oblique muscle tenectomy performed near the medial edge of the superior rectus muscle is a technique introduced by Berke

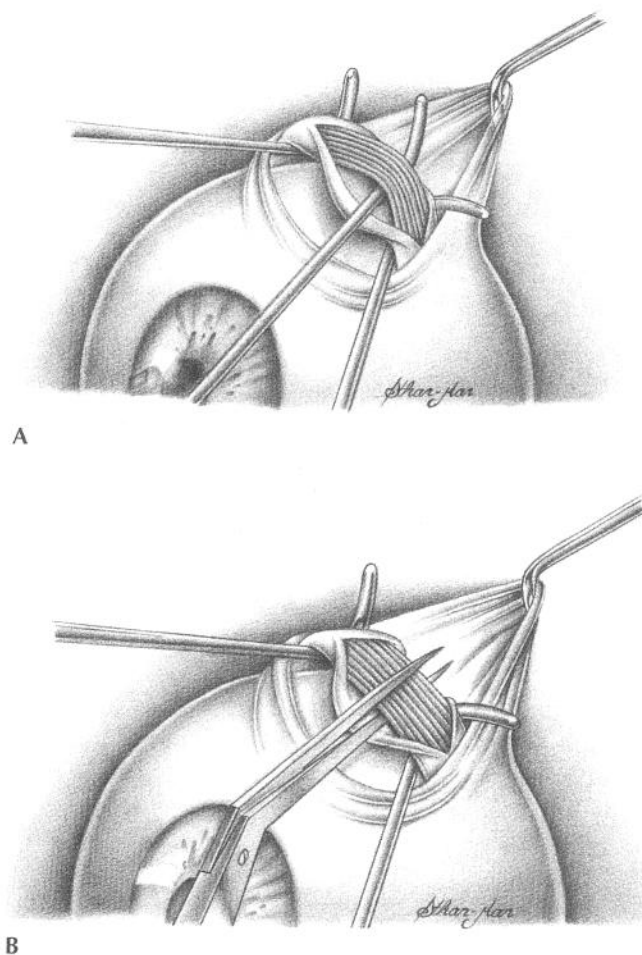


FIGURE 12-17 Berke's tenotomy (see explanation in text).

in 1946<sup>108</sup> and still is being performed in some strabismology centers.<sup>16,72,111-118</sup> Two varieties of the original technique are used: intrasheath tenotomy and fasciotenotomy<sup>16</sup> (Figure 12-17). No studies are available to compare the efficacy of the procedures. The intrasheath tenotomy and the fasciotenotomy or fasciotenectomy should be performed only in cases of severe A-pattern deviations that exhibit greater than 30<sup>A</sup> incomitance between upgaze and downgaze and also frequently in cases of Brown's syndrome with marked superior oblique muscle overaction.

**Recession** In 1970, Ciancia and Prieto-Díaz<sup>119</sup> introduced the first technique for recession of the superior oblique muscle. The initial procedure<sup>120-124</sup> was soon modified and converted to a retroequatorial recession (Figure 12-18). With this modification we avoid severe complications (limitation of depression in abduction and overconvergence in infraversion) due to reinsertion