Tissue response to the Fadenoperation

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SUMMARY The Fadenoperation was performed on 24 rabbit eyes. In 8 eyes the globe and muscle were removed intact and in 16 eyes the muscle was dissected from the sclera to determine the site and degree of attachment. The greatest degree of adherence was found between the muscle and the sclera at the site of the suture, less attachment at the lateral and medial border of the muscle, less in the central area close to the suture site, and least in the central anterior area. The Fadenoperation creates adherence of the muscle to the sclera. Its clinical usefulness will, however, depend on clinical evaluation.

The Fadenoperation is a procedure designed to change the anatomical and thereby the functional arc of contact of a muscle by suturing the muscle to the sclera 12 to 18 mm posterior to its insertion (de Decker and Conrad, 1975; Muhlendyck and Linnen, 1975; Muhlendyck, 1976). It is suggested that this procedure will alter the deviation in the field of maximum deviation with no effect in the primary position, that is, the dynamic angle as differentiated from the static angle of strabismus. Neither the clinical effectiveness nor the nature of the tissue changes have been conclusively established. It is the purpose of this study to determine the tissue changes produced by this procedure.

Material and methods

A total of 24 eyes were investigated in 13 New Zealand white rabbits with an average age of 18 months and an average weight of 4.4 kg. Topical tetracaine and 20 mg/kg of sodium pentobarbital was used for anaesthesia. A traction suture was placed at the inferior limbus, a fornix-based conjunctival flap was raised, and the inferior rectus muscle isolated. The inferior rectus was chosen since it is thicker than the horizontal rectus muscles, so that subsequent evaluation is easier. The inferior oblique was isolated and dissected free of the inferior rectus. Two 5-0 Merseline sutures were used to secure the muscle to the sclera about 8 mm posterior to the insertion. The suture was passed through the sclera and then through the muscle

2 mm from the border and tied. Indian ink was used to mark the sclera anterior to the muscle. This technique proved useful in identifying the site of muscle insertion and for the technician in preparing the sections. The conjunctiva was reattached at the limbus.

The eyes were re-examined an average of 81 days after surgery. Twenty-four muscles in 13 rabbits were reviewed. In 8 eyes the globe and the muscle were removed intact, sectioned, and stained with trichrome. In 16 eyes the muscle was redissected to determine the nature, site, and strength of scleral attachment. In several dissected eyes the eyes were sectioned and stained with trichrome subsequent to the dissection.

Results

On exposing the inferior rectus the first observation was that it was not possible to pass a strabismus hook under the margins of the muscle anterior to the suture, even if a sharp-tipped strabismus hook was used. On a 1- to 4-scale the adherence was graded 4+ at the suture site and 3+ along the margins of the muscle. This pattern of adherence was evident in all the muscles dissected (Fig. 1).

Of those eyes that were dissected 6 were dissected from the suture toward the limbus. The adherence was graded as 1+ anteriorly in the centre and 2+ posteriorly in the centre (where a strabismus hook could be passed from behind forwards between the sutures with only slight effort). In 1 eye the anterior centre was probably free of the tenuous anterior centre adhesion. In 10 eyes the muscle was dissected from the insertion toward the site of the suture. In 7 eyes the same distribution of adherence was noted.

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Fig. 1 *Blunt dissection of muscle showing the greatest adherence of the muscle to the sclera at the suture site and less adherent along the side of the muscle*

In 3 eyes the central anterior area of the muscle was apparently not adherent. Two of these eyes, however, were the first to be redissected, and it is possible that we failed to observe the adhesion, which was very tenuous. The third eye was dissected only 10 days after the original surgery. The dissected eyes were sectioned and stained with trichrome and showed muscle fibres adherent to the sclera after blunt dissection (Fig. 2).

In those eyes removed with the muscle attached without dissection and examined histologically the muscle was found to be adherent to the sclera (Fig. 3). The area around the suture showed a foreign body reaction with the most intense fibrous connective tissue adherence to the sclera. In general this method of examination yields little indication of the degree of adherence.

Discussion

The clinical effectiveness of the Fadenoperation has yet to be determined. It has been recommended in cases with a variable angle of strabismus, nystagmus,

Fig. 2 *Muscle fibres remaining adherent to the sclera after bluntly dissecting the muscle anterior to the suture*

Fig. 3 *Undissected globe showing adherence of muscle to sclera anterior to the suture site*

Fig. 4 Diagrammatic representation of the distribution and strength of adherence—4+ represents the greatest adherence and 1+ the least adherence

and in dissociated vertical deviations. Most of the cases reported by Muhlendyck and Linnen (1975) had standard horizontal muscle surgery as well as the Fadenoperation, which makes the results difficult to evaluate.

The procedure does indeed create an adherence between the muscle and the sclera. The greatest adherence is at the site of the suture, somewhat less

at the lateral borders of the muscle and least in the anterior central portion (Fig. 4). The procedure does produce the intended anatomical changes, but its usefulness will depend on further clinical evaluation.

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References

- de Decker, W., and Conrad, H.-G. (1975). Fadenoperation nach Cuppers bei komplizierten Augenmuskelstörungen und nichtakkommodativem Konvergenzexzess. *Klinische Monatsblätter für Augenheilkunde*, 167, 217–226.
- Muhlendyck, H. (1976). Diagnosis of Convergent Strabismus with Nystagmus and Its Treatment with Cuppers' Fadenoperation. *Orthoptics, Past, Present, Future. International Orthoptics Congress, 3rd Transactions, Boston, 1–3 July 1975*, pp. 143–154. Stratton International Medical Book Corp.: New York.
- Muhlendyck, H., and Linnen, H. J. (1975). Die operative Behandlung nystagmusbedingter schwankender Schielwinkel mit der Fadenoperation nach Cuppers. *Klinische Monatsblätter für Augenheilkunde*, 167, 273–290.