WORKING MODEL OF THE EXTRINSIC EYE MUSCLES*

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It is not easy for beginners to understand the actions of the extrinsic ocular muscles by simple reference to the geometry of their arrangement and attachments. A working model has been designed which has been found useful for demonstrating these actions, both singly and in groups. The requirements of a satisfactory model are that it should be large enough for movements to be easily seen and that these movements should be reasonably full and accurate.

For construction of the globe, the 3-in. diameter hardwood ball sold for the game of shinty was found to be of suitable size and quality. The hardwood base for the model was then made $7\frac{1}{2}$ in. long to represent the correct proportion of globe to orbital floor. Full movement of the ball was assured by using a thrust bearing consisting of a 2-in. diameter shallow brass cup and nylon washer, with a brass flange soldered to the inner aspect of the cup to prevent dislocation of the globe which otherwise occurs. The bearing was fixed to a rod bent through 90° and attached to the back of the upper surface of the base. This rod was also used to bear a ring at its posterior end for the attachment of the rubber bands representing the rectus muscles (Figs 1 and 2).

FIG. 1.—Lateral view of model.

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The four rectus muscles were doubly represented. Four pairs of rubber bands were fixed under brass plates screwed to the ring representing the annulus tendineus communis, and under others recessed in the globe. These bands maintained apposition of the globe and bearing and controlled movement. Tension was adjusted allowing free rotation of the ball. Four strings were attached to the same points on the globe for manipulation, and another pair was also attached to the outer posterior quadrant (Fig. 2) without rubber bands to represent the superior and inferior oblique muscles. The superior oblique string was led around a nylon pulley borne on a rod fixed to the inner aspect of the base opposite the front of the globe (Fig. 2).

FIG. 2.—Plan of construction. LR, Lateral rectus. MR, Medial rectus. SR, Superior rectus. SO, Superior oblique.

The model worked satisfactorily in the state described, but some concessions were made to appearance and to ease of manipulation. These were as follows:

(1) The appearance was made more realistic by fitting a perspex "cornea" over a $\frac{1}{2}$ -in. diameter hole simulating the pupil, and the globe was painted white. A small cross was painted on the centre of the perspex hemisphere so that movements, particularly torsion, could be more easily seen.

(2) A perspex plate, suitably drilled to transmit the strings representing the four recti and the superior oblique, was screwed to the back of the base. Each string was passed through its hole, fitted with a knob, and labelled.

Movements which can be produced by manipulation of the strings are extensive and apparently accurate. It is possible to demonstrate movements produced by single muscles easily.

The globe can be pre-set by hand to any position and progressive actions produced by manipulating the strings. For example, it can be seen that the unopposed superior oblique acting on the globe in the primary position produces depression, abduction, and intorsion (Fig. 3). The torsion is most marked in the fully abducted position, amounting to about 70° . Similarly, it can be clearly shown that the superior and inferior recti can adduct or abduct the globe in different positions, according to whether they pass medial or lateral to the vertical axis.

FIG. 3.—Anterior view showing the action of the superior oblique muscle.

When group actions of muscles are to be demonstrated a little more skill is required. This is easily acquired with practice. Examples of group action which can be shown are the inferior oblique elevating the actively adducted eye with minimal torsion, and the production of a downward and outward movement by the lateral and inferior recti working together. In the latter case it can be demonstrated that a trochlear nerve palsy would have no apparent effect. In the same way effects of paralyses of other muscles or groups can be shown.

Materials and Method

1. Shinty ball, with perspex hemisphere $1\frac{1}{2}$ -in. diameter if desired.
2. Hardwood base, shaped from a block 6 in. $\times$ $7\frac{1}{2}$ in. $\times$ $\frac{7}{8}$ in.
3. Brass rods (a) $5\frac{3}{4}$ in. $\times$ $\frac{7}{16}$ in., threaded $\frac{5}{16}$ B.S.F. for $\frac{3}{4}$ in. and bent 90° $2\frac{1}{2}$ in. from threaded end. (b) $3\frac{1}{2}$ in. $\times$ $\frac{3}{8}$ in. threaded $\frac{1}{4}$ in. B.S.F. for $\frac{3}{4}$ in.
4. Cup bearing, turned from $\frac{3}{8}$ in. brass. Diameter 2 in., depth of cup $\frac{1}{4}$ in., surrounded by a flange, $\frac{1}{8}$ in. high. Braze to unthreaded end of rod 3a.
5. Nylon ring, $\frac{1}{8}$ in. thick $\times$ $\frac{1}{8}$ in. wide, of diameter to fit inside the flange of 4.
6. Brass plate, $1\frac{1}{4}$ in. $\times$ $\frac{1}{2}$ in. $\times$ $\frac{1}{16}$ in., soldered to inner side of cup 4.
7. Brass ring diameter $1\frac{1}{2}$ in. $\times$ $\frac{3}{8}$ in. wide brazed with distance piece to rod 3a.

8. Suitable pulley $\frac{1}{2}$ -in. diameter with nylon hood if desired. Bolt to unthreaded end of rod 3*b*.
9. String, and knobs of the window blind type.
10. Natural rubber bands $\frac{1}{2}$ in. $\times$ 6 in. or more.
11. Brass plates for attaching rubber bands and string.
12. Suitable screws and nuts.
13. Rubber feet.
14. Perspex plate $3\frac{1}{2}$ in. $\times$ 2 in.

Further details of construction, which are depicted in Fig. 2, would be supplied on request.

Summary

A model to demonstrate eye movements is described. It has been found to be a useful teaching aid, and has excited favourable comment from ophthalmologists and orthoptic teachers.

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