corresponded to the inner margin of the upper lid throughout its entire length. The skin was undermined to the required depth and an upper fornix formed. A piece of dentist's mould was then shaped so as to fit snugly into the pocket.

The graft was then folded over the inlay which was put into the cavity and the wound was closed with 4 sutures. After one week the stitches were removed and a shell eye fitted in.

There was hardly any appreciable shrinkage. The patient was provided with an artificial eye and the aesthetic result is fairly satisfactory.

I was unfortunately unable to have his photograph taken before the operations; the photographs, Figs. 1, 2 and 3 illustrate the result obtained.

SURGICAL ANATOMY OF THE FACIAL NERVE*

With reference to the technique of orbicularis
block (palpebral akinesia)

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Review of Literature

IN 1914 van Lint described a method by means of which it is possible to cause temporary paralysis of the orbicularis muscle. He injected three or four c.c. of two per cent. novocain with two or three drops of adrenalin at a point situated at the intersection of a horizontal and vertical line, drawn 0.5 cm. distant from the lower and the temporal margins of the orbit. Then from a point near the external angle of the palpebral fissure three injections are given directed away from the orbital margin towards the facial nerve, one c.c. being injected at each of three separate points, so as to cover all the branches supplying the orbicularis muscle. Fig. 1.

Similar procedures advocated by Villard in 1919 and Rochat in 1920 gained little support.

Modifications aiming at blocking the peripheral branches of the nerve were suggested by Rubbrecht in 1926, and Terson in 1931. Rubbrecht advised the injections of 0.5 c.c. of 2 per cent. novocain each into the middle of the upper and lower lids, and of 0.5 c.c. near the external angle. The injections are directed towards the periosteum, and this method "makes akinesia unnecessary". Terson

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FIG. 1.

The arrows show the direction in which the injection is made in van Lint's method.

advocated (1931) injection through the conjunctiva. "Injection de détente." An injection of 3 c.c. of 2 per cent. novocain without adrenaline is made deeply above and below the external palpebral angle.

These methods aiming at the blocking of the terminal branches cause temporary paralysis of the nerve supply of the orbicularis muscle, but they have the disadvantage of causing oedema of the eyelids, during the operation. Several injections are also needed, and they may cause corneal ulcer in consequence of the lagophthalmos (Meller). However, these disabilities may be obviated. In order to overcome the lagophthalmos an injection of a few drops of novocain into the levator may be made through the conjunctiva at the middle of the upper fornix, at the same time when the akinesia injection is done (Ascher 1928). As for the oedema of the lids, this does not occur if the injection is given at the right distance from the orbital margin, and deep enough near the periosteum. Damage to the

cornea can be avoided easily by careful dressing and ensuring the closure of the lids by the use of a stitch in the upper lid, or by a narrow strip of adhesive plaster.

In contrast to these methods, there are those that aim at blocking the whole of the facial nerve. Wright (1923) and van Heuven (1926) proposed an injection near the sternomastoid foramen. Wright described two different techniques but in the majority of cases the results were unsatisfactory, and he remarked "it remains to be seen whether one can lay down definite instructions for finding the trunk with practical certainty".

O'Brien (1928) suggested blocking the nerve neither from its exit from the skull nor at its terminal but on its appearance on the face. He injected procaine around the portion of the facial nerve which lies in the parotid gland just outside the mandible. According to his description the point of the injection is just anterior to the tragus of the ear, below the posterior portion of the zygomatic process and directly over the condyloid process of the mandible. The patient is asked to open his mouth and as he does this the condyle of the mandible is felt to slide forward. When the mouth is open one notes a distinct depression under the finger tip. As the mouth is closed the condyle is felt to slip back, and it is directly over this point and down on to it that the solution is to be injected. Going straight inward with a sharp needle, one strikes the bony condyloid process at the depth of about 1 cm. As soon as this is felt an injection of 2 per cent. solution of procaine hydrochloride is made, the needle gradually being withdrawn as the injection is made. Lid paralysis begins to appear from 30 to 60 seconds and after a few minutes is so marked that the patient is unable to close the lids, and the palpebral fissure is widely opened. Atkinson (1934) suggested that if paralysis is not secured with the first injection a second injection is to be given and the needle should be inserted at another point. To avoid failure Kapuscinsky (1934) marks the site of the injection by searching the supplying nerve fibres with galvanic current which causes contraction of the orbicularis muscle if the needle is on the correct spot. This rather unpleasant procedure is quoted only to show that apparently many failures were observed.

A review of the literature shows that of the three methods, the paralysis of the terminal branches, and the O'Brien method became established, and that there is a growing recognition of the usefulness of palpebral akinesia especially in association with intracapsular extraction. Van Lint (1926) compares a cataract operation without paralysis of the lids to walking on a tight rope, and the lid retractor and bridle stitch he compares to the balancing weight which are helpful but of doubtful value. However, difficulty in laying down definite instructions for finding the facial nerve still stands, and most textbooks describe the method briefly and inadequately.

Anatomy of the facial nerve

Appreciation of the normal variations in the anatomical distribution of the branches of the facial nerve is essential both in securing more satisfactory palpebral akinesia, and in avoiding the not uncommon failures to attain any at all. For this purpose eleven dissections were carried out.

Exposure: Incisions, *superior* horizontal above the zygoma, *vertical* in front of the ear, *inferior* along the basis of the mandible. Careful dissection of the skin is essential, so as not to damage the fascia over the parotid which is attached superiorly to the zygoma and inferiorly to the mandible. Before removing this fascia, the branches of the facial nerve are sought, all of which leave the anterior border of the parotid, and lie immediately deep to the fascia. The frontalis and zygomatic branches can easily be located at the zygoma, and lying closely on the masseter several buccal branches are found together with the parotid duct and the transverse facial artery. The lower mandibular and cervical branches are looked for. Taking care of these structures the fascia is then removed.

Next the dissection is carried into the gland itself along the branches of the facial nerve, and here a natural plane of cleavage is found between the superficial and deep lobe of the gland, where the main trunk of the nerve is found.

These dissections were in agreement with the findings of Bailey, MacCormack and co-workers and taken together with the present study they allow the following account of the surgical anatomy of the facial nerve. As will be seen divergencies from the standard teaching were observed.

(a) *Landmarks and surface anatomy of the facial nerve.* The facial nerve after emerging from the stylomastoid foramen curls round the condyle of the jaw traversing the parotid gland. The main trunk divides usually into two principal divisions, the temporo-facial and cervico-facial portions. The point of the bifurcation occurs 5 to 7 mm. dorsal to the ramus of the mandible and on a slightly deeper plane and here the nerve is entirely surrounded by glandular tissue. (Figs. 2, 3 and 4).

The temporo-facial division as it lies on the mandible has a rather variable position. It is generally described as lying on the condyloid process of the mandible but these dissections showed that it constantly lies considerably lower and its site was found to be 1.5 to 2.5 cm. below the lower margin of the zygomatic arch. This point is at about two thirds of the level of the junction of the upper and middle thirds of the distance from the external angle of the mandible to the palpable condyloid process. As noted above the variation in distance as measured from the zygomatic arch is from 1.5 to 2.5 cm. and is explained on the basis of comparative headsize.

FIG. 2.

The position of the temporo-facial division in relation to the bony landmarks of the zygoma and angle of mandible. (After Tandler, modified).

(b) *Supply of the orbicularis*: The temporo-facial division of the facial nerve which usually supplies the orbicularis muscle frequently receives rami from the cervico-facial division, and this was to be found in seven out of eleven dissections.

(c) *Pattern*: Considerable variations of the pattern of distribution of the branches of the facial nerve were shown, but the textbook description of temporal, zygomatic, buccal, mandibular and cervical branches, was always identifiable. In more than half of the specimens there were connections between the temporo-facial and cervico-facial branches.

(d) *Position of the facial nerve in relation to the parotid gland*. The facial nerve lies between the two lobes of the parotid, and it partially separates the gland into a large superficial and a small deep portion, the two parts being connected by a slender isthmus which passes between the two diverging (the temporo-facial and cervical) portions of the nerve.

(e) *Other structures of the region*. The external carotid artery lies posterior and at a deeper level than that at which the injection

is usually given and the danger of injuring it is remote, but the posterior facial vein and the transverse facial artery are not free from danger.

From the above descriptions of dissections it is seen that the main divergencies from usual descriptions are (1) location of the temporo-facial division (2) The position of the facial nerve sandwiched in the parotid (3) The existence of a fascial plane in the parotid.

Discussion and conclusion

In inducing blocking of the facial nerve it is essential to know the exact point of bifurcation of the trunk into its two main divisions, and especially the location of the temporo-facial division. Both the point of bifurcation of the nerve and of main trunk of the temporo-facial division lie at the same level, namely at the junction of the upper and middle thirds of the distance between the angle of the mandible and the palpable condyloid process, which is the correct site for injection for palpebral akinesia by blocking the middle portion

FIG. 3.

The temporo-facial division is approximately at the upper third between zygoma and the angle of the mandible. In this case a novocain injection over the condyloid process (O'Brien) would probably be effective owing to the upward course of the nerve. (Author's dissection).

FIG. 4.

The position of the temporo-facial division is lower than in Fig. 3. A novocain injection over the condyloid process would give no result. But an injection given at the junction of the upper and middle thirds between zygoma and the angle of the mandible would reach the nerve. (Author's dissection).

of the course of the facial nerve. This point is considerably lower than it was suggested by O'Brien and recommended in most text-books. The needle of the syringe should aim at the posterior part of the lateral aspect of the mandible, and should penetrate to a depth of about 1 to 1.5 cm. until the bone as a landmark is reached. One to 2 c.c. of 4 per cent. procaine is injected while the needle is gradually withdrawn. This method is expected to be effective in about 90 to 95 per cent. of the cases. In the remainder the position of the temporo-facial division is such that the procaine will probably not reach it. In cases of failure, however, the technique of van Lint is advisable by which the terminal branches round the orbit are injected. The method advocated by Atkinson attempting a second injection near the site of the first injection is not recommended.

The frequency of connections between the temporo-facial and cervico-facial divisions is of interest ophthalmologically. One might

expect that these connections would carry fibres to the orbicularis muscle, and the blocking of the temporo-facial division would therefore cause only incomplete or partial palpebral akinesia. Experience with facial block has, however, shown that paralysis of the lids is complete in most cases, the failures being few, therefore these connections are possibly afferent in function.

Of interest too is the position of the facial nerve within the parotid gland. It lies between the two parts of the gland in a pre-formed tissue space. The spreading of the procaine in this tissue space may facilitate its penetration into the facial nerve.

Summary

1. Review of the literature of the facial akinesia shows three different approaches: (a) the terminal branches, (b) the main trunk at the stylomastoid foramen and (c) the middle portion of the course of the nerve near the ramus of the mandible.

2. Dissections have shown that the surface marking of the middle portion of the facial nerve corresponds to a horizontal line drawn through the junction of the upper middle thirds of the distance between the zygoma and angle of the mandible.

3. The position of the nerve within the parotid gland is in a plane of cleavage between the two lobes of the gland which may facilitate the spreading of the procaine into the nerve.

4. The correct point for the injection, when the middle portion of the course of the facial nerve is used for palpebral akinesia, lies below the condyloid process at the junction of the upper and middle third of the distance between the zygomatic arch and angle of the mandible.

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