ANNALS OF SURGERY

Vol. 146 November 1957 No. 5

Spontaneous Return of Function Following Surgical Section or Excision of the Seventh Cranial Nerve in the Surgery of Parotid Tumors *

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THE PURPOSE of this report is to present clinical evidence that following surgical section and sacrifice of a considerable segment of the seventh cranial nerve (including a portion of its main trunk and the peripheral plexus) there can be spontaneous recovery of function in a fair percentage of cases without resort to nerve grafting or any other form of neurorrhaphy.

The clinical basis for the report is an analysis of a consecutive series of 150 operative cases of malignant tumors of the parotid from the Head and Neck Service of the Memorial Hospital during the period 1949 to 1953 inclusive. Incident to the surgical removal of the tumors, 40 (27 per cent) of these patients had a deliberate section of the seventh cranial nerve and an excision of a segment of between 2.5 and 5 cm. of the main trunk of the nerve and its peripherally extending branches (plexus). Of the 40 patients with such sacrifice of the nerve, 28 were considered to be *determinate* (statistically significant). The remaining 12 *indeterminate* patients (all with cancer of the parotid) either had rapid and massive local recurrences with gross invasion of the facial musculature, or suffered generalized dissemination of cancer. None of the latter 12 patients lived long enough so that it could be established whether there would otherwise have been any return of function eventually, this being the reason for classifying them as *indeterminate.*

The noteworthy observation which we wish to place on record in this report is that *of the 28 determinate cases at least eight patients (28.5 per cent) had a fair degree of return of function in the paralyzed facial musculature without resort to nerve grafting or any other reparative operation.*

Review of the Literature on Seventh Cranial Nerve Neurorrhaphy

We have been unable to find any previous report of *recognized* spontaneous recovery of function following segmental op-

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erative defects of the seventh cranial nerve in adults. Conley [5] mentions having observed it in two children, but apparently has not recognized its possibility in adults, for he reports elaborate combinations of nerve grafting and muscle and/or fascial transplants to relieve the sequelae of such segmental defects. As we shall later discuss in more detail, we strongly suspect that spontaneous recovery has actually been observed by others (though not recognized as such), especially in most of the reported cases where a return of function has been ascribed to some form of neurorrhaphy.

In any event, a search of the literature for documentary evidence of functional recovery following neurorrhaphy in specific cases is disappointing, especially as regards nerve injuries incident to parotid surgery. In most reports on the treatment of facial nerve paralysis, the discussion is concerned mainly with the sequelae of mastoid surgery and skull fracture or with the relief of Bell's palsy. In the present report, we are concerned only with actual segmental operative defects (2.5 to 5 cm. in length) of the seventh nerve and its plexus incident to parotid surgery, and, therefore, henceforth for purposes of brevity and clarity, we shall narrow our discussion to that aspect of the problem.

For the repair of peripheral segmental defects of the seventh nerve, three general methods have been used: 1) single or branched, fresh or degenerated auto grafts have been sutured and anastomosed, end-to-end, to bridge the defect; 2) nerve grafts have been anastomosed to the proximal stump only of the seventh nerve with their branched distal ends laid loosely in tunnels in the facial musculature; 3) the distal portion of the seventh nerve has been transplanted and anastomosed with the central stump of a sectioned 11th cranial nerve.

The published reports of results of all these forms of nerve grafting are rather scanty and, in most instances, either negative or so vague as to be unconvincing. In 1932, Ballance and Duel [2] reported two cases of unbranched nerve grafts sutured end-to-end to bridge defects in the main trunk of a seventh nerve in parotid tumor cases. No end results are given, and the authors' only comment in this regard is that "good" or "perfect recovery is expected." In any case, so far as we are concerned, segmental defects of the seventh nerve incident to parotid surgery are characteristically rather extensive (2.5 to 5 cm. or even more) and, therefore, must include not only a portion of the main trunk but also a part of the plexus. And for this reason, we cannot see any practical application in parotid surgery of unbranched grafts such as those used by Ballance and Duel.

While several other authors, Furstenberg,[8] Lathrop,[9, 10] Bunnell,[3] and Ballance,[1] discuss the placement of unbranched grafts in the bony facial canal, there is little or no follow up, or at least no documentary evidence of recovery. Ballance simply states that in one such case recovery was "wonderfully satisfactory."

A fairly clear and well-documented instance of functional recovery is that published by Cardwell,[4] who in 1938 reported a staged nerve graft following a radical excision of the parotid in which several segments of the external femoral (a sensory nerve) were sutured to the proximal stump of the facial nerve and the distal ends of the grafts laid in tunnels in the facial musculature. He states that after one year there was "voluntary and emotional response in the lower two-thirds of the face and good closure of the eye." We find it difficult to accept unquestionably this single and isolated case of functional recovery as being the specific result of neurorrhaphy. It seems hardly likely to us that in the period of a year there could have been such accurate re-establishment of neural pathways between the facial nerve nucleus and the motor end plates in each of its several appropriate groups of facial muscles by way of these multiple grafts, the distal ends of

which had been laid "loosely in tunnels in the facial musculature" so as to permit of "voluntary and emotional response" and "good closure of the eye."

Maxwell,[13] in 1954, reports one case of facial nerve grafting (branched) in a segmental defect following parotid surgery. A return of function was first noted 19 months after the original sacrifice (ten months after the graft). Is it not reasonable to conjecture that the results in both of these preceding cases actually were due to spontaneous recovery?

Conley [5] reports seven instances of facial nerve neurorrhaphy combined with masseter muscle rotation and/or fascia lata suspension after parotid surgery. He used branched grafts from the great auricular nerve (sensory), the anastomoses (about four in number) with the terminal components of the seventh nerve plexus being secured by plastic tube cylinders. He reports satisfactory results (65 to 95 per cent) in three cases. From the standpoint of critical evaluation, however, it is not possible to judge the merits of neurorrhaphy alone from the latter cases, since a combined procedure (neurorrhaphy and muscle or fascia transplant) was used in all. The pattern of recovery, including the time interval in both Maxwell's and Conley's, however, is similar to our spontaneous cases.

According to the literature, the transplantation of the distal portion of the seventh nerve into the sectioned stump of the eleventh cranial has proved completely unsuccessful.* Duel and Ballance,[7] Sullivan,[14] and Lathrop [9] all deprecate its usefulness. Love and Cannon [11] mention its use only after removal of tumors of the acoustic nerve. They give no follow up. In any case, this maneuver could only be applied in cases where the peripheral portion of the seventh nerve (and plexus) consisted of the main trunk of the facial nerve, a condition not present after radical resection of the parotid.

In brief, although nerve grafting for facial nerve defects distal to the bony canal has been employed for over 25 years, few clear-cut successful results have been reported, and even in these the phenomenon of spontaneous recovery would be a fairly reasonable explanation. As recently as 1953, Lathrop,[9] reporting the experiences at the Lahey Clinic, pessimistically concludes that "under such circumstances (i.e., defects incident to parotid surgery) the facial paralysis must be alleviated by other means" (than neurorrhaphy).

We think it significant that in a single clinic we have observed more instances of spontaneous recovery (eight) in a series of 28 determinate cases of wide segmental defects of the peripheral portion of the seventh cranial nerve than the total of all documented cases reported in the literature following neurorrhaphy. Since the attempt at neurorrhaphy would in no way hinder spontaneous recovery, we strongly suspect that most (if not all from reported cases) are actually of spontaneous character.

Anatomic and Clinical Considerations of Surgical Trauma to the Seventh Cranial Nerve

The surgical anatomy of the seventh cranial nerve, after it emerges from the stylo-

* One of us (H. M.) has observed 2 cases in which the 11th nerve had been anastomosed with the terminal 7th. In one (a mastoid case) the failure of functional return was obvious and had been accepted as such by the patient. In the second (the result of a gunshot accident), the patient had been assured by his neurosurgeon that recovery had begun. Eight years later the patient appeared to have perfect confidence that such was the case, and (following the directions of the neurosurgeon) he would attempt to demonstrate this by a combined convulsive elevation of the shoulder with an exaggerated and bizarre grimace of the whole face, an act which he fondly believed to prove that there was recovery in the paralyzed side of the face. While the grotesque gesture was surely arresting to the casual observer, it was, nevertheless, completely useless, for so far as could be seen there was no active motion whatever on the paralyzed side of the face.

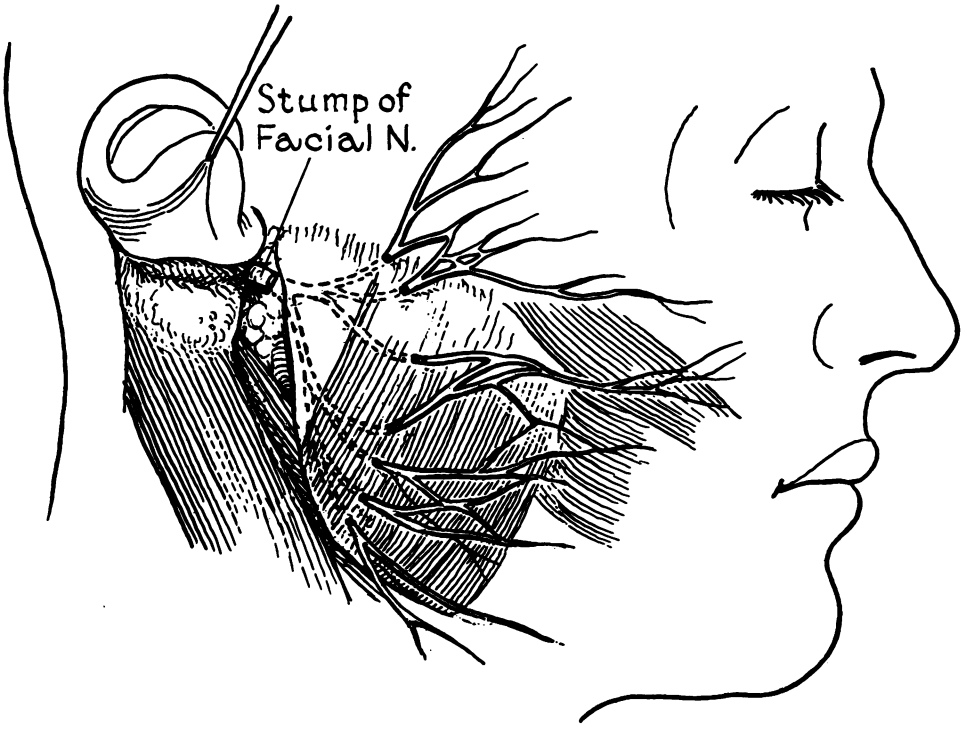


FIG. 1. The dotted lines represent the average portion of the 7th nerve (main trunk and plexus) which was removed in the cases reported in this paper.

mastoid foramen to enter the substance of the parotid gland and then to divide and subdivide after a variegated pattern (Fig. 1), renders any deep surgical exploration of this region somewhat hazardous from the standpoint of serious accidental trauma (crushing, over-stretching, or complete section) to the seventh nerve and its plexus. Only by an intimate knowledge of its local surgical anatomy, and by preliminary exposure of the main trunk of the nerve, can the likelihood of these accidental hazards be eliminated.

The parotid has a rather indistinct capsule, and in this highly vascular field it is sometimes troublesome to distinguish parotid tissue from subcutaneous fat. Except by first directly exposing the main trunk of the nerve,[12] it is difficult or even impossible subsequently to expose, identify, and preserve all portions of the plexus. Parotid tumors often appear deceptively superficial to the surgeon who lacks experience in this particular area, and as the result of the several foregoing considerations many ill-conceived, incomplete, or unnecessarily traumatic operations are performed in cases of parotid tumors. When such operations are performed (that is, without preliminary exposure of the main branch of the nerve), many seventh nerve disabilities of uncertain character occur. Under such circumstances with partial or complete postoperative paralysis the discomfitted surgeon cannot know whether he has completely sectioned the main trunk of the nerve, or one of its branches, crushed the nerve, or whether he has simply over-stretched it. Since the disability is unsightly and might even have medico-legal significance, it is understandably of considerable concern to the surgeon.

TABLE I. *Patients Showing Return of Function Following Resection of a Segment of the 7th Nerve for Parotid Tumor*

Case No.	Patient	Age	Sex	Minimum Length of Resected Segment (cm.)	Diagnosis	First Return of Function (Mo.)
1	N. W.	28	F	3	Mucoepidermoid carcinoma	8
2	L. R.	16	F	4	Adenocarcinoma	6
3	R. F.	63	M	5	Epidermoid carcinoma	6
4	J. A.	37	M	3	Recurrent mixed tumor	10
5	M. P.	26	F	2.5	Mucoepidermoid carcinoma	8
6	J. K.	48	M	2.5	Mucoepidermoid carcinoma	21
7	J. W.	6½	F	2.5	Fibrosarcoma	13
8	J. S.	60	M	4	Alveolar carcinoma	35

If then after a few weeks or several months there is a substantial degree of recovery from the paralysis, the surgeon gratefully breathes a sigh of relief and not unreasonably concludes that the degree of surgical trauma was less than complete section. While under such circumstances the recovery is most likely to be due to a reestablishment of the neural pathway through a physically intact though traumatized nerve that has been over-stretched or crushed, nevertheless, according to our observations, such a recovery could also take place after several months following complete section of the nerve (or the removal of a segment) and not necessarily by a regrowth through old channels.

In brief, should there be a functional disability of the seventh cranial nerve (either partial or complete) after a parotid operation, the actual physical status (section or lesser trauma) of the nerve cannot be known unless during the operation the main trunk and part of the plexus has been clearly exposed and identified, and then either deliberately sacrificed or its continuity carefully preserved. It is for this reason that we limit our observation to those cases in which there has been a clear exposure and identification of the main trunk of the nerve and then its deliberate section and the removal of a wide segment (2.5 to 5 cm.) of the main trunk and its peripheral plexus.

Report of Cases and Clinical Observations

In Table 1 there is given a brief resumé of the eight cases of spontaneous recovery forming the basis of this report. The patients, ranging in age from 16 to 63 years, were all operated upon during a five-year period, 1949 to 1953 inclusive. As is the routine in our clinic, the main trunk of the seventh nerve had been exposed as a preliminary step of the operation. In all instances the decision to section the main trunk and to sacrifice the nerve was then made only after it had been clearly demonstrated that the tumor was not resectable without such sacrifice. Accordingly, a segment of the main trunk of the nerve and of its adjacent plexus was removed with the

tumor and a portion of the parotid gland. The lengths of the resected segments ranged from 2.5 to 5 cm. No attempt was made in any of these (nor in any of the grand total of 40 cases) to resuture or to graft. To relieve the more serious aspects of the resultant orbicularis oculi paralysis, a fusion of the eyelids was routinely made on the affected side at the completion of the main operation. There was immediate and complete postoperative paralysis of the corresponding facial musculature in all of the cases, and, since the surgeon had no hope of a return of function, no physiotherapy (Faradic stimulation) was given.

Spontaneous Recovery of Function. In the eight cases of spontaneous recovery, the patients themselves were invariably the first to discover and announce to their respective surgeons that some active motion had returned.

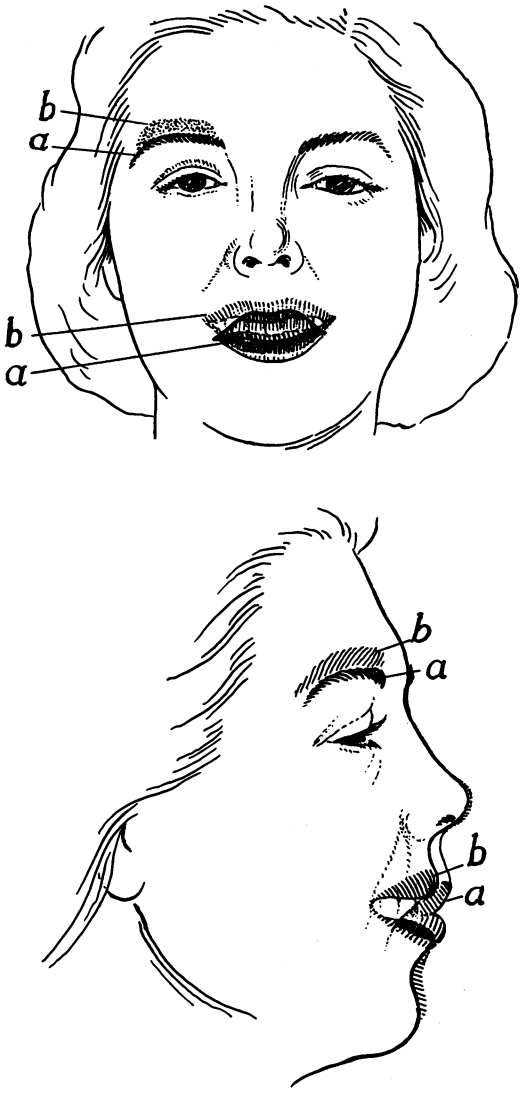
N. W., aged 28, the first case observed by us, was a singer by profession (Case 1, see Table). At her operation in June, 1950, for a twice-recurrent parotid tumor, the main trunk of the nerve was found to be completely encompassed by the growth and for this reason was deliberately sectioned and about 3.0 cm. of the nerve and a portion of its distal plexus were resected along with the tumor. A fusion of the homolateral eyelids was made. Postoperatively there was complete paralysis of the corresponding side of the face.

At one of her regular follow up visits about 8 months later, the patient announced to her surgeon (H. M.) that she could move slightly the paralyzed side of her face. As she sat in the examining chair, her efforts to demonstrate this motion were thought to be inconclusive, the disbelief being based in large part on the examiner's reasonable even though erroneous conviction that such return of motion was impossible from the anatomic standpoint. On her next visit a month later, she again insisted that active motion was present and that it had increased. At that time her surgeon and one of his associates were forced to concede that some active motion was actually present in the form of a slight voluntary retraction of the right commisure of the mouth. From that time onward there was a slow but steady improvement during a period of 2½ years, and at the present writing, over 5 years later, there is active motion in all parts of the once completely paralyzed facial

FIG. 2A (Above). FIG 3A (Below). See opposite page for legend.

musculature, including a definite wrinkling of the right forehead (frontalis), so that she can raise the eyebrow several millimeters. There is a definite activity of the orbicularis and wrinkling of the side of the cheek and nose. She can now draw back the right commisure of the mouth for a distance of over 2 cm. All these different motions are as highly selective as in the normal side of the face (Figs. 2 and 3).

As is common with complete (unilateral) facial paralysis, this patient had trained herself to main-



FIGS. 2 and 3. Fig. 2B (Above). Fig. 3B (Below). (Case 1, N. W.) Letters A refer to the position of the labial commissures and eyebrows with the face in repose. Letters B refer to the parts of the face on purposeful active motion. The photographs are double exposures and the diagrams are self explanatory.

tain the normal side of the face in relatively complete repose and to avoid as much as possible any movement which might tend to emphasize the disparity between the 2 sides of the face. To achieve the effect of a "dead pan" countenance, considerable practice in front of a mirror is required. From the beginning this patient had refused to take her surgeon's word that no recovery was possible. She was unimpressed by what we considered anatomic and surgical "facts," and she never lost faith and the determination that somehow she could achieve voluntary motion, an example of the power of faith sometimes to accomplish the seemingly impossible. The degree of recovery in this case has been progressive. She is active and confident in her social contacts.

The sequences of events in subsequent cases have been similar. The first evidence of motion in all has been the ability to pull back voluntarily the angle of the mouth, a motion which can result from the action of some or all the following facial muscles: risorius, buccinator, quadratus labii superiorus and inferiorus, canine, and triangularis. Once initiated, there is invariably a steady improvement in the degree of recovery, the voluntary motion becoming more pronounced and extending selectively to the muscles of the lower lip, cheek, and, finally, to the orbicularis oculi and frontalis. Once voluntary motion returns to any part of the face it is almost as selective in the local area as on the normal side of the face. The droop of the angle of the mouth, so characteristic of seventh nerve paralysis, completely disappears. On forcible or exaggerated motion there remains some disparity between the two sides of the face, but in repose and with ordinary facial motion the difference is so slight as to be unobjectionable. We have reason to believe that such recovery of motion is favored and hastened if the patient actively and consistently (daily) practices in front of the mirror.

The interval between the operation and the first sign of recovery was six and eight months (two cases each) and, in each of the others, 10, 13, 21, and 35 months. One of the deterrents and handicaps in the detection and observations of this phenomenon is, at first, the natural disbelief of the surgeon who, having resected a segment of the facial nerve, cannot bring himself at first to accept the patient's claim of voluntary motion. In brief, since such recovery is thought to be impossible, there may seem

to be little point in making careful observations. During the early years of our observations we noted such an attitude of amused and tolerant disbelief on the part of most of our colleagues and of visitors when we first reported and discussed this phenomenon at the Head and Neck Conferences at Memorial Hospital.

Explanations of the Phenomenon

From the purely theoretical standpoint there might seem to be several possible explanations for a return of function following complete section with a loss of substance of the seventh cranial nerve. After consideration of these, it is our opinion that the most reasonable explanation is that new motor pathways are established through the fifth cranial nerve. We shall elaborate on this theory in a subsequent section after first discussing other explanations which we consider less tenable.

Spontaneous Regrowth of Seventh Cranial Motor Nerve Fibers Across a Defect of Several Centimeters. In our cases there was an unbridged defect of between 2.5 and 5 cm., and if one postulated that a regrowth of nerve fibers took place across this defect, one would also have to concede that in some manner the advancing nerve fibers must have sought out and joined up with a number (at least four or five) of widely separated stumps of the distal plexus and, in addition, that this complex re-anastomosis was effected in such an exact manner as to permit of selective action in the various facial muscles.

If regrowth across the operative field and re-anastomosis were responsible for the return of function (through the remaining seventh cranial nerve structures) then a re-excision of the parotid area for recurrence would obviously interrupt such neural pathways, and whatever active motion had been re-established would immediately be lost. On the contrary, in two of our cases in which considerable function had returned, a second excision of the local area only temporarily interfered with such function as had been re-established following the first operation. These facts are briefly stated in the following paragraphs.

M. P., aged 26 (Case 5, see Table 1), was first seen in our clinic in 1947 with a postoperative recurrent tumor in the right parotid area. A diagnosis of "mucoepidermoid carcinoma" had been made on a submitted slide. When first seen in our clinic there was no seventh nerve disability. She was operated upon for the second time in 1947, at which time the main trunk of the nerve was exposed, preserved intact, and the recurrent tumor excised. Following this operation there was only temporary disability of the seventh nerve. The growth recurred 3 years later, and a 3rd operation was performed in June, 1950, at which time the main trunk of the nerve was again exposed, but was found so intimately associated with the growth that a segment consisting of the main trunk of the nerve and 2.5 cm. of its peripheral plexus was resected along with the tumor. Postoperatively there was complete paralysis of the corresponding side of the face. Eight months later (February, 1951), a definite beginning return of voluntary motion was first noted (spontaneous recovery). Improvement continued steadily, so that about a year later there was practically a complete return of function. She was then followed free of disease for about 4 years (until January, 1955), when a 3rd recurrence was noted. In January 1955, a 4th operation was made, at which time a wide local excision was again made which included an area of skin between 4 and 5 cm. in diameter, and all of the underlying tissue in the parotid area, including the masseter muscle and posterior belly of the digastric. A skin graft was applied, a portion of which lay on the periosteum of the mandible. For the first few days there appeared to be apparent complete paralysis, although there was some difference of opinion among the surgeons who observed her. The patient, herself, however, thought she could move the face slightly. A month later there was definite motion about the mouth and cheek, and within 2 months the function had returned to the same degree which was present before the 4th operation.

L. R., aged 16 (Case 2, see Table 1), had been operated upon elsewhere for a parotid tumor in October 1951, following which there was temporary paralysis of the nerve and subsequent complete recovery. A year later there was a recurrence which had been locally excised.

She was first seen in our clinic in April 1953, at which time there was a bulky recurrence under the scar in the left parotid area. In April 1953, one of us (H. M.) made a radical resection of the recurrence, including a total excision of the parotid. At that time the main trunk of the 7th nerve was exposed and a section made just at its emergence from the stylomastoid foramen. Following this operation, there was complete loss of active motion in the corresponding side of the face. In October (6 months later) there was a beginning return of function that continued to improve in degree until February 1954.

The patient lived at a distance and did not return for observation until July 1954, at which time a 3rd recurrence was noted in the parotid area, apparently lying mainly in the retromandibular area. She was again operated upon, and at this time the retromandibular area was entered through a surgical exposure of at least 6 cm. in its vertical extent and the recurrent tumor widely removed. Briefly, whatever regrowth or anastomosis might have occurred in the defect of the 7th nerve, the latter operation must have completely interrupted it.

Within a period of 2 weeks postoperatively, however, it was noted that the same degree of active motion (present before the last operation) was again noted in the left side of the face. The patient returned to her home some distance from New York and was not again observed. We subsequently learned that local recurrence and general dissemination of the disease took place and the patient died several months later.

In two of our cases of spontaneous recovery (Cases 2 and 5, see Table 1), the patients with a fair degree of spontaneous recovery of function after segmental defects of the seventh nerve were again operated upon for recurrence and a wide and deep portion of tissue removed from the parotid area, which obviously must have included any possible regrowth and direct bridging of the defect of the seventh nerve. The latter operations did not disturb the functional recovery. In our opinion these observations clearly negate the theory that the spontaneous recovery of function was due to regrowth of seventh nerve fibers across the defect.

Decussation and/or Anastomosis Across the Midline of the Face. The existence of neural motor pathways crossing the midline of the face from the opposite side has been postulated from observations on the slight motions of the frontales and the orbicularis oris muscles on the paralyzed side in cases of unilateral seventh nerve paralysis. A more reasonable explanation for the latter phenomenon is that the motion of one side would naturally tend to cross to the opposite side due to the interlacement of muscle fibers of the muscles in the midline. In any case, if such a cross innervation were responsible for the recovery in our cases, the action could hardly be voluntarily selective to a localized group of muscles without activating both sides.

Establishment of New Motor Pathways Through the Fifth Cranial Nerve

According to standard anatomical texts, the main trunk of the fifth cranial nerve is made up of two components: a motor and a sensory division respectively. The motor component is usually alleged to be separate and to pass entirely into the third division (mandibular nerve) and then into three main branches: 1) the masticator nerve (motor and sensory), 2) the lingual nerve (sensory), 3) the inferior alveolar nerve (sensory). The other two branches of the fifth cranial nerve (the ophthalmic and the maxillary nerves) are thought to be wholly sensory.

Communications or Anastomoses of the Terminal Branches of the Fifth Cranial Nerve with the Terminal Branches of the Seventh Cranial Nerve. A reference to the detailed anatomy of the fifth and seventh cranial nerves reveals what, in our opinion, is a highly significant fact, namely, that there are elaborate anastomoses (plexuses) between the terminal branches of the fifth and seventh cranial nerves in all parts of the facial musculature from the forehead to the lower lip (Fig. 4). Beginning from above, they are briefly outlined as follows:

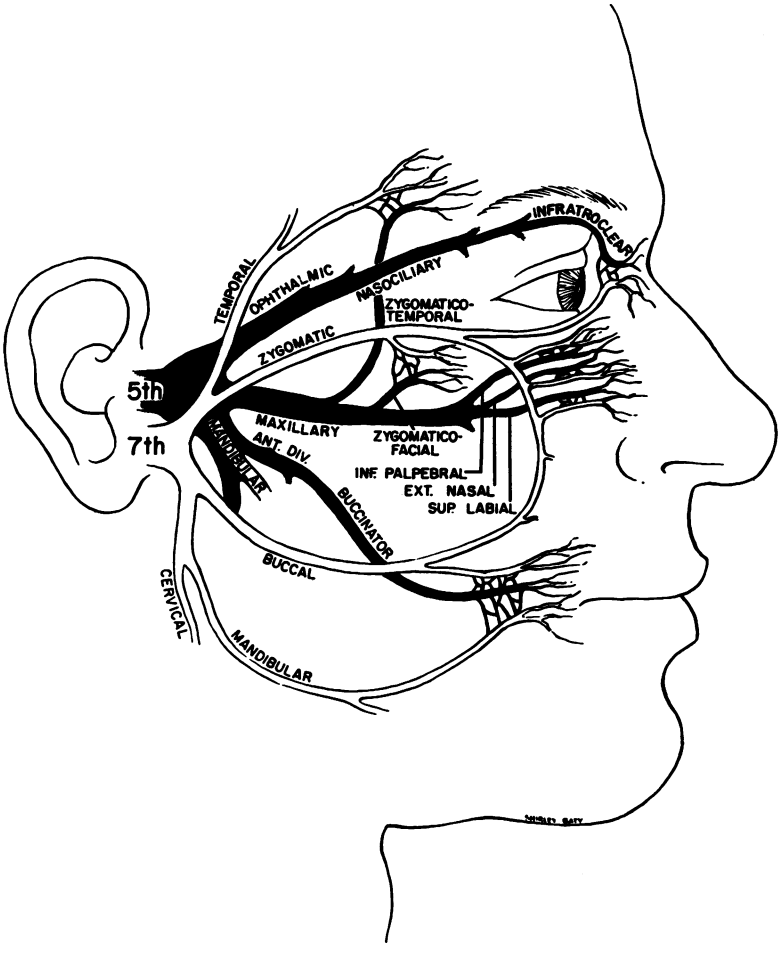


FIG. 4. Anastomoses (plexuses) of the terminal branches of the 5th and 7th cranial nerves.

1. The auriculo-temporal branch (V Cr.) communicates within the parotid gland with branches of the facial nerve (VII Cr.).

2. The infratrochlear branch of the ophthalmic nerve (V Cr.) communicates with the zygomatic branches of the facial nerve (VII Cr.).

3. The zygomatico-facial branches of the maxillary nerve (V Cr.) communicate with the zygomatico-facial branches of the facial nerve (VII Cr.).

4. The zygomatico-temporal branches of the maxillary nerve (V Cr.) communicate with the temporal branches of the facial nerve (VII Cr.).

5. The infraorbital branch of the maxillary nerve (V Cr.) communicates with the zygomatic branches of the facial nerve (VII Cr.) and then rises to form the infraorbital plexus.

6. The masticator branch of the mandibular nerve (V Cr.) communicates at the angle of the mouth with the plexus of the facial nerve (VII Cr.).

From the afore-mentioned (possibly incomplete) listing, it will be seen that there

are at least six plexuses made up of communications of terminal branches of the fifth and seventh cranial nerves which are definite enough to be recorded by anatomists. So far as we know, the function of these plexuses has never been definitely established, but it is reasonable to suppose that they could hardly be present without some purpose or potential function possibly having to do with emotional expression shared by both nerves. Such terminal communications must obviously include, or at least be closely associated with the motor end plates, and to us it seems reasonable to conjecture that following complete and permanent interruption of the motor pathway through the seventh cranial nerve, voluntary motor impulses by re-education may find their way from the cortex through the fifth cranial nerve to the respective muscles.

What at first may seem to be merely an additional minor anatomical detail may actually also have considerable significance. The masticator nerve (fifth cranial) is known to contain both motor and sensory fibers. Its buccinator branch (which according to Cunningham [6] is only sensory) *perforates the buccinator muscle* before supplying sensation to the skin and mucous membranes of the cheek. The significant question is whether or not the latter supposedly only sensory nerve might also carry some dormant motor fibers which are given off as the nerve pierces the buccinator muscle. If such were the case, there would be a reasonable explanation for the fact that in our eight cases a voluntary drawing back of the angle of the mouth (by buccinator contraction?) has invariably been the first sign of recovery.*

* A similar uncertainty as to the possibility of an associated motor function in a predominantly sensory nerve existed for many years as regards the superior laryngeal nerve whose actual function in the complicated act of swallowing has not as yet been clearly established.

Resumé and Conclusions

Although at first there may be some reluctance to accept the theory that the new motor pathways may be established by way of the fifth cranial nerve, it seems to us, nevertheless, to be one of the most reasonable explanations for the uncontestable fact that functional recovery has actually been observed by us in eight cases despite segmental defects of several centimeters of the main trunk and plexus of the seventh cranial nerve, and that such recovery is not disturbed by complete re-excision of the parotid area through which all theoretical regrowth from the resected seventh nerve must have passed.

The pattern in all of our cases has been rather uniform; that is, in general beginning about six to 14 months after sacrifice of a segment of the seventh cranial nerve, there has occurred a slight voluntary retraction of the angle of the mouth, progressively increasing in extent, the motion finally extending to all parts of the face with a selective action in the various portions of the facial musculature at the will of the patient finally permitting an interplay of action of these muscles so as to produce a variety of emotional responses characteristic of normal movement.

As the result of our observation on the frequency of spontaneous recovery (whatever its actual explanation), we question the justification for any form of neurorrhaphy or extensive plastic repair (except eyelid fusion) for seventh cranial nerve paralysis due to operative defects until at least a year or more has passed. We submit, furthermore, that in view of the fact that spontaneous recovery has taken place in over one-fourth of our cases, there is considerable doubt that any of the few recoveries, as reported in the literature, following neurorrhaphy, are actually due to that cause.

Summary

Eight cases of spontaneous recovery of seventh nerve function following segmental operative defects of the seventh cranial nerve are reported. These cases make up 28.5 per cent of 28 determinate cases occurring in the five-year period 1949 to 1951. Various explanations for this phenomenon are discussed, and the opinion given that the motor pathways to the facial musculature are re-established by way of the fifth cranial nerve.

Addendum

Since the completion of the statistical analysis in August 1956, we have noted beginning recovery of function in 2 additional cases. But to include these 2 patients in the body of the main text would require a reworking and analysis of the statistical accounting of 3 additional years of parotid surgery, which would delay the publication. Actually we have noted a return of function in a total of 10 cases to date.

References

1. Ballance, C.: The Operative Treatment of Facial Palsy with Observations on the Prepared Nerve-graft and on Facial Spasm. Proc. Roy. Soc. Med., 27:1367, 1934.
2. Ballance, C. and A. B. Duel: The Operative Treatment of Facial Palsy by the Introduction of Nerve Grafts into the Fallopian Canal and by Other Intratemporal Methods. Arch. Otolaryng., 15:1, 1932.
3. Bunnell, S.: Suture of the Facial Nerve within the Temporal Bone with a Report of the First Successful Case. Surg., Gynec. & Obst., 45:7, 1927.
4. Cardwell, E. P.: Direct Implantation of Free Nerve Grafts Between Facial Musculature and Facial Trunk; First Case to be Reported. Arch. Otolaryng., 27:469, 1938.
5. Conley, J. J.: Facial Nerve Grafting in Treatment of Parotid Gland Tumors. A. M. A. Arch. Surg., 70:359, 1955.
6. Cunningham's Text-Book of Anatomy. Fifth Edition. William Wood and Company, New York, 1921.
7. Duel, A. B.: Clinical Experience and Surgical Treatment of Facial Palsy by Autoplastic Nerve Grafts: The Ballance-Duel Method. Arch. Otolaryng., 16:767, 1932.
8. Furstenberg, A. C.: Reconstruction of the Facial Nerve. Arch. Otolaryng., 41:42, 1945.
9. Lathrop, F. D.: Management of Traumatic Lesions of the Facial Nerve. A. M. A. Arch. Otolaryng., 55:410, 1952.
10. Lathrop, F. D.: The Facial Nerve: Technique of Exposure and Repair. Surg. Clin. of North America, 33:909, 1953.
11. Love, J. G. and B. W. Cannon: Nerve Anastomosis in the Treatment of Facial Paralysis: Special Consideration of the Etiologic Role of Total Removal of Tumors of the Acoustic Nerve. A. M. A. Arch. Surg., 62:379, 1951.
12. Martin, H.: The Operative Removal of Tumors of the Parotid Salivary Gland. Surgery, 31:670, 1952.
13. Maxwell, J. H.: Repair of the Facial Nerve after Facial Lacerations. Tr. Am. Acad. Ophth. & Otolaryng., 58:733, 1954.
14. Sullivan, J. A.: Recent Advances in the Surgical Treatment of Facial Paralysis and Bell's Palsy. Laryngoscope, 62:449, 1952.

Additional References

The authors are surgeons, not neuroanatomists nor neurophysiologists, but they submit the bibliography below, which includes considerable background for this article.

1. Beahrs, O. H. and B. F. L'Esperance: The Facial Nerve in Parotid Surgery. J. A. M. A., 162:261, 1956.
2. Berry, Charles: Personal communications.
3. Bunnell, S.: Surgical Repair of the Facial Nerve. Arch. Otolaryng., 25:235, 1937.
4. Collier, J.: Facial Paralysis and Its Operative Treatment. Lancet, 2:91, 1940.
5. Duel, A. B.: History and Development of the Surgical Treatment of Facial Palsy. Surg., Gynec. & Obst., 56:382, 1933.
6. Foote, F. W., Jr. and E. L. Frazell: Tumors of the Major Salivary Glands. Cancer, 6:1065, 1953.
7. Frazell, E. L.: Clinical Aspects of Tumors of the Major Salivary Glands. Cancer, 7:637, 1954.
8. Haymaker, W. and B. Woodhall: Peripheral Nerve Injuries. W. B. Saunders Company, Philadelphia, 1945.
9. Lyons, W. R. and B. Woodhall: Atlas of Peripheral Nerve Injuries. W. B. Saunders Company, Philadelphia, 1949.
10. Mackay, R. P., S. B. Wortis, P. Bailey and O. Sugar, Editors: The Year Book of Neurology, Psychiatry and Neurosurgery (1955–1956 Year Book *Series*). The Year Book Publishers, Inc., Chicago, 1956.

11. Maxwell, J. H.: Extra-temporal Repair of the Facial Nerve; Case Reports. Ann. Otol., Rhin. & Laryng., **60**:1114, 1951.
12. Myers, D.: War Injuries to the Mastoid and the Facial Nerve. Arch. Otolaryng., **44**:392, 1946.
13. Platt, H.: On the Results of Bridging Gaps in Injured Nerve Trunks by Autogenous Fascial Tubilization and Autogenous Nerve Grafts. Brit. J. Surg., **7**:384, 1920.
14. Pollock, L. J. and L. Davis: Peripheral Nerve Injuries. Paul B. Hoeber, Inc., New York, 1933.
15. Pollock, L. J., J. G. Goldseth, F. Mayfield, A. J. Arieff, E. Liebert and Y. T. Oester: Spontaneous Regeneration of Severed Nerves. J. A. M. A., **134**:330, 1947.
16. Ramon y Cajal, S.: Degeneration and Regeneration of the Nervous System. Oxford University Press, London, 1928.
17. Sperry, R. W.: The Problem of Central Nervous Reorganization after Nerve Regeneration and Muscle Transposition. The Quarterly Review of Biology, **4**:311, 1945.
18. Weiss, Paul: Personal communications.