EXPERIENCE WITH TOPECTOMY FOR THE RELIEF OF INTRACTABLE PAIN*

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Initiated by Pool in 1946, topectomy in his hands has been a less muti-
lating and as efficient an operation as bilateral leucotomy in the treat-
ment of many lasting mental disorders. Bilateral topectomy of the region
of areas 9, 10, and 46 appears to produce an especially marked effect on the
anxiety of patients. This fact, and the reports of some good results obtained
by Freeman and Watts and others using bilateral leucotomy in cases of
intractable pain, led me to try bilateral topectomy in such conditions. It
was hoped that intractable pain could thus be relieved without mental
deterioration. The first results were reported in 1948. Those early cases, in
which operation was performed in 1947, and more recent ones, are presented
here, making a group of 25 patients with intractable pain submitted to
bilateral topectomy.

OPERATIVE TECHNIQUE

The details of the operative technique have been described before and
will therefore be omitted here. However, there are certain points to which
attention may be called. The first is the actual extent of excised cortex. As
a rule, we remove a cortical zone starting 5–6 cm. in front of the coronal su-
ture, and 3–4 cm. long, ending 1–2 cm. from the medial part of the orbital
roof. Laterally it extends 3 cm. from the medial line (a little more on the
right side than on the left). Medially it is between 1–1½ cm. down along
the falx. The average weight of our specimens was 10–12 gm. on each side;
that is, about half as much as Pool’s removals, which extend definitely
deeper (2 cm.) on the medial aspect of the hemisphere. In that respect, it
is important to state again that, as a rule, we are not dealing here with
mental cases, where 20–25 gm. on each side seem to be the measure of corti-
cal removal necessary. Rightly or wrongly, in our patients with pain a more
limited removal and possibly a more specific effect were looked for.

As prefrontal lobe surgery is still partly in the research stage, it is nec s-
sary to check the extent of excised cortex by taking postoperative roent-
genograms; if care is taken to place Cushing clips on the limits of the cortical
resection (without putting any on the dura) a fairly precise evaluation is
obtained. This can be very useful when, as happened in 2 cases, recurrence
of pain apparently is related to too limited a resection.

In Figs. 1 and 2, we would say that there were excised the rostral half

* Since this paper was received, the follow-up notes have been brought up to date of September 1949.
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of area 9, the dorsal two-thirds of area 10, and the medial third of area 46. This calls for an explanation of what is meant here by these area numbers; they are used merely as topographical landmarks and for brevity of language. For instance, instead of saying that one excises a region of prefrontal cortex within such and such distance in cm. from the orbital roof, the Sylvian fissure, the callosal fissure, etc., we find it more convenient to say that one excises “area 10.” This is a short term for area 10 as depicted in Brodmann’s classical map, though we do not believe that we excise with precision delicately defined architectonic areas. We are to be blamed in using area numbers in such a loose sense, but we find it a very simple way of describing the operation.

POSTOPERATIVE COMPLICATIONS

Thirty operations were performed on 25 patients, with 2 postoperative deaths: 1 from acute lung edema (carcinoma of lung), and 1 from vascular collapse (thalamic syndrome and high blood pressure in patient aged 65). Indeed, many patients with intractable pain are poor operative risks, and especially in those over 60 with arterial disorders, unilateral lobotomy, as proposed by Scarff, should be tried first, in our opinion.

Neurological complications were rare. In 2 patients, one epileptic attack occurred the night following the operation, without recurrence. For the time being, none of them has epilepsy; none of them takes luminal or dilantin. In 1 case (thalamic syndrome, Case 15), motor aphasia lasted for 2 days. The longest follow-up period has been 23 months.

Sphincteric disturbances (incontinence) were not always met; when they
did occur, they persisted less than 1 week. Sometimes they lasted between 4 and 6 days, as in Case 6 (resection of 10 and 11), Case 14 (thalamic syndrome), and Case 19 (tabes dorsalis). Eventually bladder function always became normal. In that respect, the importance of good nursing should be stressed; patients as a rule should get up no later than the 10th postoperative day and start walking 1 or 2 days later.

Postoperative mental disorders were met in nearly all cases; in two-thirds of them, it was a mild indifference and apathy, which cleared completely after 6 or 8 days. In one-third, some agitation persisted for 2 or 3 days but was not difficult to control without morphine. A typical “frontal syndrome” lasting 2 and 4 weeks was observed in Cases 2 and 19. Finally, in Case 4, which turned out eventually to be a failure, there was mental confusion for 2 months (the patient was an old woman with a history of mental disorders in the family).

The problem of the definitive action of topectomy on the normal or abnormal pre-operative mental condition will be discussed later.

**ACTION OF TOPECTOMY ON PAIN**

1. **General Results.** The results of the operation are summarized in Table 1. The effect on pain is expressed by the following scale: 0 means no change whatever occurred in the patient’s experience of pain; 1 means suppression of sedatives such as morphine, although the patient still complains; 2 means that the patient no longer behaves as if he still had pain, but nevertheless states that he has pain when asked about it; finally, 3 means the patient himself says he has no more pain, or only occasionally has pain.

   From a practical point of view, it must be borne in mind that not only grade 3, but grade 2 as well, are equivalent to a very good result, next to a complete cure. In grade 2, the patients exhibited three improvements in objective behavior, which are more important to us than psychological tests. These patients sleep again without sedatives; they eat again and gain much weight; they work again. Furthermore, relatives are satisfied that the patients are no more worried by pain. Finally, even when the patient states after questioning that he still experiences pain, never does his facial expression betray it, and his behavior remains calm and composed.

   Thus it is believed that practically complete cure was achieved in patients classified 2 and 3. We have 19 such cases out of 25. But, as can be seen in Table 1, for most of them the follow-up is not long enough, and all that can be said is that bilateral topectomy has rid them of their pain to date. In 11 cases (Nos. 1, 2, 3, 5, 6, 8, 9, 10, 11, 18, 22), good results have lasted more than 8 months, and, in 2 instances, almost 2 years. On the other hand, it should be noted that failures always become evident within less than 3 months. There were several such patients, and a few were submitted to another intervention, as will be discussed in the following paragraphs.

2. **Failures and Possible Causes.** One reason for failure might be when one has tried to deal with an evolutional disease by topectomy. This appeared
TABLE 1
Topectomy and intractable pain (25 cases)

<table>
<thead>
<tr>
<th>Case No. and Diagnosis</th>
<th>Result on Pain</th>
<th>Postoperative Follow-up (in months)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NEURALGIAS—7</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Atypical Facial</td>
<td>2</td>
<td>33</td>
</tr>
<tr>
<td>2. Atypical Facial</td>
<td>2</td>
<td>22</td>
</tr>
<tr>
<td>3. Atypical Facial</td>
<td>2</td>
<td>16</td>
</tr>
<tr>
<td>4. Atypical Facial bilateral</td>
<td>0</td>
<td>(3)</td>
</tr>
<tr>
<td>5. Occipital</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>6. Hemicranial</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>7. Perineal</td>
<td>1</td>
<td>(1 week)</td>
</tr>
<tr>
<td><strong>NERVE INJURIES—6</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Cervico-occipital</td>
<td>3</td>
<td>16</td>
</tr>
<tr>
<td>9. Occipital</td>
<td>3</td>
<td>19</td>
</tr>
<tr>
<td>10. Causalgia</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>11. Causalgia</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>12. Phantom Limb</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>13. Painful Stump</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td><strong>VASCULAR AND INFECTIOUS NERVOUS DISEASES—6</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15. Thalamic Syndrome</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>16. Thalamic Syndrome</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>17. Eencephalitis</td>
<td>0</td>
<td>(3)</td>
</tr>
<tr>
<td>18. Tabes Dorsalis</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>19. Herpes Zoster</td>
<td>3</td>
<td>3 weeks</td>
</tr>
<tr>
<td><strong>CARCINOMAS—6</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20. Rectum</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>21. Stomach (L)</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>22. Lung (L)</td>
<td>?</td>
<td>Postop. death</td>
</tr>
<tr>
<td>23. Uterus (L)</td>
<td>0</td>
<td>(1)</td>
</tr>
<tr>
<td>24. Spine (x)</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>25. Tonsil (x)</td>
<td>0</td>
<td>(1)</td>
</tr>
</tbody>
</table>

(L) = Unilateral left topectomy.
(x) = Two operations performed for recurrence of pain.
In the follow-up column, numbers in parentheses express when failure became apparent.

...to be the explanation in Case 17, where violent and nearly permanent occipito-cervical and brachial pains were checked for only 2 or 3 months after operation. After that, signs of evolitional encephalitis with alterations of the cerebrospinal fluid (without germ) were observed with periods of amelioration; one phase of mental confusion appeared 3 months after operation and then cleared up. Later, with a better psychic state, the patient complained of violent pains as before, but they were not so lasting. This evolitional factor may explain, too, why long-term results are doubtful in cases of rapidly growing carcinoma. On the other hand, intermittent attacks of violent pain, as in Case 18 (tabes dorsalis) and Case 10 (causalgia with both permanent pain and paroxysm), were checked after bilateral topectomy. In
any event, the problem of how a topectomized patient would react to a new and permanent cause of violent pain is not yet solved.

It is possible to explain two other failures we observed, by the contention that in these cases neuralgia was associated with a definitely abnormal pre-operative mental state. In Case 7, the patient was an old man with marked hypochondria for more than 20 years; the only postoperative result was the suppression of his drug addiction. In Case 4, the patient was an old woman with hereditary and familial evidence of indefinite mental disturbances; she suffered from a bilateral permanent facial neuralgia, and topectomy brought about improvement for less than 3 months.

Finally, other failures may be due to an insufficient cortical excision. In Case 23, (pelvic carcinoma, sciatic pain, morphine addiction), unilateral left topectomy proved futile, since within 1 month both pain and morphine addiction reappeared. The patient then refused a right topectomy. In Case 11 (causalgia) and Case 24 (carcinoma of the spine), unilateral left topectomy was tried first, with recurrence of pain within about a month. Right topectomy was then performed with good results (1 month in Case 24, after which death occurred as the disease progressed; 4 months to date in Case 11). But one very good result was achieved in a case of left topectomy (Case 21); coeliac pains disappeared for 8 months, until the time of the patient's death. On the whole, unilateral topectomy seems not so good as unilateral lobotomy, if Scarff's results are confirmed. In Case 16 of our series, a left lobotomy did not rid the patient of his complaints, and a right topectomy was then successful. However, the postoperative follow-up on this patient is too short to be certain of results.

Insufficient cortical excision is the reason for failure in some cases of bilateral topectomy. We had 2 such cases (8 and 25).

In Case 8, which is the more interesting, there developed a depressive state, which was treated by electric shock; the patient then complained of unbearable permanent occipito-cervical pain. Believing in the existence of a vertebral fracture, a surgeon operated on this patient, and a posterior cervical radicotomy was performed. The situation grew worse and worse, even after performance of a bilateral prefrontal leucotomy, which was probably incomplete. When we first saw the patient, she presented a mixture of anxiety, persecution, and constant complaints of occipito-cervical pain. On Nov. 10, 1947, bilateral topectomy brought about a definite improvement, but 2 months later, recurrence of pain and the anxiety state was obvious. On examining the resected cortical areas, it was found that their weight was only 6 gm. on the right side and 5 gm. on the left, and it was judged that removal had not extended far enough from the medial line.

On May 1, 1948, at re-intervention, area 46 on the left side was undercut, and on the right side its medial third and the dorsal half of area 10 were excised. From that day on, marked and progressive improvement was observed, and when last seen a year later, the patient was judged mentally normal. She no longer complained of pain but stated that her neck was still stiff (which indeed it was). She had gained much weight and for the past 6 months had again been able to take up her work as dressmaker with good success.
In Case 25, the patient had a tonsillar carcinoma with violent permanent pain and unbearable attacks of pain when he tried to eat. On Nov. 11, 1948, bilateral topectomy was performed, with great improvement which lasted 3 months. Then the situation progressively returned to its former state. Here again, cortical fragments were found to be very small; about 5 gm. had been removed on each side, and they looked too narrow (under 15 mm.). Comparing this with Case 11, a re-intervention was then decided on, and on April 21, 1949 more cortex was excised on each side, extending over area 46, 30 mm. on the left side and 35 mm. on the right side from the medial line. The patient was better for 1 month, then he complained again while his carcinoma grew very rapidly; death occurred 3 months later.

It would therefore seem that 5 or 6 gm. on each side is definitely not enough to achieve lasting results, although as in our Case 9, that amount of cortical resection gave a very good result lasting 15 months to date. When, on the other hand, it is noticed that in one of our definite failures (Case 17) the amount of resection was 15 gm. on each side, the only reasonable conclusion is that it is too soon to tell whether the action of topectomy on pain is a quantitative effect. It can only be stated that the best results were obtained on the average with a weight of 10 to 12 gm. on each side, when care was taken to excise as far as 30 mm. laterally (medial third of area 46). The problem of localization will be referred to again in this article.

RESULTS OF TOPECTOMY IN RELATION TO DIFFERENT CLASSES OF PAIN

Three classes of pre-operative pain are recognised: (A) Pain with no known organic lesion, and as a rule with an abnormal mental state, (B) pain with a definite organic nervous lesion, and a normal mental state, and (C) mixed cases.

If we refer again to Table 1, it will be seen that the Neuralgia group belongs to Class A, whereas the other 8 groups belong to Classes B and C. In Class B we place Cases 10, 18, 19, 20, 21, 24, 25; in Class C, Cases 8, 9, 11, 12, 13, 15, 16, 17, 23.

A. Pain Not Related to Any Known Organic Lesion. This class comprises the 7 patients with neuralgia, and all of them were in an abnormal mental state before the operation. Two had definite mental disorders: Case 7 (hypochondria), with a result of nearly complete failure, and Case 5 (obsessive compulsive), with a good result for pain and no mental improvement. The other 5 patients were mostly in anxiety states developing at the same time as permanent pain. Case 4 is a failure, and another intervention is contemplated. (Unfortunately, the first cortical fragments were lost and not weighed, but the operative description leads one to believe they were too small.) Cases 1, 2, 3, and 6 were very good results and lasting ones. Case 2 is the most demonstrative one, since the patient, a skilled worker, is back at his former job, which had been interrupted for 1 year before topectomy. The others are housewives and lead a normal life. These 4 patients are not only rid of their pain, but they are rid of their anxiety as well, and whatever the final explanation may be, it is a fact that there was a close parallel between
the establishment of anxiety and unbearable pain, and between their disappearance following bilateral topectomy. This may have a physiological significance.

Practically, the so-called "psychalgias" seem eminently suitable for topectomy. Of course, peripheral nerve sections are futile, though it is sometimes difficult to tell in advance. Indeed, our patients, 1, 2, and 3 were submitted to trigeminal root section and then exhibited the condition known as anesthesia dolorosa. Bilateral frontal lobotomy is likely to work, but topectomy has the great advantage of not leaving any significant mental deterioration. We do not know if unilateral lobotomy gives lasting good results in such cases.

Incidentally, the use of the word "psychalgia" or "psychic neuralgia" should be discussed. It is not a bad expression if it means that the responsibility for unbearable pain lies in the central nervous system, not in the spino-thalamo-parietal circuit. But if it means that this pain is something akin to hysteria or to a disorder of the patient's imagination, this does not make physiological sense to us. It is suggested that the word souffrance should be used, as it conveys the impression of a mixture of organic pain and anxiety. Souffrance, it is hoped, may be submitted to some sort of physiological analysis, as will be seen presently.

B. Pain Related to a Definite Organic Lesion, with No Significant Pre-operative Mental Change. This group is made up of 4 patients with carcinomas (Cases 20, 21, 24, 25) without morphine addiction; 1 with causalgia (the patient was on 1–2 gr. morphine daily but did not show at all the toxic-comanic mentality); 1 tabetic with 3 or 4 weekly attacks of very severe pains in the legs; and finally, 1 very distressing case of ophthalmic neuralgia following herpes zoster.

All results but 1 in this group are listed as 3, meaning that they are the best possible. But it must be stated at once that in 4 cases the follow-up did not last more than 4 months. Three patients with carcinoma were completely relieved up to the time of their death, and this was 8 months in 1 case. The 4th case was a failure.

Non-malignant diseases are of course more interesting in measuring the value of topectomy against unbearable organic pain. The case of causalgia (No. 10) lent itself to some physiological study of unbearable pain, or souffrance, as described in the following report.

Case 10. A male, aged 47 years, in a car accident on June 25, 1948, injured his left forearm with destruction of skin, muscles, brachial artery and median nerve. One month later, a typical causalgia appeared with both permanent pain and unbearable paroxysms, either spontaneously or after the slightest touch. Morphine was necessary. The pain soon invaded the precordial area with anginoid feeling; the left hand exhibited classical vasomotor disturbances, and no movement whatever of the left wrist was possible. On Sept. 29, 1948, excision of the stellate ganglion and the first 2 thoracic was performed. There was improvement for 3 weeks, and then the pain recurred. Also, a hypersensitivity of the ulnar nerve below the left elbow developed progressively and grew worse after an operation aimed at freeing the nerve from a bone fragment. When the patient was seen in January, 1949, his con-
dition was pitiful, but it must be stressed that, although morphine was necessary, he exhibited no anxiety other than what was related to his pain. He was a perfectly normal man before the injury and held a responsible position in a telegraphic organization.

This patient seemed an ideal case to test any objective change in unbearable pain after the operation, because sensitivity and reaction to pain could be explored over the left arm by means of localized pressure (measured in grams). Fig. 3, showing the pre-operative state and the postoperative changes, speaks for itself. Two thresholds were determined: first, the patient's recognition of unpleasant pain, which

[Diagram showing thresholds before and after operation.

Fig. 3. Case 10. Thresholds for unpleasant and unbearable pain are expressed in grams. Operation: Bilateral topectomy.

is not the threshold of identification of pain as such but a larger one; second, the state of unbearable pain when the patient can no longer submit his forearm to investigation. The second threshold is of course even higher than the first. Admittedly, an analysis of this kind cannot be a very precise one, but the postoperative changes are so striking (compare A and E) that there is little doubt that topectomy brought about an objective change in what we call souffrance.

Other changes were in the surface of the reactive area (where unbearable and unpleasant pain could be elicited), which shrank down to next to nothing. Morphine was suppressed at once and ever since. Precordial pain and anginoid feeling disappeared. Anxiety progressively subsided, and the patient realized his pain was less and less marked. Finally, due to disappearance of pain, voluntary movements became possible in the left wrist, and vasomotor disturbances were improved.

Mentally, after about a week of relative indifference, the patient became completely normal again, interesting himself in his social and affective life. He flew back to Morocco 3 months later to resume his work, and up to August, 1949, the cure can still be considered as complete.

Now the follow-up of such a case is too short to be sure of a definitive cure. But this does not alter the fact that souffrance was objectively changed and could be roughly measured. The already noted parallel between anxiety and souffrance leads to bring them together, and they may very well be two
sides of the same cerebral function. If this is true, the above case of causalgia presents a physiological means of measuring a mental state.

From a different and practical point of view, in unbearable pain consecutive to organic nervous lesions, topectomy seems a promising operation. For the same reasons as above (Class A), we are not in favour of bilateral lobotomy, though mental changes are of lesser social importance when dealing with a rapidly growing carcinoma. Unilateral lobotomy should be considered, as Scarff reported very good results in such conditions. But unbearable pain related to an organic nervous lesion lying below the 5th cervical segment should be submitted to heterolateral cordotomy first, if the patient is not on morphine and if the pain is strictly unilateral. Walker's mesencephalic tractotomy deals with heterolateral pain in the cervical and cranial segments; in such conditions, which operation should be chosen first is still open to discussion, and bilateral topectomy is technically easier to perform.

C. Pain Related to Organic Lesion, with Mental Abnormality. This class includes in our series 5 nerve injuries (Cases 8, 9, 11, 12, 13); 3 brain diseases (15, 16, 17); and 1 carcinoma with drug addiction (23). In all these 9 cases, the pre-operative mental state was abnormal, and this could be related in 6 cases to an aftereffect of pain, either too long-standing, or too acute, or both. Five patients became drug addicts following the actual experience of pain. One patient had causalgia for more than 25 years; drug addiction did not develop, but a schizoid mentality became more and more marked. In the 3 remaining cases (8, 9, 17), it is likely that the preoperative mental disturbance was not directly related to pain, at least at the beginning.

Two cases were complete failures: a unilateral left topectomy (23), and an evolutionary encephalitis (17). But 6 among the 7 remaining patients did very well, and in 2 at least the follow-up seems satisfactory (16 and 19 months), the patients having resumed their work of charwoman and dressmaker. Case 11, with causalgia of the left median nerve, allowed us to perform the same experimental control as in Case 10, described above in Class B. Fig. 4 shows the pre-operative state, the changes following left topectomy, and the changes following bilateralization of the topectomy, with good results which appear stabilized by now. In the same time, the patient in whom a schizoid personality developed in the course of his 25 years of causalgia showed an important mental improvement; he gave up his isolated life, lives and talks with people he avoided before, and is ready to start as active work as possible. As in Case 10, a striking parallel is observed between the improvement in pain and the gradual disappearance of feelings of anxiety. Objectively, the result with regard to pain is not so good as in Case 10, in which duration of causalgia was much shorter. In any event, here again we feel topectomy enabled us to measure roughly a special quality of pain, called souffrance, and closely related to, if not the same as, a special quality of mind called anxiety. The same tests were performed on Case 15 (thalamic syndrome), in whom postoperatively were found much higher thresholds for bearable pressure.
Class C, together with Case 7 in Class A and Cases 10 and 20 in Class B, provide a good opportunity for studying the action of topectomy on drug addiction. Nine patients regularly took morphine, or Sedol, or Demerol before the operation, but only 6 exhibited the general features of drug addiction. If we exclude Case 23, where unilateral topeetomy led to a failure, it will be seen that in all cases during the hour following operation, morphine or Sedol or Demerol were suppressed abruptly. Only luminal, and sometimes chloral, was given for a few days. None of the 8 patients ever asked for his drug again, and none of them showed any significant withdrawal symptoms. This means that some agitation could be observed sometimes for 24 or 48 hours, but it

is in no way different from what could happen in non-addict patients submitted to topectomy. The most striking observation is Case 10, who was on more than 10 cc. of Demerol daily before the operation. This patient, who belongs to a high social group and is concerned with many business dealings, is now back at his former position with an entirely normal mental state.

This apparent cure of toxicomania, realized dramatically without any signs of withdrawal, has been observed before. In Scarff's article on unilateral lobotomy, for instance, this was stressed, but morphine suppression was not always so immediate and so complete as in our own cases. It leads to two conclusions: first, the so-called “withdrawal accidents” are just secondary effects consecutive to an excessive anxious agitation; second, there are no profound physiological changes related to drug addiction, with the exception of the disturbance of the anxiety or souffrance cerebral circuit.

In the same line of physiological action of topectomy, occasional cure of impotence in male subjects was observed. In our Case 10, complete impotence existed for 6 months, and disappeared 3 weeks after the operation. Of course the mechanism of this is not quite clear; it may be due to the suppression of anxiety, or to the suppression of drug addiction, or both.
TOPECTOMY FOR THE RELIEF OF INTRACTABLE PAIN

From a practical point of view, in patients having a mixture of organic unbearable pain and an abnormal mental state, no operation such as cordotomy or tractotomy should be tried. Bilateral lobotomy we disapprove of, as the potential risk of mental deterioration is too great. Bilateral topectomy is strongly advised, and unilateral lobotomy is a possibility if further observations confirm its value.

PHYSIOLOGY OF UNBEARABLE PAIN

Unbearable pain has been observed for many years, but little is known about its mechanism. The work of Weddell and his associates is an important step in the sense that unpleasant pain seems related to an abnormal innervation of the skin (one terminal instead of several). If this is confirmed, it will give a satisfactory explanation for unbearable pain following all sorts of peripheral nerve lesions. In any event, it gives an anatomical basis to a special quality of pain.

Our work on topectomy may, it is hoped, belong to the same field. Unpleasant or unbearable pains of different origins are likely to express the disturbance of a single cerebral function. We call souffrance this disturbance, and in some cases, a way of measuring its variations is given (causalgias, thalamic syndromes). Furthermore, souffrance always showed a close parallel with anxiety. It is true that few physiological tests were used. We rely mostly on grosser impressions; the patient's personal feeling and behavior, the family's opinion, quality of social contacts and of professional work. All these things being considered, it can be said that the effect of topectomy on the mental action of these patients seems very much a specific effect on anxiety. This is only a confirmation of the very detailed studies of the Columbia-Greystone Group. In no other mental activity were the patients disturbed; they resumed their work with the same knowledge and initiative as before; they seem to have the same drive in planning and trying to take care of business difficulties; they do not show any indifference to their affective life; if anything, they appear to be more inclined to social life than before.

Bilateral topectomy limited to the zone we term briefly “areas 9, 10 and 46” seems, therefore, to have a dual and limited effect: one on souffrance, one on anxiety. It is suggested that souffrance and anxiety are different ways of looking at the same cerebral function. Very little more can be said at the present time, except that this function is probably regulated through a circuit defined by at least three relays: dorsomedial nuclei of the thalamus, granular prefrontal cortex, and hypothalamus.

The anatomical and physiological proofs of such a circuit are progressively being given, thanks to the studies of Mettler, Le Gros Clark, Ward and McCulloch, and Murphy and Gellhorn. It is tempting to assert that the thalamo-prefrontal-hypothalamic circuit, when interrupted by topectomy, does not allow some or all modified spinothalamic impulses to reach the brain through mechanisms which play a primary role in the phenomenon
called consciousness. This of course goes much too far beyond actual experimental knowledge, and in that connection it is to be hoped that such a technique as thalamotomy (Wycis) will be able to yield precise information in the near future.

Before closing remarks on the theoretical aspect of relations between topectomy and souffrance, the question of specific localization in the prefrontal cortex should be discussed. Is there a limited zone in the prefrontal cortex which is concerned with the development of unpleasant pain? Roughly speaking, two tendencies oppose each other, advocating either a qualitative effect or a quantitative one. It should be stressed again that the expression area (9, 10, 46) is a single topographical symbol, meaning little more than a certain part of the prefrontal granular cortex. Even so, partisans of the quantitative effect hold that the mental action of topectomy is proportional to the amount of resected cortex and does not depend on any particular prefrontal zone. The excellent psychological studies made on Pool's patients with mental disorders are not in favor of such a theory, since they showed a marked effect of ablation of 9, 10, 46 on anxiety. The study of our patients with pain, most of them mentally normal, is in favor of the theory of qualitative action. It seems a fact that there is a threshold in the necessary amount of excised cortex, but this is in no way a refutation of specificity. The main evidence against specific action comes from the good results of Scarff's unilateral lobotomy, as opposed to our own poor results with unilateral topectomy. The first step should be to confirm without any doubt this difference in action on unbearable pain, which has by no means been done as yet. Even so, only comparable patients should be used, for instance, patients in whom souffrance is objectively measurable (as in our causalgic or thalamic cases). In 1 case of thalamic syndrome, unilateral left lobotomy was not a success in that respect, and for the time being, it is our opinion that unilateral lobotomy brings about only a partial improvement of souffrance, as compared to bilateral topectomy. Further studies are necessary.

SUMMARY AND CONCLUSIONS

1. Following Pool's lead in the surgery of mental disorders, bilateral topectomy of the 9, 10, 46 region was performed since 1947 on 25 patients suffering from different kinds of unbearable pain.

2. Results are generally good with a bilateral cortical excision of a total of about 20 to 25 grams. Unilateral topectomy failed often. Some results have lasted nearly 2 years to date.

3. Different classes of unbearable pain are analyzed. The action of topectomy is beneficial on both organic unbearable pain or the so-called "psychic" pains. Indications for other operative procedures are discussed.

4. An objective technique of measuring unpleasant and unbearable pain is given. Such a condition is called souffrance, and its close relationship with
anxiety is shown. A step is taken in bringing a mental condition up (or down) to a physiological phenomenon.

5. Possible mechanisms and localizations involved are briefly discussed.

REFERENCES