TUMORS OF THE OCCIPITAL LOBE*

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FEW cases of tumors of the occipital lobe were recorded before the early part of the present century, and no large series of cases of tumors confined exclusively to this lobe was reported before that of Horrax and Putnam in 1932.

ANATOMY

Though often titled, divided and subdivided, the occipital lobe is still without definite boundaries. In man this lobe is roughly pyramidal in shape having three dural surfaces: a lateral convex surface opposes the dura of the skull, a medial flat surface opposes the falx and an inferior sloping surface opposes the tentorium. Posteriorly, the three surfaces meet in a curved "point" corresponding to the cavity formed by the junction of the falx, tentorium and dura of the skull. It is generally agreed that the medial surface is bounded anteriorly by the parieto-occipital fissure. Books on anatomy differ as to the anterior limits of the other two surfaces. The lateral surface is bounded by an imaginary line drawn from the parieto-occipital fissure to the preoccipital notch, an indefinite landmark indicated by Ranson as a fifth of the distance from the occipital to the temporal pole and by Gray as a third of this distance.

The inferior surface is variously bounded. Gray used a perpendicular line from the preoccipital notch to the parieto-occipital fissure. Ranson depicted a perpendicular line from the tip of the calcarine fissure to the collateral fissure and from there on back, presumably to the level of the preoccipital notch.

Inasmuch as the calcarine fissure extends beyond its junction with the parieto-occipital fissure to a point just beneath the splenium and as the visual cortex has been definitely identified to this point, for the purpose of our study, Gray’s arbitrary boundary line is slanted forward to extend from the preoccipital notch to the point where the calcarine fissure terminates beneath the splenium (Fig. 1).

In order to determine what proportion of the entire brain is constituted by the occipital lobe, a normal brain of an adult male body obtained at necropsy was fixed in formalin and sectioned. The cuts were made perpen-

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dicular to the cortical surface along the three boundaries as designated: Laterally, a line connecting the parieto-occipital fissure with the preoccipital notch which was taken as a point a third of the distance from the occipital to the temporal pole (Figs. 2 and 3); inferiorly, a line connecting the preoccipital notch with the anterior end of the calcarine fissure beneath the splenium (Fig. 1); and medially, a line connecting this point with the parieto-occipital fissure at its posterior boundary (Figs. 1 and 4).
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When these cuts were completed the resected mass was found to be roughly a double pyramid with opposing triangular bases. The volume of the resected mass was 50 cc. and with its fellow occipital lobe it constituted one-thirteenth or 7.6 per cent of the volume of the supratentorial portion of the brain.

TYPES OF BRAIN TUMORS AND INCIDENCE

It is generally maintained that the occipital lobe is rarely disturbed by tumors. Unfortunately, for purposes of comparison, most of the cases reported either do not give exact locations or do not indicate whether pituitary body, pineal body, cerebellum or other portions of the brain are included.6,13,33

White,26 in 1885, reported cases of 100 tumors of the brain none of which was limited to the occipital lobe, although it was involved in 6 of them. In 1899 Bramwell7 found 2 of 40 tumors, or 5 per cent, to involve the occipital lobe. He included gummas. Clarke,9 in 1916, reviewed 99 cases of intracranial tumors and found 4 in the occipital lobe: 3 gliomas and 1 meningioma. His series included pituitary tumors. The incidence of tumors in the occipital lobe would appear to be slightly more than 4 per cent.

Dowman and Smith14 reported a series of cases in 1928 which could be broken down by definite location. Their series of 100 tumors included 10 pituitary, 2 pineal and 12 infratentorial tumors which left 76 supratentorial tumors with which the occipital lobe could compete for frequency of involvement. Of these, 2 tumors, or 2.6 per cent, were tumors of the occipital lobe.

In 1929 Frazier and Waggoner19 reported the first sizable study of tumors limited to the occipital lobe, although 9 of their 40 tumors extended to the temporal lobe. It is impossible to state what percentage the 40 tumors represented since the total number was not given, but of the 40 tumors, 44 per cent were gliomas, 26 per cent fibroblastomas (probably meningiomas), 11 per cent cysts, 17 per cent tuberculomas and 2 per cent metastatic tumors.

One year later Allen1 reported a series of 40 cases in which 24 tumors

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Fig. 4. Postero-inferior view of same brain as in Fig. 3. On the right the resected lobe has been tilted back as though hinged along the superior border (arrows). The apex of the triangle (A) fits into the point beneath the splenium, visible in the photograph just behind the collicular plate (C).

On the left a similar lobe was resected but sectioning was continued anteriorly along the calcar avis until all striate cortex was removed from deep in the curve of the lateral ventricle.
were confined entirely to the occipital lobe. For the reason previously stated it is again impossible to state what percentage of a total this represents. Of Allen's 40 tumors 16 were gliomas, 4 endotheliomas, 3 sarcomas, 2 gummas and 1 was an angioma, and 1 a cyst. The remaining 13 were miscellaneous.

Elsberg\textsuperscript{17} in 1931 reported on meningiomas only, and of a total of 102, listed 2 that were limited to the occipital lobe, being attached to the lateral sinus, and 13 more attached to the dura at the base which involved either occipital or temporal lobes.

In his book on intracranial tumors, published in 1932, Cushing\textsuperscript{10} did not give the localization of all the tumors. He does break down the group to the extent that 366 infratentorial tumors, 360 pituitary tumors, 14 pinealomas and 92 craniopharyngiomas can be subtracted from his total of 2,023. This left 1,191 supratentorial tumors.

In the same year Horrax and Putnam\textsuperscript{24} reported a series of 40 tumors of the occipital lobe from a total of 1,881 intracranial tumors. They discarded all tumors that extended beyond the occipital lobe, all multiple tumors and all tumors that involved both occipital lobes. Assuming that none of the 1,881 tumors were infratentorial, pituitary or pineal, 2.1 per cent of the series consisted of tumors of the occipital lobe.

It would seem justifiable to go further than this, however. The series of cases reported by Horrax and Putnam were part of the series reported by Cushing. Hence, of Cushing's 1,191 supratentorial tumors, excluding tumors of the pineal and pituitary bodies, at least 40 were confined to the occipital lobe. This amounts to 3.3 per cent in the largest series yet available.

The series of cases of Horrax and Putnam is the first in which tumors were confined entirely to the occipital lobe so that their study presents an incidence of this particular type of tumor which is of genuine value. Of the 40 tumors, 50 per cent were gliomas, 35 per cent were meningiomas and the remaining 15 per cent consisted of 2 angiomas, 1 hydatid cyst, 1 metastatic tumor and 2 unclassified tumors.

Elvidge, Penfield and Cone,\textsuperscript{19} in 1937, reported on a series of 210 gliomas. Of these, 63 were subtentorial (including spinal and peripheral nerves) or pineal, which left only 147 to be considered as tumors located in the cerebrum. Unfortunately the group of 55 astrocytomas is the only one broken down beyond hemispheric distribution, and in this group 1 tumor was in the occipital lobe.

In a series of 223 intracranial gliomas, excluding infratentorial tumors and tumors affecting the optic nerve, Baker\textsuperscript{4} listed 42, or more than 18 per cent, as occipital. Bennett,\textsuperscript{4} in 1946, presented a detailed report of 446 primary intracranial tumors in a group of patients of military age. Of these, 75 were in locations other than the cerebrum, that is, in the pituitary or pineal body, infratentorial, and so forth. This left 371 tumors, of which 11 or 2.9 per cent were occipital. These 11 tumors included 2 meningiomas (of the total 39 meningiomas), 2 gliomas (1 of the 6 astroblastomas, 1 of the 13
spongioblastoma polares), 3 hemangiomas (of the total 30 hemangiomas) and 1 cyst (of the total 16 cysts).

Thus, from the few large series in the literature that could be analyzed it would seem that tumors of the occipital lobe constitute from 2 to 5 per cent of the supratentorial tumors eliminating tumors of the pituitary body, pineal body, and so forth. It must be remembered, however, that unless specified otherwise, designation of the lobe in which the tumor is located in

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Fig. 5. Deep-seated astrocytoma, grade 2, in the right occipital lobe of a 59-year-old man. Considerable pleomorphism is exhibited but there is minimal if any vessel change and no mitoses are present (hematoxylin and eosin, X235).

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the series mentioned is probably on the basis of major rather than exclusive localization.

The type of tumor and its incidence, as obtainable from the few reports that lend themselves to such analysis, would average roughly as follows: gliomas, 45 per cent; meningiomas, 25 per cent, and a wide variety of tumors23,25,32 none of which occurred in significant portion, 30 per cent.

At the Mayo Clinic in the past 25 years 275 cases of primary tumors involving the occipital lobe were reported. All metastatic and multiple tumors were excluded from this figure. These 275 cases were reviewed from the point of view of exact confinement to the occipital lobe in so far as surgical reports
and specimens removed at necropsy allowed. All cases in which extension occurred beyond the boundaries previously given (Figs. 1 to 4) were discarded.

There remained a group of 50 primary tumors strictly limited to the occipital lobe (inadequate tissue for diagnosis excluded 9). These 50 tumors formed the basis of our study. They comprised between 2 and 3 per cent of

![Image](image-url)

**Fig. 6.** Myxopapillary type of ependymoma, grade 1, on lateral surface of occipital lobe of 48-year-old man. There was strand-like calcification noted by roentgenogram 8 years previous to operation. The patient was alive 12 years postoperatively. Pleomorphism, anaplasia or mitoses were not present (hematoxylin and eosin, ×145).

the total supratentorial tumors over the same period after subtracting the pineal and pituitary groups.

Nineteen of the 50 tumors, or 38 per cent, were meningiomas, 6 of which were malignant. Thirteen, or 26 per cent, were glioblastomas; 2 were astrocytomas; 2 were astroblastomas, and 1 was an oligodendroblastoma. There were 6 ependymomas, making a total of 24, or 48 per cent, belonging to the glioma group.

According to the classification of Svien, Mabon, Kernohan and Adson, 34 17 of these 24 gliomas were astrocytomas; 2 were astrocytomas grade 1, 2 grade 2 (astroblastomas) (Fig. 5), 11 grade 3 (glioblastoma multiforme) and
2 grade 4 (glioblastoma multiforme). Of the 6 ependymomas 1 was of grade 1 (Fig. 6), 1 of grade 2 (ependymoblastoma), 3 of grade 3 and 1 of grade 4.

The remaining 7 of the 50 tumors in the occipital lobe included unclassified gliomas, a fibrosarcoma (Figs. 7 and 8), a hemangiosarcoma and an osteogenic sarcoma.

The tumors were distributed evenly between the sexes within limits of expected error for such a small group, there being 23 males and 27 females. This relative proportion holds throughout the various types of tumors.

Fig. 7. Serial sections of occipital lobe of 30-year-old man show a small fibrosarcoma which did not reach the surface at any point.

Thus it can be seen from the literature and from our cases that primary tumors rarely involve the occipital lobe exclusively. The percentage of tumors affecting the occipital lobe only (2 to 3 per cent) is considerably less than the percentage of the supratentorial brain occupied by the occipital lobe (7.6 per cent by volume). Many tumors, however, are larger than the occipital lobe (50 cc.) by the time operation or necropsy is performed, and hence they would extend beyond this small, fairly silent lobe before data were secured in any reports for statistics.

The 275 cases in which the occipital lobe was involved by tumor represent a much higher percentage of the total brain tumors than the percentage of the supratentorial brain which is occupied by the occipital lobe. Thus, it is felt that the occipital lobe is probably involved by tumor as often as any other region of equal volume in the cerebrum. Because of its small size, however, it is rarely the exclusive site of a primary brain tumor.

The types of tumors found in the occipital lobe include practically all types of supratentorial tumors, excepting, of course, those that affect only
certain portions of the brain such as pineal and pituitary bodies. The vast majority of occipital tumors are gliomas and meningiomas.

CORRELATION

Correlation of the average total duration, that is, preoperative duration of symptoms plus postoperative survival, with the grade of each tumor gave the following results: (1) for astrocytomas of grade 1, 312 months, those of grade 2, 57 months, those of grade 3, 18 months, and those of grade 4, 9 months; (2) for ependymomas of grade 1, the average history covered a total of 230 months, those of grade 2, 132 months, those of grade 3, 27 months, and those of grade 4, 2 months.

These two types of tumors thus demonstrate the same general pattern as those presented by Svien and associates for the astrocytomas and by Mabon and associates for the ependymomas although the duration for any one grade differs slightly. This is no doubt explainable by the fact that the number of tumors in each grade is too small in this series to yield a representative average.

The total duration from onset of symptoms plus postoperative survival for the group having benign meningiomas averaged 207 months and for malignant meningiomas, 46 months. It should be mentioned that in many instances the last entry on the record of a patient having a meningioma was to the effect that he was still living, and this date was used to figure the postoperative survival time. In the cases of malignant meningiomas and the

Fig. 8. Marked anaplasia and hyperchromatism of many nuclei of tumor shown in Fig. 7. A small amount of collagen is present (hematoxylin and eosin, X185.)
gliomas a higher proportion of the survival times represented actual time until death. Hence duration of the condition for the benign group errs on the low side.

COMMENT

An occipital lobe severed along the most definite boundaries established by the anatomists while making allowance to include all the visual receptive cortex, is about 50 cc. in volume and with its fellow represents about 7.6 per cent of the supratentorial portion of the brain.

Reports from the literature that contain information relative to the exact frequency of involvement of the occipital lobe by tumor are rare. Most of the large series of cases reported do not indicate how many tumors were occipital or what proportion of an entire series the enumerated occipital lobe tumors constitute. The series of cases reported by Horrax and Putnam was the only one of any size in which the tumors were confined entirely to the occipital lobe. Hence, it is the only series in which the incidence of this type of tumor is of genuine value.

From the few available figures in the literature, tumors of the occipital lobe appear to constitute between 2 and 5 per cent of the supratentorial tumors excluding pineal and pituitary tumors. There is a close agreement between the figures in our series and those of Horrax and Putnam for the two main groups of tumors, meningiomas and gliomas. In our series of cases 48 per cent of the tumors were gliomas; in Horrax and Putnam’s series 50 per cent. In our group 38 per cent were meningiomas of which 6 or 12 per cent of the 50 tumors were malignant, and in Horrax and Putnam’s series 35 per cent were meningiomas.

When the percentage of cases of brain tumor in which the occipital lobe only is involved by tumor (2 to 3 per cent) is compared with the percentage volume of the supratentorial portion of the brain occupied by the occipital lobe (7.6 per cent), it seems that the occipital lobe is rarely involved by tumor. If, however, the total number of cases in which the occipital lobe is involved is considered, the ratio is overbalanced the other way. It is concluded that the occipital lobe is probably involved by tumor as frequently as any other region of similar size (50 cc.) of the cerebrum. It is rarely exclusively involved because most tumors attain a greater size than may be contained in the occipital lobe and invade other tissue before they reach surgical attention. The peritocrular meningiomas are a notable exception. While it is true that they may attain a size of 200 cc. or more before surgical attention is necessary, they remain limited to the lobe as they frequently push the lobe ahead of them without involving any other region of the brain (Fig. 9).

SUMMARY

The occipital lobe comprises about 7 per cent of the supratentorial portion of the brain. Tumors limited exclusively to this lobe comprise about 3
per cent of the tumors of the supratentorial portion of the brain minus pineal and pituitary tumors.

About five times as many tumors involve the occipital lobe without being confined to this one lobe as those which remain within the lobe. This study indicates that the occipital lobe is involved by tumors as frequently as any other portion of the cerebrum of like size.

About 50 per cent of the tumors affecting the occipital lobe are gliomas, about 35 per cent are meningiomas and the remaining 15 per cent may be any of the tumors to which the cerebrum and supporting structures are subject.

The correlation between the degree of malignancy and the duration in our cases was comparable to that for other studies.

REFERENCES

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