LAMINECTOMY AND REMOVAL OF SPINAL CORD TUMORS UNDER LOCAL ANESTHESIA

By E. B. TOWNE,* M. D., *San Francisco*

Laminectomy can be painlessly carried out after infiltration with local anesthesia.

Exploration of all aspects of the cord, and removal of extramedullary tumors, are painless, provided that handling of the posterior columns and posterior nerve roots can be avoided.

Compression of the medulla or upper cervical cord, causing impaired function of the diaphragm, is a positive indication for the use of local anesthesia.

If visceral disease contra-indicates narcosis, exploration of the cord should be done under local, with the temporary addition of general anesthesia, if necessary, during manipulation of the cord.

DISCUSSION *by Walter F. Schaller, San Francisco; Carl W. Rand, Los Angeles; Howard C. Naffziger, San Francisco.*

LOCAL is preferable to general anesthesia for operations on the scalp, skull, and brain, because hemorrhage from the vessels of the scalp is decreased, intradural tension is diminished, and prolonged operations are followed by little or no shock unless they are complicated by bleeding incidental to removal of a tumor. Craniotomies and osteoplastic explorations can be painlessly carried out without narcosis. I employ a general anesthetic for head cases only when the age or mentality of the patient contra-indicates the use of procain. Until the first patient described below came under observation, I saw no reason for using local anesthesia for exploration of the spinal cord, because hemorrhage is not troublesome, there is no problem of increased intradural pressure, and the cord, unlike the painless brain, is extremely sensitive. In this case respiratory embarrassment made local anesthesia imperative, and the result was so satisfactory that the procedure has been repeated on three other patients.

CASE REPORTS

CASE 1—*Compression of medulla and upper cervical cord by meningeal tumor. Tetraplegia, hypoesthesia of entire spinal distribution, and paresis of diaphragm. Extirpation followed by complete recovery.*

Mr. J. V. B. (Disp. No. 116,360), a clerk aged 28 years, entered Lane Hospital on November 18, 1923.

History—In November, 1922, he began to suffer from pains which radiated from the back of neck to the right shoulder. This was followed by numbness in the posterior cervical and occipital regions. Paraesthesias and loss of strength in the right arm began in March, 1923, and soon involved the right leg and the left arm. Partial retention of urine was noted in June. After July, he was unable to walk or to use his fingers efficiently. In September he developed increasing respiratory difficulty.

Examination—The patient lay propped up in bed, entirely helpless. Respiration was thoracic in character, and no movement of the diaphragm could be detected. Unfortunately, a fluoroscopic examination of the diaphragm was not done. All muscles except those of the face were spastic, and showed loss of power varying from complete paralysis of the muscles below the knees and of the small muscles of the hands, to marked weakness of the muscles of the neck, shoulders, and thorax. Voluntary motions were limited to slight, slow contractions of the neck, shoulder, and upper arm muscles. All tendon reflexes were hyperactive, abdominal reflexes were absent, and plantar reflexes were pathologic. Normal cutaneous sensibility was limited to the distribution of the fifth cranial nerve. The entire spinal distribution showed diminution of pain, touch and temperature perception, which was most marked in the first to fifth cervical areas. Joint and vibration sensations were impaired. Retention of urine required catheterization. All cranial nerves reacted normally.

Wassermann reactions on the blood and spinal fluid were negative. The spinal fluid was clear and colorless, had 3 leucocytes per cmm., and showed positive Nonne and Noguchi reactions. Roentgenograms of the foramen magnum and the cervical spine were negative.

Diagnosis—(Dr. Walter F. Schaller and Dr. Thomas G. Inman). Compression of the upper cervical cord.

Operation—December 1, 1923, at 8 a. m. Morphia gr. 1/6 was given hypodermically at 6:30, and repeated with atropin gr. 1/150 at 7:30. The patient was in prone position, with his forehead resting on a crutch and his shoulders supported by sand-bags. His respiration was very labored in this position. The soft parts were infiltrated through punctures 5.0 cm. to either side of midline. Injections were made into the periosteum of the occipital bone and of the second to fifth cervical laminae, avoiding any deep infiltration, except when the needle was in contact with bone. One hundred and twenty cc. of 0.5 per cent procain, containing ten drops of 1/1000 adrenin, were used. The soft parts were cleared from the occipital bone and the upper five cervical laminae. The first, second, and third laminae were removed, and the dura was incised. The lower surface of a nodular, encapsulated tumor, attached to the dura under the posterior margin of the foramen magnum, presented at the upper end of the incision. After cutting around the dural attachment, the tumor was lifted out of a deep depression in the posterior aspect of the medulla and cord. Immediately after the removal of the tumor the patient began to breathe more easily, and during closure of the wound he talked freely. He suffered no pain during the operation, and left the table with a pulse of 80.

The tumor (Figure 1) weighed 9 gm. and measured 2.7 by 2.5 cm. Microscopic examination showed it to be a meningeal tumor (dural endothelioma or arachnoid fibrosarcoma).

Post-operative Course—The wound healed cleanly. After two catheterizations he regained control of the bladder. On the first day, abdominal palpation showed that the diaphragm was functioning. On the sixth day, he was able to move the arms and legs freely. On the tenth day, spasticity was greatly diminished, tendon reflexes were less active, and hypoesthesia could be demonstrated only below the waist. On the twenty-fifth day he began to walk with a spastic and ataxic gait. On the thirty-fourth day, when he left hospital, the dynamometer readings were right 35, left 45; sensation was normal except in the hands; and tendon reflexes were only slightly hyperactive. March 17, 1924, he considered himself entirely well, and went to work as a bank clerk. In November, 1924, beyond some restriction of the motions of the upper cervical spine, nothing abnormal could be found.

CASE 2—*Compression of dorsal cord by intra and extradural fibroma. Paraplegia and hypoesthesia. Extirpation followed by complete recovery.*

Mr. E. S. (Disp. No. 122,853), a railroad laborer aged 25 years, entered Lane Hospital December 3, 1923, recommended by Dr. C. G. Scaparone of San Francisco.

History—Periodical attacks of dull, non-radiating pain in the left lumbar region, worse when lying down and relieved by motion, began in 1918. After September, 1923, the pain was very troublesome every night. Stiffness, weakness, and paraesthesias of the legs began in Octo-

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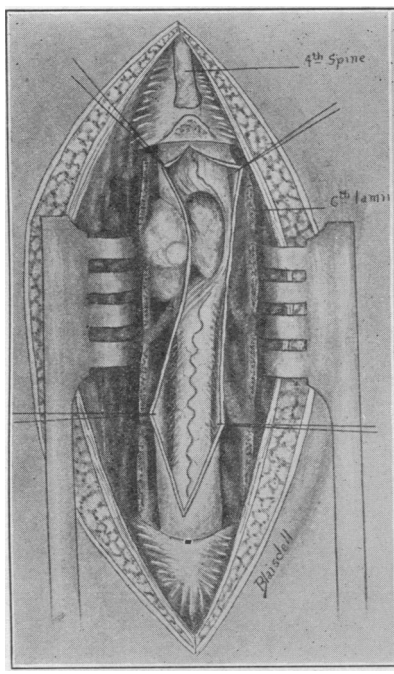

Fig. 2

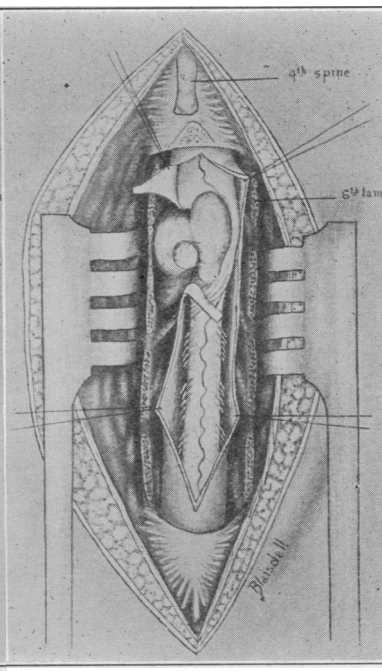

Fig. 3

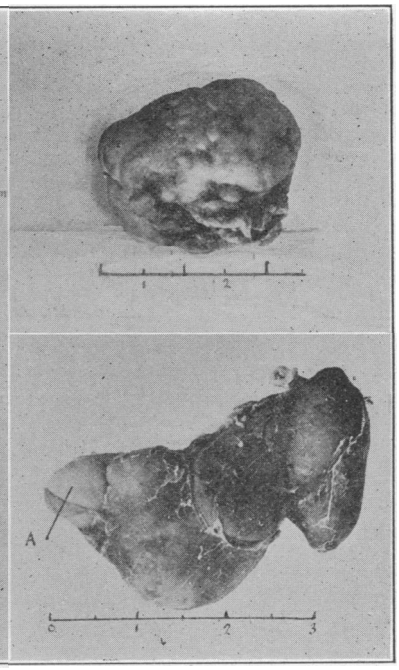

Fig. 1

Fig. 4

Fig. 1. Case 1—Photograph of tumor.
Fig. 2. Case 2—Extra and intradural tumor. Drawing from sketch made at operation.
Fig. 3. Case 2—Appearance after incision of band of dura posterior to neck of tumor.
Fig. 4. Case 2—Photograph of tumor. Capsule intact except at A, where it was included in the ligature.

ber, 1923. In 1920 the patient had a chancre, which was not followed by secondary manifestations.

Examination—The gait was spastic, and the muscles of the lower extremities were hypertonic. The tendon reflexes of both legs were exaggerated, the plantar reflexes were pathologic, the upper abdominal reflexes were present, and the lower were absent. There was diminished pain, touch and temperature perception up to and including the tenth dorsal segment. The functions of the bladder and rectum were not disturbed.

Roentgenograms of the spine and Wassermann reactions on the blood and spinal fluid were negative. The spinal fluid, which was clear and slightly yellow, showed 8 leucocytes per cmm., and positive Nonne and Noguchi reactions.

Diagnosis—(Dr. Thomas G. Inman.) Compression of the ninth or tenth dorsal segment of the cord.

Operation — December 11, 1923. Preliminary morphia and atropin, as in first case; prone position; infiltration with 300 cc. of 0.5 per cent procain containing twenty drops of 1/1000 adrenin. The fifth to the tenth dorsal laminae were cleared, and the seventh, eighth, and ninth laminae were removed. This exposed the lower margin of an extradural tumor projecting downward from under the left sixth lamina. The sixth laminae were removed, and the dura was incised, disclosing an intradural tumor (Figure 2). After a probe had demonstrated the continuity of the extra and intradural portions of the tumor, the dura over the constricted neck was incised (Figure 3). The intradural part of the growth was elevated, and posterior adhesions between the dura and the tumor were freed. This caused severe pain until an adherent posterior nerve root, thought to be the fifth or sixth dorsal, was identified and cut. Further dissection showed that the tumor extended into the foramen between the sixth and seventh vertebrae, where it was firmly attached. A ligature was slipped down over this part of the tumor and tied after freeing the capsule. The patient's pulse varied between 80 and 94 during the operation; the field was practically bloodless; and there was no pain except when elevation of the tumor put traction on a posterior root.

The tumor (Figure 4) weighed 7 gm. and measured 3.5 by 2.5 cm. Microscopic sections showed it to be a fibroma.

Post-operative Course—On the eighth day the plantar reflexes were normal, and the sensory loss was less marked. He walked on the eighteenth day, when examination showed no sensory loss, no spasticity, and normal tendon and skin reflexes. January 3, 1924, the patient was dismissed from the hospital. January 16 he went to work as a waiter. In February he returned to his former employment as a railroad laborer. In November, 1924, the patient reported for observation. He had been working steadily at pick-and-shovel labor, and considered himself perfectly well. Examination showed nothing abnormal.

Case 3—*Negative exploration of the lumbosacral cord.*

Mr. K. B. (Disp. No. 123,888), a painter aged 51 years, entered Lane Hospital on January 8, 1924.

History—Rest from work had led to prompt recovery from two attacks of lead palsy; of the legs in 1915, and of the right arm in 1920. In 1922 he began to have cramp-like pains in the right hip, followed by weakness of both legs. Early in 1923 the right thigh and leg became stiff and "jumpy," and motions of the right ankle and toes were lost. The palsy increased with long withdrawal from exposure to lead.

Examination—The muscles of the right buttock, thigh and leg were atrophic. All motions of the right ankle and toes were absent. The flexors and extensors of the right knee were slightly weak. The knee-jerks were very active, the right more than the left. There were bilatral crossed adductor responses. The left ankle jerk was hyperactive, but the right was absent. The Babinski reflex was positive on the left, negative on the right.

The afternoon temperature was about one degree above normal. The leucocyte count varied between 9000 and 17,000. Wassermann reactions on the blood and spinal fluid were negative. The roentgenograms showed six lumbar vertebrae, with the right sixth transverse process articulating with the sacrum. The spinal fluid was clear, colorless, and showed 2 leucocytes per cmm.; one specimen gave positive Nonne and Noguchi reactions, and another gave a negative Nonne and a positive Noguchi. Twenty-five cc. of spinal fluid were replaced by the same amount of air. Dr. R. R. Newell reported: "A large quantity of air has been injected into the lower portion of the spinal canal. The nerve trunks can be seen as

slightly denser masses on either side. The canal has been demonstrated sufficiently well to rule out any except a very small tumor at the level of the second lumbar vertebra or below. Higher than this the examination gives no information."

Diagnosis—Opinion varied as to whether the lesion involved the conus or the cauda equina. On the basis of the pyramidal tract signs and the spinal pneumogram, exploration of the lumbosacral cord was decided on.

Operation—February 19, 1924. Preliminary medication as before; prone position; infiltration with 300 cc. of 0.5 per cent procain containing eighteen drops of 1/1000 adrenin. The eleventh and twelfth dorsal and the first lumbar laminae were removed and the dura was incised. The posterior aspect of the exposed cord was normal. Two dentate ligaments were cut to permit lateral and anterior exploration, which was negative. A ureteral catheter passed up and down the canal without meeting obstruction. The operation was painless, even when the cord was lifted by traction on the divided dentate ligaments.

Post-operative Course — The wound healed cleanly During his stay in the hospital the patient continued to have an afternoon rise of temperature, for which no cause was ever found. He was dismissed unimproved. Dr. R. W. Harvey of San Francisco informed me that the patient had a left foot-drop, in addition to his other palsies, in September, 1924.

CASE 4—*Exposure of intramedullary tumor at level of sixth cervical laminae. Brown-Sequard syndrome. Improvement following roentgen-ray treatment.*

Mr. R. E. E. (Disp. No. 128,076), a laborer aged 39 years, entered Lane Hospital May 18, 1924.

History — For fifteen years he had been troubled by pains which radiated from the posterior cervical region toward the left shoulder. For one year he had noted increasing loss of sensation of the right leg, thigh and body up to the nipple line, and weakness of the left leg.

Examination—Temperature sensation was absent, pain sensation diminished, and touch sensation normal below the first dorsal segment on the right. The second dorsal segment on the left was hyperesthetic. The left lower extremity was weak. The left knee-jerk was greater than the right, and the left plantar response was pathologic. Wassermann reactions on the blood and spinal fluid, roentgenograms of the spine, and analysis of the spinal fluid were negative.

Diagnosis—(Dr. Walter F. Schaller.) Tumor at second or third dorsal segment of the cord.

Operation—June 13, 1924. Preliminary medication and position as in previous cases. Infiltration with 100 cc. of 0.5 per cent procain, containing fifteen drops of 1/1000 adrenin. After removal of the fifth, sixth, and seventh cervical laminae, the dura was incised and the adherent arachnoid was separated from the dura. There was a slight enlargement of the cord at the level of the sixth laminae, which was at first thought to be within normal limits. Anterior exploration, after incision of a dentate ligament, was negative. A ureteral catheter passed up and down the canal without meeting obstruction. It was decided that the lesion might lie below the exposed field; and, in order to save time (as the lower limit of infiltration was at the first dorsal laminae), the patient was given a general anesthetic for removal of the first and second dorsal laminae. Bleeding was troublesome, in contrast to the dry field while working with procain. The cord under these laminae appeared normal. More careful inspection of the enlargement at the level of the sixth cervical laminae showed that cord pulsation was absent below this point. A longitudinal incision was made through the left posterior column, which exposed a yellowish infiltrating tumor 2 mm. under the pia. No specimen was taken, for fear of doing damage. The dura was sutured. The patient suffered no pain during the part of the operation which was done without narcosis.

Post-operative Course — The wound healed cleanly. He was in a chair on the nineteenth day, and walked on the twenty-second day, when the hyperesthetic zone on the left had disappeared, and the left leg was stronger. Roentgen-ray treatments were started on the twenty-fourth day, when the patient left the hospital. On August 7, the loss of temperature and pain sensation was limited to the right lower extremity, the strength of the left leg was improving, and the left plantar reflex was normal. On October 4, only a few patches of temperature loss were found over the right thigh and leg. There was no motor weakness, and the left knee-jerk was only slightly greater than the right. On November 6, no sensory loss could be demonstrated. He had been doing heavy labor in a grain warehouse for six weeks. He receives roentgen-ray treatment once a month.*

DISCUSSION

Although textbooks on local anesthesia and on surgery of the spinal cord describe methods of anesthetizing for laminectomy, there are few reports of operations under local anesthesia. Heidenhain (Laminectomie in Lokalanästhesie, Zentralbl. f. Chir., 39:281 (March 2), 1912) did four painless operations, in which no intradural procedures, beyond two negative explorations, were necessary. Strachauer (Laminectomy under local, not spinal, anaesthesia, Journal-Lancet, 36:93 (February 15), 1916) removed a localized hypertrophic pachymeningitis from one patient, and an extramedullary tumor from another. The operations were painless, free from shock, and practically bloodless. Frazier (Laminectomy and regional anaesthesia, Ann. Surg., 68:12 (July), 1918) did a negative exploration, and he noted that there was pain only when the posterior roots were disturbed. Neuhof (Giant endothelioma of medulla. Suboccipital craniotomy and removal of arches of atlas and axis under local anesthesia, Surg. Clin. N. Am., 1:1693, 1921) operated on a patient whose condition was very similar to that of the first patient of this report. The tumor was more extensive, however, and only the presenting portion could be removed. There was no shock, but death from respiratory failure occurred thirty-six hours after operation. Ranzi (Operationen wegen Rückenmarkstumor und ihre Resultate, Arch. f. klin. Chir., 120:489, 1922), in Case 14, removed a small endothelioma, probably using ether for the intradural work. Farr (Practical local anesthesia, Phila., Lea & Febiger, 1923) removed two extramedullary tumors, one with local anesthesia alone, and the other with ether for the intradural manipulations.

These reports are in agreement with my findings. The laminectomy can be done without causing pain, while the intradural procedures may be painless, or may require temporary narcosis. Some extramedullary tumors have been removed painlessly (Strachauer, Neuhof, Farr's first case and my first case), and others required general anesthesia (Ranzi, Farr's second case). My second patient suffered momentary severe pain until an adherent posterior nerve root was cut, and he should have been under narcosis during this stage of the operation. Negative explorations and exposures of intramedullary tumors are painless (Heidenhain's third case, Frazier, the third and fourth cases of this report).

The uncertainty about how much can be done within the dura, limits the scope of such operations under local anesthesia. If the condition of the patient does not contra-indicate narcosis, there is no good reason for avoiding it, because a properly conducted laminectomy under a general anesthetic

*This patient was working steadily at heavy labor in November, 1925. It would appear that the roentgen ray has had a beneficial effect on this tumor.

should not be complicated by troublesome hemorrhage or shock. My last three patients would probably have done quite as well after operation under ether. Case 1, however, is clearly an example of a condition in which narcosis is impossible. The respiration was almost, if not entirely, thoracic in character, and the patient was constantly under the strain of aerating the lungs by voluntary effort. In such a situation one must expose the lesion without narcosis, and, if necessary, employ nitrous oxide during the removal of the tumor. Fortunately, in this case, as well as in Neuhof's, narcosis was not required for the intradural work.

Aside from compression of the medulla or upper cervical cord, the indications for local anesthesia in exploration of the spinal cord are the same as for any other operation, such as herniotomy. Cardiorenal disease or chronic respiratory infection may make narcosis undesirable. In such cases the operation can be done under procain with minimal risk of ensuing complications. It would seem that Hibbs' ankylosing operation on the spine would offer a promising field, for patients suffering from Pott's disease are often poor subjects for a general anesthetic.

The technic employed in these operations was simple infiltration of the soft parts and of the periosteum of the laminae. Paravertebral blocking was not attempted, because it was thought that a needle introduced between the transverse processes might puncture the dura. Infiltration proved to be perfectly satisfactory. As much as 300 cc. of 0.5 per cent procain have caused no ill effect. In this, as in any other operation, the amount of 1/1000 adrenin has been kept below twenty drops.

CONCLUSIONS

1. Laminectomy can be painlessly carried out after infiltration with local anesthesia.

2. Exploration of all aspects of the cord, and removal of extramedullary tumors, are painless, provided that handling of the posterior columns and posterior nerve roots can be avoided.

3. Compression of the medulla or upper cervical cord, causing impaired function of the diaphragm, is a positive indication for the use of local anesthesia.

4. If visceral disease contra-indicates narcosis, exploration of the cord should be done under local, with the temporary addition of general anesthesia, if necessary, during manipulation of the cord.

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DISCUSSION

WALTER F. SCHALLER, M. D. (Medical Building, San Francisco)—Doctor Towne, in his several case reports, has given me an opportunity to again meet old friends. I recall particularly the first case reported, in which the diagnosis was obscure for a long period and, indeed, uncertain until marked and dangerous paralyses had made their appearance. Thus the operative risk, always considerable in cervical cord tumors, was made greater in the face of marked respiratory distress. I doubt if this patient would have survived under a general anesthetic. The strong point in Towne's paper, in my opinion, is the preference for local anesthesia in operations on cervical cord tumors. I witnessed one unfortunate outcome recently, following removal of an extradural cervical tumor. A general anesthetic had been given. On regaining consciousness the patient was in fairly good shape, but complained bitterly of pain. The house officer ordered a hypodermic injection of ¼ grain morphin sulphate, following which marked respiratory embarrassment ensued with a respiratory death. The post-operative condition in operations on the central nervous system following local anesthesia is in striking contrast to the condition following general anesthesia. There is a striking difference in the amount of shock and intoxication in favor of the former. In selected cases I should say that laminectomy under local anesthesia is indicated in cervical tumors and other selected cases in persons whose fortitude and temperament render them good subjects.

CARL W. RAND, M. D. (Pacific Mutual Building, Los Angeles)—That local anesthesia is the method of choice in certain instances when the spinal cord and brain are to be explored, there can be no question. It is not infrequently applicable when the ventricles are to be inflated or foreign bodies removed. Neurosurgery, as conducted in the field during the war, was done largely under local anesthesia, and it was surprising how much could be accomplished with it. I think this fact has added impetus to its more general use in civil practice. If I am not mistaken, some operators are carrying out chordotomy under local, so that the anesthesia produced by severing the pain and temperature fibers may be accurately estimated at the time and guide the operator as to the depth of his incision. General infiltration, as recommended by Towne, meets all the requirements in both cranial and spinal surgery, and is simpler than any other type of block or regional anesthesia.

HOWARD C. NAFFZIGER, M. D. (380 Post Street, San Francisco)—I feel quite in accord that local anesthesia has a definite and important place in surgery of the nervous system.

The first case of Towne's was ideally adapted to it. In the few traumatic cases that require laminectomy it should also be of value. The advisability of any considerable amount of morphine in cases with respiratory distress might be questioned. In cranial surgery local anesthesia, in my experience, has been of widest value in traumatic cases—penetrating wounds, depressed fractures, decompressions and drainage operations.

In exploratory operations and other diagnostic procedures with patients adaptable to it, it is most satisfactory.

In surgery of brain tumors, while it lessens bleeding and intracranial tension, it has certain disadvantages. One may be deterred in a tumor removal of considerable gravity by the knowledge of a conscious patient. In these, ether has its advantages. I am aware of the impression that long ether anesthesias are poorly borne, and I feel that this is true of children. I believe, however, that the risk of long anesthesia is much overdrawn.

We are a little prone to attribute post-operative results to anesthesia. Usually an unfortunate condition of the patient is much more soundly explained by other factors. While firmly convinced of the value of local anesthesia in many cases, I believe that the mental and nervous tax of a long and trying operation on a conscious patient is not to be minimized nor borne with equanimity by all of us.

The Sella Turcica—Observations made by John D. Camp, Boston *(Journal A. M. A.)*, based on anatomic specimens and roentgenograms show the normal sella to vary in contour and size. Variations in contour may be classed into three types: the round, oval and flat, of which the oval type predominates in the adult. The average sella will measure 1.06 cm. and 0.81 cm. in the anteroposterior and vertical directions, respectively. Variations in the shape of the clinoid processes are numerous, and union between the anterior, middle and posterior clinoids, producing a bridged sella, occurs in about 5 per cent of cases. Such an anatomic variation seems to be of no clinical significance. Pseudo-defects and apparent anomalies of structure are easily produced in a roentgenogram by faulty localizing technic. Pathologic conditions producing changes in the sella are numerous, and the differentiation of these changes as to cause is often difficult. Owing to the characteristic deformity of the sella usually produced by each, the differentiation between an intrasellar and extra-sellar lesion is generally possible.