VARIOUS SHAPES OF THE DUMB-BELL TUMOURS OF THE SPINAL CORD

by

MASATOSHI HOSOKAWA

From the Department of Orthopedic Surgery, School of Medicine, Keio University
(Director : Prof. TORAI IWAHARA)

Received for publication Apr. 5, 1963

INTRODUCTION

There is a group of the spinal cord tumours, constricted by the dural sheath or vertebral canal consequently forming the dumb-bell shape. ANTONI (1920) gave the name of dumb-bell or hour-glass tumour to this special form of the spinal cord tumours, though it was usually described as the spinal cord tumour until the end of the 19th century.

In Japan, INABA (1927) reported the first case of this tumour, and followed by IWAHARA (1932) and JINNAKA (1933). Over 40 cases have been reported in Japan up to date, and they have been considered relatively rare and interesting form of the spinal cord tumours.

BORCHARDT (1926) divided the dumb-bell tumour into 5 groups. HEUER (1927) and EDEN (1941) classified them into 4 groups. Their classifications, however, are insufficient to describe all types of the dumb-bell tumours. In addition, the term dumb-bell tumour of the spinal cord implies many conditions, various shapes and clinical features etc, thus a new and complete classification of the dumb-bell tumour will be required.

CASES AND CLASSIFICATION

At the Department of Orthopedic Surgery of Keio University the dumb-bell tumour was first operated by Prof. IWAHARA in 1932, since then 19 cases have been operated until the end of 1962. Here, I am going to describe various forms of the dumb-bell tumours, based upon these 19 operated cases.

The dumb-bell tumours are classified into several groups in accordance with constricting structures and their localization. Each group will be further divided into complete and incomplete types, in accordance with their so-called dumb-bell shapes being complete or not. For instance, the dumb-bell tumour existing in more than two spaces with the incomplete constriction will be called as the incomplete type. In addition, the tumour, existing within one space, will be called as the subtype, even though it seemed to be in more than two spaces.

1. THE DURA-CONSTRICTION GROUP

The tumour of this group is situated entirely within the vertebral canal and is partially intradural, partially extradural, as if it were constricted by the dura. This coincides with BORCHARDT's group 1 (1926) (partially intra-and partially extradural tumours).

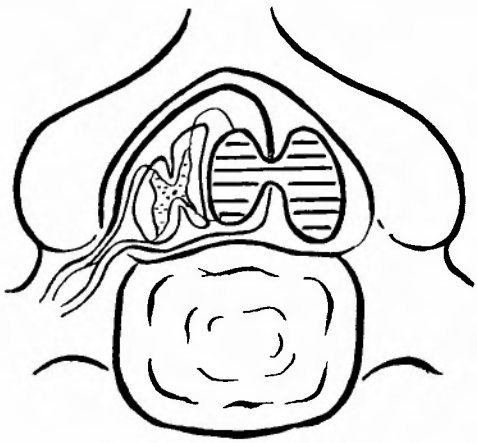

Fig. 1. The dura-constriction group (complete type).

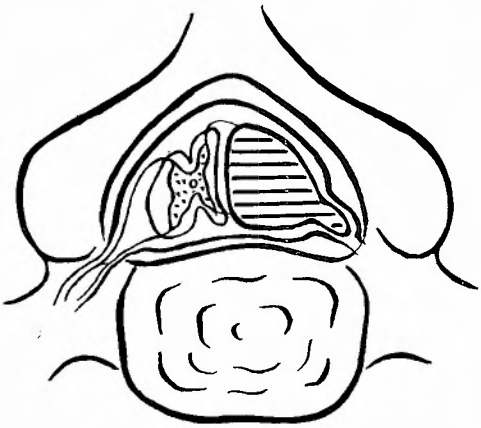

Fig. 2. The dura-constriction group (incomplete type).

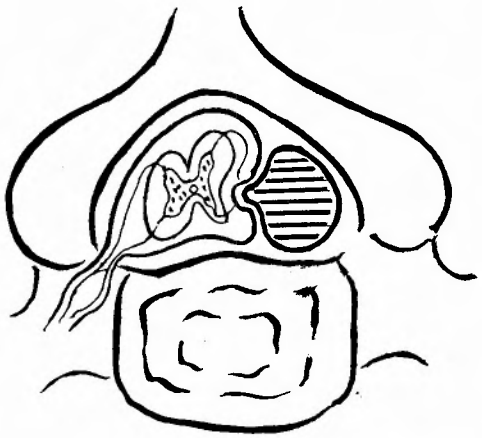

Fig. 3. The dura-constriction group (incomplete type).

This group, however, is further divided into the complete and incomplete type. The one forms a dumb-bell shape over-riding the dural sheath (Fig. 1), the other is an incomplete dumb-bell shape, though it extends to the root-pouch from the intra- or extradural space and expands it. This is the subtype at the same time (Fig. 2 & 3).

Case 1. A 32 year old married woman has been suffering from pain on the ulnar side in her arms for 5 years, without any treatment. About 8 months ago, she developed so-called SHIBIRE-feeling in her legs and weakness of the extremities.

On examination, hypesthesia was elicited on the ulnar side of her arms and below the 2nd rib. Legs were spastic, and disturbance of micturition was noted.

X-ray of the cervical spine disclosed no enlargement of the intervertebral foramen and the vertebral canal.

The C5. 6. 7 laminectomy was performed and the dural canal was opened. A tumour, like a broad bean in shape and size, was seen on the right side ventral to the cord at the level of C6 nerve root, penetrating the root-pouch, the extradural portion being just the same in shape and size. The tumour was completely extirpated, and she was discharged with a good condition 44 days after operation.

Histologically, the tumour was a ganglioneuroma, consisting of the fibrous tissue with the spotted gangliocells (Fig. 4).

Case 2. A 45 year old male had been suffering from so-called SHIBIRE-feeling and occasional pain on the right shoulder down to the figers for past 3 years. With the

complaint of weakness of the right hand and fingers, he was admitted to our hospital.

There were atrophy in the intrinsic muscles of the right hand, hypesthesia below the right shoulder, and slightly spasticity in the right leg.

X-ray findings was nothing in particular.

The laminectomy revealed a tumour at the level of the pedicle of C2 on the right side of the cord, lying within the dural canal and extending 2cm further into the enlarged C3 nerve root-pouch.

Histologically, it was a neurinoma.

Case 3. A 33 year old married woman had been suffering from so-called SHIBIRE-feeling in the right foot, followed by the disturbance of gait, without spontaneous pain for past 5 months.

On extension of her neck, she complained of pain radiating down to her left arm. Both legs were spastic being more remarkable on the left side. Hypesthesia was evident in the left arm and below the 2nd rib on the right half of the trunk.

X-ray showed the enlargement of the left intervertebral foramen of C3-4.

At operation, a cherry like intradural tumour was found on the left side, at the level of C3-4 extending into the C4 nerve root-pouch towards the foramen forming the dumb-bell shape.

Histologically, it was a neurinoma.

Case 1 and 3 belong to the complete types and case 2 to the incomplete type of the dura-constriction group. It may be interesting that all of this group were found in the cervical cord region. The dumb-bell tumour of the cervical cord is usually situated intra- and extravertebrally. In addition, case 1 seems to be an extremly rare one, because this ganglioneuroma was located in the cervical region of the adult, and futhermore formed a dumb-bell tumour, growing partially intra- and partially extradurally. Ganglioneuroma, as a rule, has been discovered in the thoracic spine of childhood, forming the extradural or extravertebral tumour, for ganglioneuroma originates from the sympathetic system. Of the cervical intra- and extradural dumb-bell ganglioneuroma there has been only one case reported by SHEPHARD and SUTTON (1958), as far as I could find in the available literature. Their case, however, was multiple ganglioneuromas.

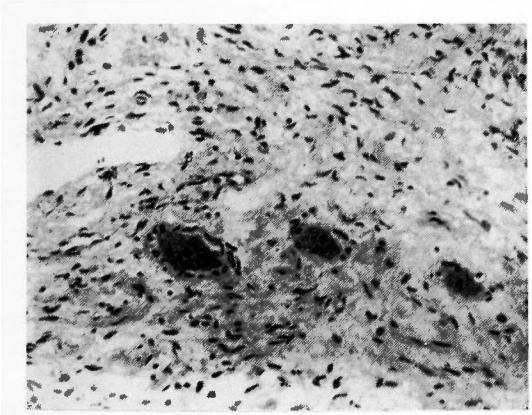

Fig. 4. Case 1. Section of ganglioneuroma.

The incomplete type like case 2 of this series (Fig. 3), growing from the extradural into the intradural space has never been reported.

2. THE FORAMEN-CONSTRICTION GROUP

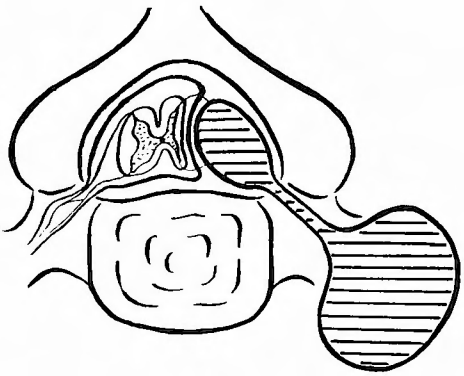

Fig. 5. The foramen-constriction group (complete type).

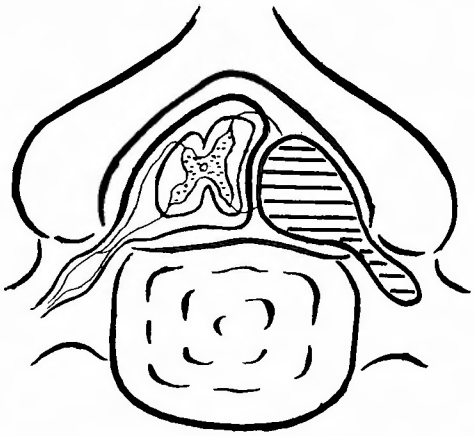

Fig. 6. The foramen-constriction group (incomplete type).

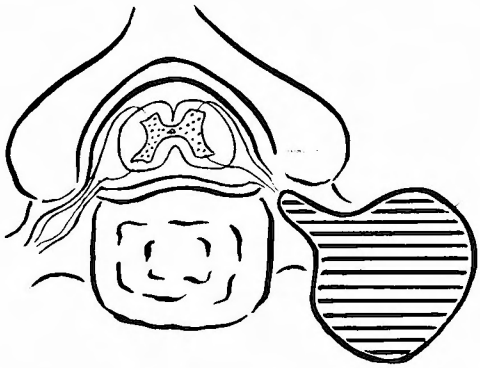

Fig. 7. The foramen-constriction group (incomplete type).

This group is consisted of the partially intra-and partially para-or extravertebral tumours of dumb-bell shape, constricted by the intervertebral foramen. This coresponds to BORCHARDT's group 4 (1926) (extradural and extravertebral), and this should be called the complete type of the foramen-constriction group (Fig. 5). On the other hand, a tumour, existing within the intervertebral foramen, not forming so-called dumb-bell shape yet, should be called the incomplete type of this group. The incomplete type might be further divided into two, the one belonging to BORCHARDT's group 3 (1926) (extradural and inter- or paravertebral) (Fig. 6), the other to the paravertebral and foramental one (Fig. 7) as HEUER (1927) and EDEN (1941) mentioned.

Case 4. A 66 year old female complained of so-called SHIBIRE-feeling in her feet four and half years ago, and about one year later she was operated twice at some hospital on diagnosis of the spinal cord tumour. But 3 years after the last operation she complained of the same SHIBIRE-feeling again.

On examination the legs were atrophic, weakened and slightly spastic. She complained of hypesthesia below the 4th rib and urinary bladder dysfunction.

X-ray revealed loss of the spinous processes at the level of T2. 3. 4 and enlargement of the right T2-3 intervertebral foramen.

Incising the double operated scar, the normal lamina of T1 was appeared. In the defect where laminectomy had been performed, the muscles were found to be degenerated into the cartilage-like tissues, and these extradural scars were carefully removed little by little from the normal tissues. The spinal cord was compressed towards the left side by

the tumour. Foraminotomy of the right T2-3 was performed, and the tumour was found expanding from the extradural spaces into the enlarged foramen.

Histologically, it was a meningioma.

Case 5. A 18 year old male was admitted to our clinic with the complaint of disturbance of gait.

Myelogram revealed an extradural tumour at the level of T3.

The tumour was a half of the thumb in size, lying on the right side of the cord, at the level of T3-5, extradurally, expanding into the right foramen of T4-5.

Histologically, it was a neurinoma.

Case 6. A 46 year old male had been suffering from so-called SHIBIRE-feeling in the hands for past three years and a half. He was admitted to our hospital with the complaint of motor disturbance of the right arm.

By backward extension of the neck, he complained of a tight sensation, but without spontaneous pain. The muscles of the right arm and hand were atrophic and weakened, and the right arm was slightly spastic, but the reflexes of the legs were normal. Hypesthesia was elicited in the area of the right ulnar innervation.

X-ray showed erosion on the right side of C4 body, and atrophy of the right pedicle and the articular process.

Myelography revealed the evidence of extradural compression at the level of C3.

The C5. 4. 3 and a part of C2 laminectomy was performed, the right lamina of C 3.4 was hard but thin. The tumour, little finger tip in size, appeared on the right in front of C 3.4, compressing the dural sheath to the left and backward, and extending into the foramen. The tumour adhered with the capsule firmly to the dura and immobile. Suspecting the intradural extension of the tumour, the dura was opened with no evidence of intradural growth. Foraminotomy of C3-4 was added, the bone was thin but hard. The foraminal tumour was curettaged, but the upper half of the extradural portion was not removed because of bleeding.

This tumour was a neurinoma.

Case 4, 5 and 6 are the incomplete type of the foramen-constriction group. Of the complete type of this group, 3 cases were reported by IWAHARA (1932) and ITO (1935) and another case of the dumb-bell neurinoma was reported by KOIZUMI and MUTO (1943) at our clinic.

In the literatures, this group is the most common one, and its extravertebral portion sometimes grows so large that it becomes palpable. Occasionally, therefore, this large portion of the tumour can be detected in many other soft part by X-ray. It may be found to be a dumb-bell tumour, though operation was performed anticipating either a mere spinal cord tumour or a mediastinal tumour.

In addition, the incomplete type like Fig. 7, does not usually show so-called cord sign. Therefore, in order to diagnose the dumb-bell tumour, it is very important to take a roentgenogram and know whether the intervertebral foramen is enlarged or not.

3. THE DURA- AND FORAMEN-CONSTRICTION GROUP

This group is the dumb-bell tumour, having characteristics of two groups above mentioned simultaneously. The complete type, that is constricted by the dura and the intervertebral foramen completely, coincides with BORCHARDT's group 5 (1926) (intradural extradural and extravertebral) (Fig. 8) and nothing further remains to be explained.

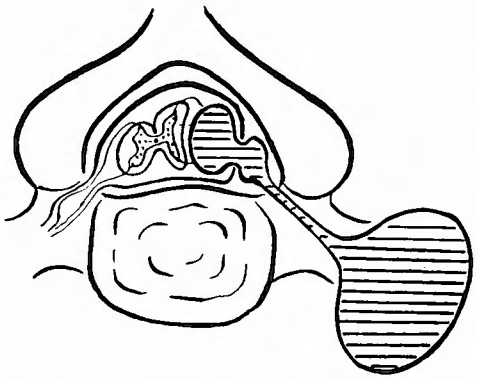

Fig. 8. The dura- aud foramen-constriction group (complete type).

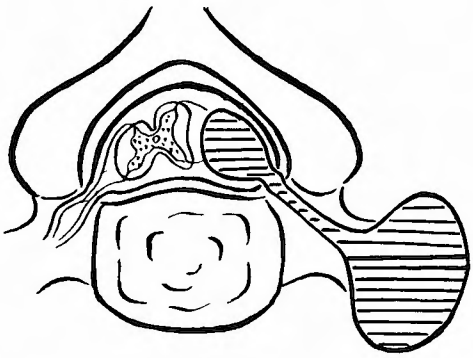

Fig. 9. The dura- and foramen-constriction group (incomplete type).

On the other hand, the incomplete type of this group has many forms, according to the combinations of the constricting dura and foramen. The incomplete type of the two groups means that the shape of dumb-bell itself is incomplete. In this group, however, there is a unique incomplete type too. This is the type due to the constricted site. Because of the lack of the space between the dura and the wall of the spinal canal, this type of tumour appears to be constricted just at one site (Fig. 9).

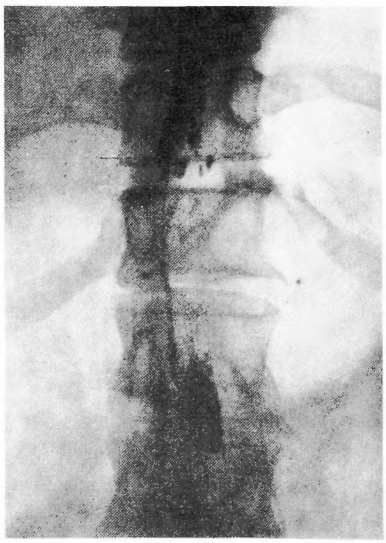

Fig. 10. X-ray of the dura- and foramen-constriction group in Case 7.

Case 7. A 47 year old male complained of low back pain about 4 years ago, and developed disturbance of gait. Five months later he was admitted to a hospital, where the intradural neurinoma was removed. He was discharged from the hospital with good condition, but one year later the same symptom appeared which forced him to be admitted to our clinic.

On examination, a tumour, about 8 × 9cm in size, was palpable at the site of the operated scar. The muscles of the legs were atrophic and spastic, active movement of the ancle joint being lost. Hypesthesia was elicited below the inguinal band, but micturition was regular.

X-ray revealed erosions on the left 12th rib and the left side of T12 body. L1 was atrophic too (Fig. 10).

Incision was made just above the tumour down to the dura. The dural sheath, milky in colour, was compressed by the tumour from the left dorsal to the right ventral. Medial part of the left 12th rib was destroyed with compression and the rest of the left transvers process of L1 was noted in the scar tissue. That is to say, the tumour grown in the epidural space, expanding into the retroperitoneal space ventro-upwardly, raising the back muscles dorsally, destroyed the bone dorsomedially, and compressed the dural sheath and the cord.

The tumour seemed to have relation to the left T12 nerve root.

The tumour was 120g in weight, and was a neurinoma histologically.

This case seems to be a complete type of the dura- and foramen-constriction group. Complete type of this group was already reported by KAN (1936), and KOSHIBA and NARIUCHI (1948) at our clinic.

In addition, this tumour recurred one year later, as just the intradural portion of the tumour had been removed. An intradural tumour is the most common of all the spinal cord tumours, while dumb-bell tumour is relatively rare, and it is likely that the extradural part of this recurrent tumour had been neglected, because of its invisibility due to bleeding.

At operation of the dumb-bell tumour, various shapes of the tumour should be always kept in mind.

Case 8. A 45 year old male had been occasionally suffering from abdominal and low back pain for past 10 years. There developed so-called SHIBIRE-feeling and weakness of the legs about one year ago.

On examination, there were patches of brownish pigmentation from the nuche down to the arms and trunk, but there was no kyphosis. Reflexes of the legs were weakened, so-called saddle shape hypesthesia was elicited, but micturition was normal.

Myelogram showed the figure of so-called saddle shape (intradural extramedullary tumour) at the level of T11 at 30 minutes shot, and the same figure at the level of T12 at 90 minutes shot.

The laminectomy of T11. 12 and L1 was performed, and a tumour, one third of the little finger in size, was appeared on the right side of the spinal cord at the level of T11, extending to the root-pouch. The nerve root in normal size was seen at its apex, and a few small tumours, a half size of rice, were attached at its transmitional site. This was not a dumb-bell tumour exactly, but just beneath it another intradural tumour, a pigeon egg in size, was appeared on the left side of the cord at the level of L1, extending into the foramen, forming a dumb-bell tumour. Both tumours were removed completely. Histological diagnosis of these tumour were neurinomas.

Case 9. A 27 year old male had been suffering from so-called SHIBIRE-feeling and weakness of flexion in the left ancle joint for past 7 months. He was admitted to our clinic with the complaint of so-called SHIBIRE-feeling of the arms and weakness of gait, without any spontaneous pain.

The muscles were atrophic in his left arm and hand, movement of fingers weakened,

and reflexes of the arms also diminished. On the other hand, reflexes of the legs were elevated and pathological reflexes were evident.

X-ray showed enlargement of the left foramen at the level of C5-6, and on the myelogram it seemed to be an intradural extramedullary tumour.

At operation, the tumour was located extradurally at the level of C4-6, compressing the cord toward the right side. Cutting its capsule and pulling it, the intradural portion of the tumour, small bean in size, appeared from the upper medial end. The tumour seemed to have connected with the C5 nerve root. The tumour had expanded the spinal canal, particularly at the level of the left pedicle of C5, growing into the intervertebral foramen.

Histologically, it was a neurinoma (Fig. 11).

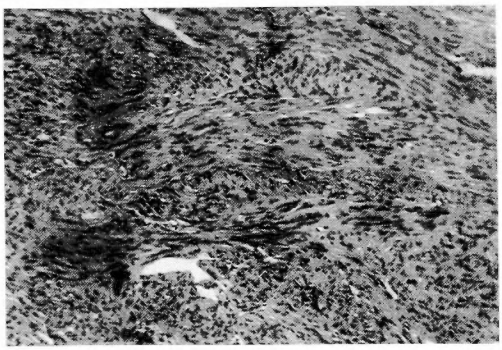

Fig. 11. Section of the neurinoma in Case 9.

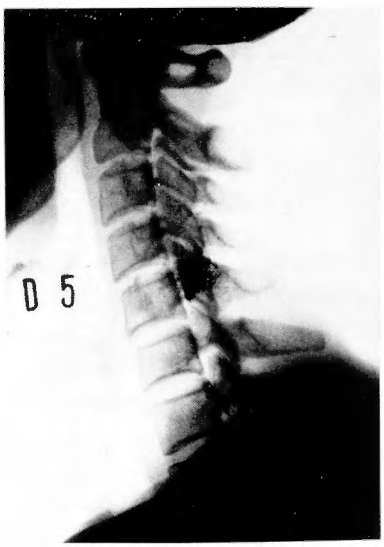

Fig. 12. Myelogram of the dura- and foramen-consticton group (incomplete type from the view point of the double constrition) in Case 10.

Case 8 and 9 are the incomplete type of the dura- and foramen-constriction group. This means its dumb-bell shape is incomplete.

In general the dura- and foramen-constriction group of all dumb-bell tumours of the spinal cord is considered to be rare, this group is, however, not so rare, if these incomplete types were included.

Case 8, in addition, is what one of the multiple spinal neurinomas formed a dumb-bell shape. The similar case is rarely found in the literatures, except KATO's case (1961) in Japan.

Case 10. A 47 year old female had been suffering from pain of the nuche and the left arm for past one year. She was admitted with the complaints of disturbance of gait and motion trouble of fingers.

There was so-called claw hand deformity, and the legs were spastic.

X-ray showed a round opacity, finger tip in size, at the lamina of C6, and at the same level moljodol stopped completely, forming the so-called saddle shape (Fig. 12).

Operation revealed a spheric intradural portion of the tumour, thumb end in size, at the level of C5-6 lamina, on the left-ventral side of the cord. Its extradural portion,

middle finger end in size, extending latero-caudally, expanded the left foramen. The epidural space was vanished by the compression of the tumour, and therefore, it seemed as if the dumb-bell tumour were constricted just at one site.

This was a neurinoma.

Case 11. A 45 year old female had been suffering from pain in the left arm for past 10 years. She was admitted with the complaint of difficulty in gait.

The laminectomy of C4. 3. 2 was performed and the extradural tumour appeared on the left side. Being the main portion of the tumour below the upper ridge of C4 lamina, the laminectomy was added down to T2. There were two tumours extradurally on the left side, but unmovable on palpation. The dura was opened with the suspect of the dura-constriction dumb-bell tumour, a tumour was found on the left-ventral side of C5 cord and adhered to the C6 nerve root. Adhesion was detached, but mobility did not come out. In order to curet the tumour, the capsule-like tissue was held. However, it was not the capsule but the dura itself. It seemed as if this tumour were intradural, but actually this is extradural one pushing inward with the dura capped, and had been constricted by the dura at the neck. Furthermore, the dumb-bell tumour extended into the foramen with the C6 nerve. There was another tumour expanding from the extradural space into the foramen, and adhering to the C7 nerve root.

Both dumb-bell tumours were removed completely.

Histologically, they were neurimomas.

Case 10 is the incomplete type from the view point of the double constriction, and case 11 has two types of tumours namely the subtype of incomplete type of the dura- and foramen-constriction group (Fig. 13), and incomplete type of the foramen-constriction group. This case is considered to be very rare because of its very type and co-existence of two independent dumb-bell tumours. If one of the tumours does not grow into the intervertebral foramen, then it should be called as the subtype of the dura-constriction group (Fig. 3).

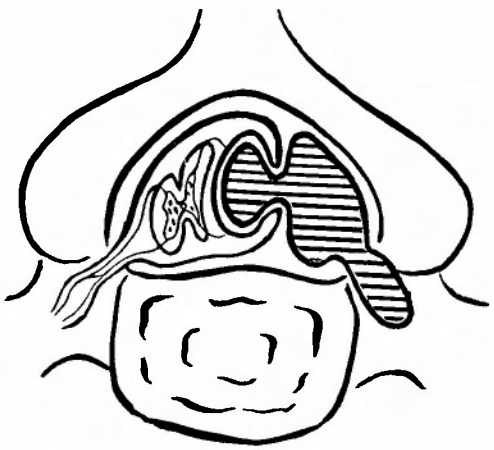

Fig. 13. The dura- and foramen-constriction group (subtype).

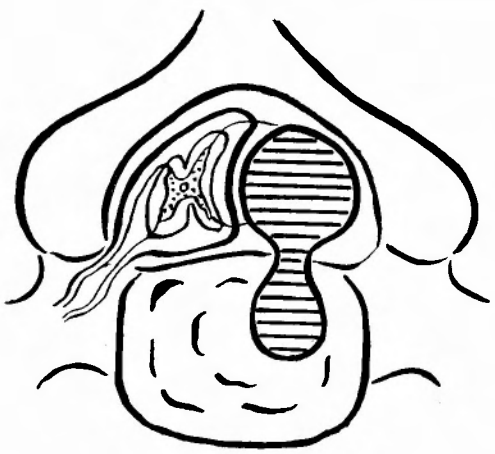

Fig. 14. The vertebral body eroding group.

4. THE VERTEBRAL BODY ERODING GROUP

This is the group of the dumb-bell tumour, which is situated entirely within the epidural space, having its own capsule, and does not infiltrate into the vertebral body, as does a malignant tumour, but erodes the body (Fig. 14).

Case 12. A 48 year old male had complained of increasing difficulty of gait for past 2 years, and one year later he was operated on the spinal cord tumour at some hospital, but complete extirpation was failed on account of much bleeding, and only a portion of the extradural tumour at the level of T12 was removed. After operation his gait became normal, but about half a year later disturbance of gait reappeared and he was admitted to our hospital one year later postoperatively.

On examination there was the scar of operation around the T12, but a tumour was not palpable. Reflexes of the legs were absent. Pathological reflexes were not evident. He had loss of sensation in the 5th lumbar and the sacral segments. The difficulty of micturition was also noted.

X-ray showed erosion of the T12 body and its pedicle, but the lateral contour of the body was intact (Fig. 15).

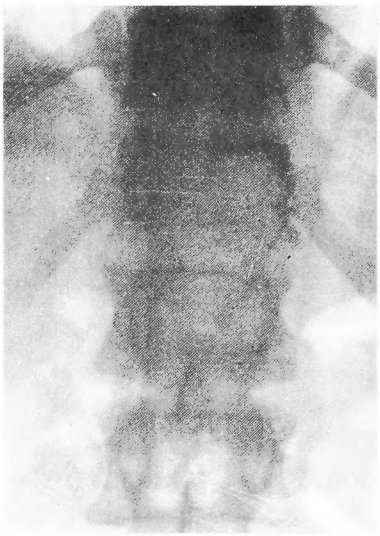

Fig. 15 X-ray of the vertebral body eroding group in Case 12.

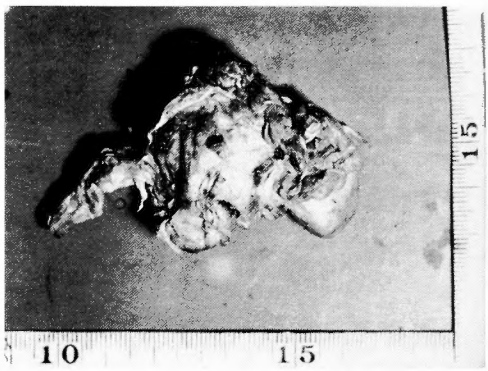

Fig. 16. The tumour removed in toto at operation in Case 12.

Separating the scar, and dividing the muscles of the back, the tumour, thumb in size, appeared extradurally at the level of T12. Apex of the tumour was found behind the L1 lamina, and the other end of the tumour, expanding the left T12-L1 foramen, intruded furthermore into the left ventral wall of the spinal canal and about 2cm farther into the body. Inserting an elevatrium in the bed of the tumour, it was removed in toto (Fig. 16). A small rent was opened at the site of T12 nerve root, and liquor oozed out. It seemed that the tumour might come from the T12 nerve. Histologically it was a neurinoma.

Case 13. A 25 year old female, pregnant, complained of so-called SHIBIRE-feeling in the left leg about 9 months ago, but became well by Vit.B1 therapy. She complained of the same SHIBIRE-feeling again about 3 weeks ago, then the difficulty of

gait.

Both legs were spastic. Pathological reflexes were elicited, and hypesthesia was evident below the T8 segment.

On X-ray the left pedicle of T8 was almost diminished and the digital impression was seen at the left half of T8 body. But the contour of the body was not erosive (Fig. 17). Myelogram showed a typical figure of the extradural tumour above the T8 (Fig. 18).

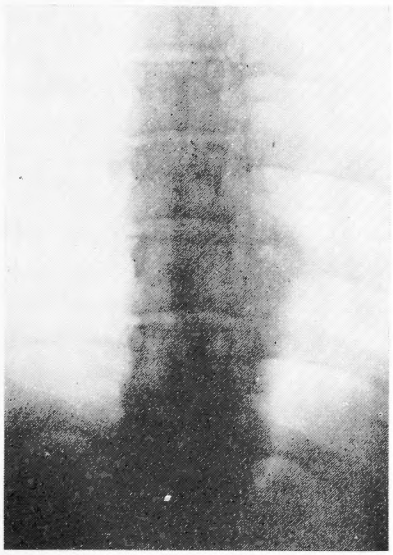

Fig. 17. X-ray of the vertebral body eroding group in Case 13.

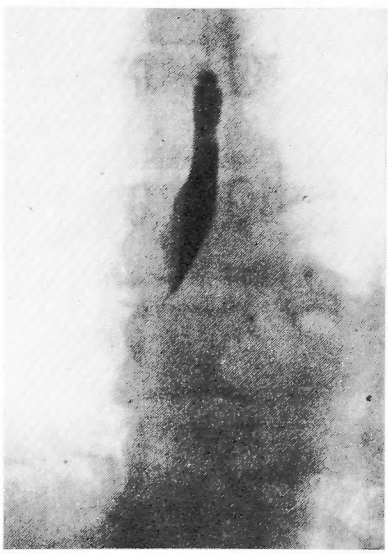

Fig. 18. Myelogram in Case 13.

The laminectomy of T7.8 and a portion of T9 was performed, the laminae were as a thin as sheet of paper, and the tumour appeared on the left side of the dural sheath. The left pedicle and the transvers process were eroded and the foramen was very enlarged by the tumour. As the T7 nerve root involved by the tumour, it was cut, and the tumour was removed. A cavity, $1.5 \times 1.5 \times 0.5$cm in size, remained in the T8 body, as the tumour had eroded the body. The left part of the bottom of the cavity, was deeper by 1.0cm and the cavity was of the two stepped form.

Histologically, it was a neurinoma.

Case 12 is the typical one of the vertebral body eroding group, and also case 13 does. Most of the dumb-bell tumours of the spinal cord grow from the related tissues with the nerve root. Therefore, they will develop along the nerve root, and seldom erode the vertebral body.

KOZUKI (1937) reported the intra- and extravertebral dumb-bell tumour in which a portion of its extravertebral tumour invaded into the T4 body. The tumour of his case, however, like case 7, is not so rare, and it can be differentiated from this group by X-ray.

A characteristics of A-P X-ray in this group is a figure of digital impression in the

vertebral body. On the contrary, when a tumour compresses or infiltrates the body extravertebrally, it will show erosion or atrophy of the body as well as its lateral margin.

5. ANOTHER GROUPS

Besides four groups including their incomplete types or subtypes, there remain still some other groups. One is the group of tumours, grown in the spinal canal, expanded through the laminae into muscles of the back and thus constricted by the laminae. It might be called the laminae-constriction group (Fig. 19), but this has not been experienced at our clinic. Probablly it may be the case of a malignant tumour, but it would be very rare in case of a benign tumour.

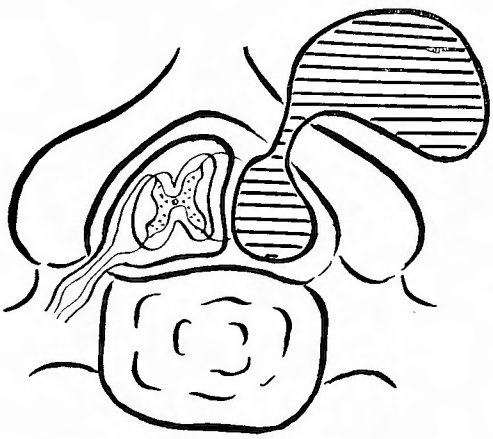

Fig. 19. The laminae-constriction group.

Combining the laminae-constriction group and the foramen-consriction group, it may be called the vertebral canal-constriction group, but I dare to divide them, since the one is rare and the other is common. Signs, symptoms and X-ray findings were different each other.

GULEKE (1922) reported an extradural tumour, locating on the inside and outside of the lamina and, at the same time, on the inside and outside of the foramen, invading into the body, and forming the dumb-bell shape. This case had many characteristics of the dumb-bell tumour, and should be called the complicated group. This is a very rare group.

DISCUSSION

Ninety-three cases of the spinal cord tumour have been operated at the Orthopedic Department of Keio University up to 1962, of which 19 cases (20.4 per cent) are the dumb-bell tumour.

Four cases out of 81 described cases in ELSBERG's (1925) 100 spinal cord tumurs seemed to be the dumb-bell tumour (4.9 per cent). JINNAKA (1933), gathering 63 dumb-bell tumours from the literatures, stated 9 per cent of the spinal cord tumours was the dumb-bell tumour. Recently, EDEN's (1941) 32 cases out of 234 spinal cord tumours, (13.7 per cent), and OGAWA's (1958) 8 cases out of 73, (11.0 per cent), are the dumb-bell tumour, but there have been no reports of such a high incidence like at our clinic's. It may be due to the fact that there have been so many incomplete types of this tumour at our clinic, and they have been all regarded as the dumb-bell tumour.

Table 1 shows the dumb-bell tumours at our clinic : 3 cases of the dura-constriction group, 7 cases of the foramen-constriction group, 7 cases of the dura- and foramen-constriction group, and 2 cases of the vertebral body eroding group. The dumb-bell tumours of the spinal cord, in Japan, have amounted to 44 cases, as in Table 2, in which 40 cases have had the description concerning the horizontal localisation of the tumour. The

tumours belonging to the dura-constriction group are 5 cases, the foramen-constriction group are 25 cases, and the dura- and foramen-constriction group are 10 cases. The foramen-constriction group has absolute majority. On the other hand, at our cases, the dura- and foramen-constriction group is abundant if the secondary dumb-bell tumours are

Table 1. Cases at Our Clinic

	Age	Sex	Level	Group	Pathology	Reference
1	32	우	C7 Nerve Root	Dura-constriction (Complete Type)	Ganglioneuroma	
2	45	좌	C3 Nerve Root	Dura-constriction (Incomplete Type)	Neurinoma	
3	33	우	C4 Nerve Root	Dura-conetriction (Complete Type)	Neurinoma	
4	40	좌	T12-L1	Foramen-constriction (Complete Type)	Sarcoma	Reported by Iwahara
5	46	좌	T5-6	Foramen-constriction (Complete Type)	Cancer	Reported by Ito
6	31	우	T7-8	Foramen-constriction (Complete Type)	Sarcoma	Reported by Ito
7	40	좌	C2 Nerve Root	Foramen-constriction (Complete Type)	Neurinoma	Rerorted by Koizumi, Muto
8	66	우	T2-3	Foramen-constriction (Incomplete Type)	Meningioma	
9	18	좌	T4 Nerve Root	Foramen-constriction (Incomplete Type)	Neurinoma	
10	46	좌	C4 Nerve Root	Foramen-constriction (Incomplete Type)	Neurinoma	
11	29	좌	T1 Nerve Root	Dura-& Foramen-constriction (Complete Type)	Neurinoma	Reported by Kan
12	25	우	T10 Nerve Root	Dura-& Foramen-constriction (Complete Type)	Neurinoma	Reported by Koshiba, Nariuchi
13	47	좌	T12 Nerve Root	Dura-& Foramen-constriction (Complete Type)	Neurinoma	
14	45	좌	L1 Nerve Root	Dura-& Foramen-constriction (Incomplete Type)	Neurinoma	
15	27	좌	C5 Nerve Root	Dura-& Foramen-constriction (Incomplete Type)	Neurinoma	
16	47	우	C6 Nerve Root	Dura-& Foramen-constriction (Incomplete Type)	Neurinoma	
17	45	우	C6 Nerve Root	Dura-& Foramen-constriction (Subtype)	Neurinoma	
			C7 Nerve Root	Foramen-constrition (Incomplete Type)	Neurinoma	
18	48	좌	T12 Nerve Root	Vertebral Body Eroding	Neurinoma	
19	25	우	T7 Nerve Root	Vertebral Body Eroding	Neurinoma	

Table 2 The Dumb-bell Tumours Reported in Japan.

	Reporter	Year	Age	Sex	Level	Group	X-P				Pathology
							Vertebral Canal	Foramen	Vertebral Body	Paravertebral Opacity	
1	Inaba	1927	51	좌	T7-8	Foramen-constriction					Fibroma
2	Iwahara	1932	40	좌	T12-L1	Foramen-constriction				(+)	Sarcoma
3	Jinnaka Ikuta	1933	26	우	T11-12	Foramen-constriction	Enlarged	Enlarged			Fibroma
4	Ito	1935	46	좌	T5-6	Foramen-constriction	Normal	Normal			Cancer
5	〃	〃	31	우	T7-9	Foramen-constriction	Normal	Normal			Sarcoma
6	Kan	1936	29	좌	C7-T2	Dura-& Foramen-constriction					Neurinoma
7	Kawahara Kikuchi	1936	52	우	T7-8	Dura-& Foramen-constriction			Erosive	(+)	Neurofibroma
8	Kozuki	1937	49	좌	T4-5	Foramen-constriction				(+)	Neurinoma
9	Ohashi	1938	41	우	T					(+)	Cancer
10	Tsujii	1941	53	좌	T8	Dura-constriction					Neurinoma

11	Oka	1943	16	우	C2-3	Foramen-constriction					Neurinoma
12	Koizumi Muto	1943	40	좌	C1-2	Foramen-constriction	Normal	Normal			Neurinoma
13	Koshiba Nariuchi	1948	25	우	T10-11	Dura-& Foramen-constriction		Enlarged			Neurinoma
14	Mitsuyasu Nishio	1950	26	좌	T6-7	Dura-& Foramen-constriction	Enlarged	Enlarged			Fibroma
15	〃	〃	15	우	T7-8	Foramen-constriction	Enlarged	Enlarged			Neurinoma
16	〃	〃	19	좌	T12-L2	Foramen-constriction	Enlarged	Enlarged			Neurinoma
17	〃	〃	14	좌	T6-7	Foramen-constriction					Neurinoma
18	Hasegawa	1951	35	우	T5-6	Foramen-constriction	Enlarged	Enlarged			Meningioma
19	Kambara	1952	46	우	T3-5	Foramen-constriction	Enlarged				Hemangioma
20	Honda Sato	1953	37	좌	T11	Dura-& Foramen-constriction					Neurinoma
21	Munakata	1953	15	좌	T5-6	Foramen-constriction					Neurinoma
22	Aoki	1953	57	좌	C2-3	Foramen-constriction					Neurinoma
23	Mori Osuda	1954 1957	43	좌	C5-6	Dura-& Foramen-constricton		Enlarged		(+)	Neurinoma
24	Ikari	1955	13	좌	T8-10	Dura-& Foramen-constriction	Enlarged	Enlarged		(+)	Neurinoma
25	Yamamoto	1955	18	우	T1-3	Foramen-constriction	Enlarged	Enlarged			Neurinoma
26	〃	〃	17	좌	T7-8	Foramen-constriction	Enlarged	Enlarged			Neurinoma
27	〃	〃	13	좌	T8-9	Foramen-constriction	Enlarged	Enlarged		(+)	Neurinoma
28	Miura Endo	1955	47	좌	T5-6	Dura-constriction	Normal	Normal			Neurinoma
29	Kawaguchi Ueki	1956 1958	63	좌	T11-12	Dura-& Foramen-constriction	Normal	Normal			Neurinoma
30	Hatakeyama Kusumoto	1956	37	좌	T8	Dura-constriction	Normal	Normal			Meningioma
31	Nojima Fukuda	1957	43	우	T	Dura-constriction					Neurinoma
32	Suzuki, the others	1957	29	우	L1-2	Foramen-constriction					Meningioma
33	Nishi Watabe	1958	17	우	T7-8	Foramen-constriction			Erosive		Neurinoma
34	〃	〃	58	우	T3-4	Foramen-constriction				(+)	Neurinoma
35	Ito Ishikawa	1958	42	좌	T12-L1	Foramen-constriction	Enlarged	Enlarged			Neurinoma
36	Yamakawa	1959	29	우	L						
37	〃	〃	27	우	C						
38	〃	〃	21	좌	L						
39	Araki Terajima	1959	33	좌	T7-8	Dura-constriction					Neurinoma
40	Harada	1960	28	우	T9-10	Dura-& Foramen-constriction	Normal	Normal			Neurinoma
41	Horiki, the others	1960	5	좌	T5-6	Foramen-constriction	Enlarged	Enlarged			Ganglio-neuroma
42	Kato	1961	30	우	C7-T1	Dura-& Foramen-constriction	Normal	Normal			Neurinoma
43	Kinoshita Honma	1962	18	우	T7-8	Foramen-constriction					Neurinoma
44	〃	〃	12	좌	L2-3	Foramen-constriction					Neurinoma

excluded. It is because the incomplete type, remaining whithin the intervertebral foramen, belonged to the dura- and foramen-constriction group, but it is no wonder that the foramen-constriction group is less, because, in general, the intradural tumour is more frequent than the extradural one.

In view of vertical localization of our dumb-bell tumours, 8 are cervical cases, 10 thoracic, and 1 lumbar. Cervical dumb-bell tumours hold the first rank, if the secondary dumb-bell tumours are excluded. In our series of 93 operated spinal cord tumours, the cervical tumours are 30, the thoracic are 40, and the dumb-bell tumour seems to be more frequent in the cervical region, although the cervical dumb-bell tumours are only 6 cases out of 44 dumb-bell tumours in Japan.

ELSBERG (1925) quoted RAVENEL as describing that the length of the cervical cord was 10cm (23 per cent), that of the thoracic was 26cm (58 per cent), and that of the lumbosacral was 8.5cm (19 per cent), and presented that his own incidence of the spinal cord tumours was 32 in the cervical, 54 in the thoracic, and 14 in the lumbosacral region, and concluded that incidence of the spinal cord tumour was proportionate to the length of the spinal cord and there was no special localisation frequently involved. Since then the dumb-bell tumour has been also thought to have no special favorite localization but to be proportionate to the number of the spinal cord segments, as a common spinal cord tumour does. Prof. IWAHARA (1956), however, described that the spinal cord tumours were frequently discovered in the cervical and lumbar ampulla of the cord.

Most dumb-bell tumours are neurinomas, originated from the tissues related to the nerve root. Therefore, it is considered that there are particular sites frequently occupied by the dumb-bell tumour, from the view point of the length and direction of the nerve root to the foramen, shape of the foramen, and condition of the dura mater, as well as number and quantity of the roots.

Because of the special shapes of the dumb-bell tumour, many authors have discussed as to whether development of the tumour was centripetal or centrifugal to the spinal cord. BOERNER (1902) reported a case which was thought to be centripetal, but GULEKE (1922) and BORCHARDT (1926) respectively described it as centrifugal. COENEN (1927), on the other hand, dated the origin of the tumour to the stage prior to the growth of the vertebral canal and the dura mater, and was confident that the tumour will grow to be spherical, if there were no obstacles; but it became to the dumb-bell shape, hindered by the dura or the vertebral canal which grows later. HEUER (1929) agreed to this opinion.

The dumb-bell tumours, however, have various shapes, some of them seemed to be centripetal (case 11), some are thought to be centrifugal (case 2, 3, 5 and 6), and some are considered to support COENEN'S theory (case 12 and 13). It may be reasonable to assume that as the tumour is growing to all direction, like a tumour in general, the dura or the vertebral canal just happens to disturb its growth making it dumb-bell shape, and to think that its growth is neither centripetal nor centrifugal, being dazzled by its peculiar shape. When and where does the dumb-bell tumour originate from, is unknown so as a tumour in general does.

The reason why the dumb-bell tumour is treated as a particular group of the spinal cord tumour may be that its frequency is rare, that a part of the tumour is sometimes

remained unremoved by operation, and that its X-ray findings shows special figures.

GULEKE (1930) mentioned roentgenographic charcteristics of the dumb-bell tumour : 1) enlargement of the intervertebral foramen, 2) enlargement of the vertebral canal, 3) erosion of the vertebral body, 4) opacity in the paravertebral spaces, and recommended stereoscopy of the spine.

These characteristics, however, are not always particular to the dumb-bell tumour, and not always seen in every type of the dumb-bell tumour. In some of the spinal cord tumours in general, ELSBERG-DYKE'S curve sometimes shows enlargement of the vertebral canal or the interbertebral foramen, in addition, it is no wonder that enlargement of the foramen is not proved in the dura-constriction group, which does not extend into the foramen. In fact, 2 cases out of 3 dura-constriction group do not show enlargement of the foramen in X-ray. And in some of its incomplete type of the foramen-constriction group enlargement of the foramen are not seen.

It may be statistically insignificant to show the correct percentage as my cases of dumb-bell tumours are so few, but the X-ray characteristics of each group of the dumb-bell tumour, in the typical case, may be recapitulated as follows ; in the dura-constriction group the spinal canal is enlarged but the foramen is normal, in the foramen-constriction group enlargement of the foramen is more remarkable than that of the spinal canal and opacity is shown in the paravertebral spaces, in the dura- and foramen-constriction group both the spinal canal and foramen are enlarged and paravertebral opacity is seen, and in the vertebral body eroding group erosion or compression is visible within the vertebral body but contour of the body is intact.

Of course, enlargement of the foramen and the spinal canal or erosion of the bodies will be made not only by compression of the tumour, but also by the influences of the quality of the tumour or other factors. Those changes, however, most frequently appearing in the existence of the tumour are believed to provide one of the most conclusive evidences as to what group that particular dumb-bell tumour belongs.

CONCLUSION

1) On the basis of 19 operated cases of the dumb-bell tumour at our clinic, they were classified into 5 groups ; the dura-constriction group, the foramen-constriction group, the dura- and foramen-constriction group, the vertebral body eroding group, and the another group (the laminae-constriction group and complicated group.).

2) Out of 93 operated spinal cord tumours at our clinic, 19 cases (20.4 per cent) were the dumb-bell tumour. It is considered that dumb-bell tumours are not so rare conditions, if the incomplete types are included to the dumb-bell tumour.

3) It was observed that dumb-bell tumours grew frequently at the level of the ampulla of the spinal cord.

4) Roentgenographic characteristics of a dumb-bell tumour are enlargement of the vertebral canal and the intervertebral foramen, erosion of the body, and paravertebral opacity.

These characteristics are not always seen in every type of the dumb-bell tumours. However, these changes most frequently appearing in the existence of the tumour are believed to provide one of the most conclusive evidences as to what group that particular

dumb-bell tumour belongs.

I would like to express my grear thanks to Prof. Torai Iwahara, Department of Orthopedic Surgery, School of Medicine, Keio University.

References

1) Borchardt, M. : Bemerkungen zu den sogenannten Sanduhrgeschwülsten des Rückenmarkes und der Wirbelsäule. Klin. Wschr. **5**, 636-642, 1926.
2) Boerner, E. : Über Fibrome des Halses mit Beziehungen zum Rückenmark. Dtsch. Z. Chir. **67**, 309-320, 1902.
3) Coenen, H. : Die Entstehung und Entwicklung der Sanduhrgeschwülste an der Wirbelsäule und der hantelförmigen Lipome desThorax. Dtsch. Z. Chir. **203-204**, 71-92, 1927.
4) Dandy, W. E. : The diagnosis and localization of spinal cord tumours. Ann. Surg. **81**, 223-254, 1925.
5) Eden, K. : The dumb-bell tumours of the spine. Brit. J. Surg. **28**, 549-570, 1941.
6) Elsberg, C. A. : Tumours of the spinal cord, 1925. Hoeber, New York.
7) Guleke, N. : Über eine zu den Sanduhrgeschwülsten der Wirbersäule gehörige Gruppe von Wirbelsarkomen. Arch. Klin. Chir. **119**, 833-844, 1922.
8) Guleke, N. : Zur Diagnose der Sanduhrgeschwülsten der Wirbersäule nebst Bemerkungen über deren Entstehung. Arch. Klin. Chir. **161**, 710-720, 1930.
9) Heuer, G. J. : The so called hour-glass tumors of the spine. Arch. Surg. **18**, 935-981, 1929.
10) 伊藤　原：砂時計形ヲ呈セル二次性脊髄硬膜外腫瘍ニ就テ，日整会誌，**10**，208-226，昭10.
11) 岩原寅猪：「ミエログラフィ」ト脊椎及脊髄外科知見補遺，脊髄硬膜外腫瘍ニ就テ，日整会誌，7，303-316，昭7.
12) 岩原寅猪；日本外科全書，12巻，金原出版・南江堂，東京，昭31.
13) 神中正一・生田有年；脊髄砂時計腫に就て，グレンツゲビート，**7**，1-18，昭8.
14) 菅　千里；砂時計腫ヲ形成セル大ナル脊髄「ノイリノーム」ノ一手術治験例，日外会誌，**37**，118-126，昭11.
15) 加藤　正；頸・胸・腰髄部3ヶ所に発生し，異なる病理組織像を示した脊髄腫瘍の1例，整形外科，**12**，180-184，昭36.
16) 小泉次郎・武藤春雄；剔出後脊髄液瘻を形成した砂時計腫の治験，外科，**7**，677-688，昭18.
17) 小柴清定・成内頴三郎；硬膜及び椎管により重複絞扼せられたる脊髄砂時計腫治験並にその診断に就て，日整会誌，**21**，59-64，昭23.
18) 小川　寿；脊髄腫瘍の病理並に臨床的研究，医学研究，**28**，2258-2271，昭33.
19) Shephard, R. H. and Sutton, D. : Dumb-bell ganglioneuroma of the spine with a report of four cases. Brit. J. Surg. **45**, 305-317, 1958.
20) 所　安夫；脳腫瘍，医学書院，東京，昭34.

和文抄録

いろいろの形の脊髄砂時計腫

慶応義塾大学医学部整形外科学教室（主任：岩原寅猪教授）
細川昌俊

慶大整形外科において昭和37年までに93例の脊髄腫瘍患者を手術したが，その中19例即ち20.4％が砂時計腫である．その19例を基として砂時計腫を絞扼場所によつて，1）硬膜絞扼形 2）椎間孔絞扼型 3）硬膜椎間孔二重絞扼型 3）椎体侵入型 4）その他（椎弓絞扼型，複合型）に分け，更に腫瘍の形によつてそれぞれの完全型，不全型及び亜型に分けて述べた．

この分類によれば我々の19例は，硬膜絞扼型3例，椎間孔絞扼型7例，硬膜椎間孔二重絞扼型7例，椎体侵入型2例である．

従来，脊髄砂時計腫は比較的稀で，特にいわゆる二重絞扼型は稀とされているが，不全型を含めれば共に必ずしも稀ではない．

また，脊髄砂時計腫は一般脊髄腫瘍と同様，好発高位がなくその発生分布は脊髄々節数に比例するとされていたが，我々の症例では頸部および腰部膨大部に好発する傾向が見られた．

砂時計腫レントゲン像の特長として，1）脊椎管の拡大 2）椎間孔の拡大 3）椎体の萎縮・破壊・圧痕像 4）椎体側方の腫瘍陰影像等があげられるが，これらは総ての砂時計腫に見られるものではなく，逆にこれらの所見の組合わせによつて砂時計腫がいかなる型に属するかを推定し得ると思われる．