

Prosthesis for an Excised Lumbar Vertebra: A Preliminary Report

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THE purpose of treatment when a vertebra is infiltrated by tumour (usually metastatic) has been to relieve pain and to prevent further bone destruction. Vertebral collapse may produce paralysis; in an effort to prevent it complete immobilization of the patient is eventually required. The traditional measures available have been limited to anodynes, leg traction, irradiation, complete rest in bed and sometimes hormones. Direct operative treatment in the region of the lesion has been limited to laminectomy for the relief of pressure on nerve roots or on the spinal cord.

I report here a method whereby, after excision of a lumbar vertebra and the adjacent intervertebral discs, a metal prosthesis is used; stabilization of the spine is reinforced by another metal prosthesis applied posteriorly to the spinous processes, one above and one below the excised area.

Experiments on cadavers with various forms of replacement were carried out so that the prosthesis could be introduced without injury to the dural sac and its contents. To determine the range of variations in the spaces to be occupied by the prosthesis, 10 adult males and females, ranging in height from 5 feet to 6 feet 3 inches, had radiographs of their lumbar spines. The minimal and maximal lengths were used as guides in deciding on the range of adjustment required in the prosthesis; these were found to be 4.2 cm. and 5.0 cm. respectively.

The one-piece semicircular prosthesis finally developed (Fig. 1) is made of stainless steel 316. With the patient in the prone position the spinal area is exposed through a posterior approach and the entire affected vertebra is excised. The prosthesis is then slipped into place from one side or the other; this requires transection of one nerve root. While the prosthesis is being inserted the open end faces the dura; then it is rotated 180°. The three pillars are all adjustable and with wrenches can be widened to fill the gap while the patient is prone. (It is expected that a prosthesis of one size can be used for any normal adult). The screws are then rotated and by insertion into the bodies of the

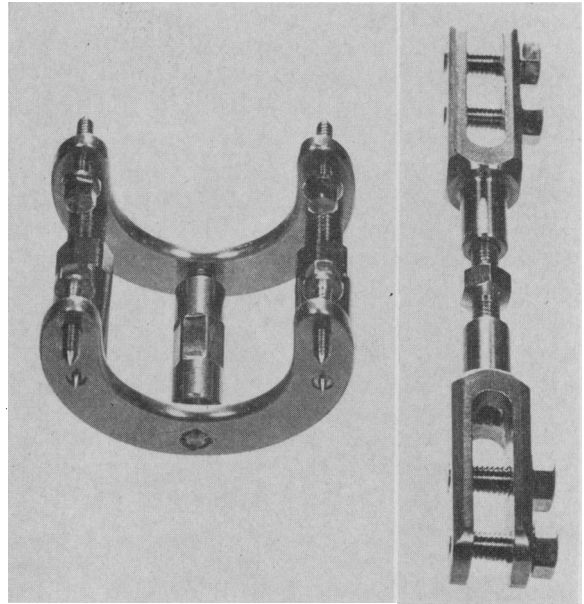


Fig. 1

Fig. 2

Fig. 1.—The prosthesis that replaces the vertebral body (left). Fig. 2.—The prosthesis that is placed over the spinous processes of the vertebrae above and below the excised area (right).

vertebrae, above and below, fix the prosthesis in place. The posterior component of the pro-

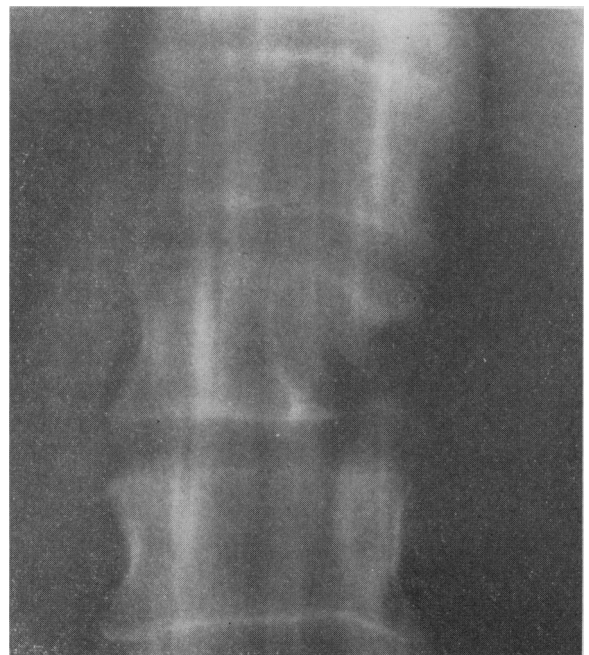


Fig. 3.—Case 1. Anteroposterior view from a tomogram series illustrating the infiltration of the body of the vertebra.

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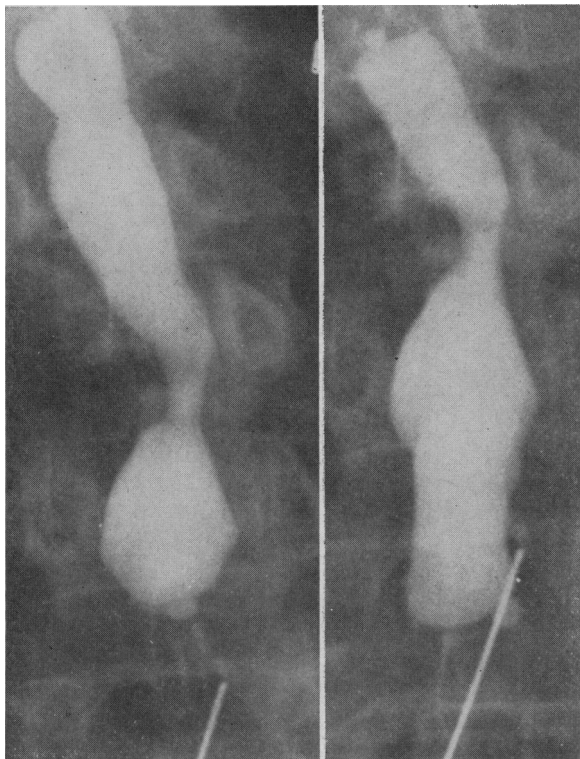


Fig. 4.—Case 1. Preoperative myelogram.

thesis is much simpler (Fig. 2). It is screwed to the base of the spinous processes and in this position abuts against the roots of the laminae. The length can be adjusted with a wrench.

CASE REPORTS

CASE 1.—A 65-year-old man complained of back pain radiating down the right leg. Clinical examination did not show any abnormality except an absent right knee jerk. Radiographs and tomograms of the spine showed a lesion involving the body of the second lumbar vertebra (Fig. 3). A myelogram showed a large filling defect at the same level, especially on the right side (Fig. 4). Extensive investigations, including an x-ray survey of his bones, did not show any other lesion. Kidney, bowel and lung involvement was also excluded. During these investigations total collapse of the affected vertebra appeared imminent, so that complete rest in bed in hospital for two weeks was enforced while preparations were made for operation.

During this period a serum protein electrophoresis showed reduced normal gamma globulin and a protein of altered mobility, probably a monoclonal gamma globulin. The presence of this abnormal constituent was confirmed by immunoelectrophoresis.

At operation on August 2, 1968, the tumour was more extensive than the radiological and clinical examinations had suggested. A mass about 4 cm. in diameter which involved the right nerve root was removed. The infiltrated vertebra was then excised. The radiograph taken subsequently is shown in Fig.

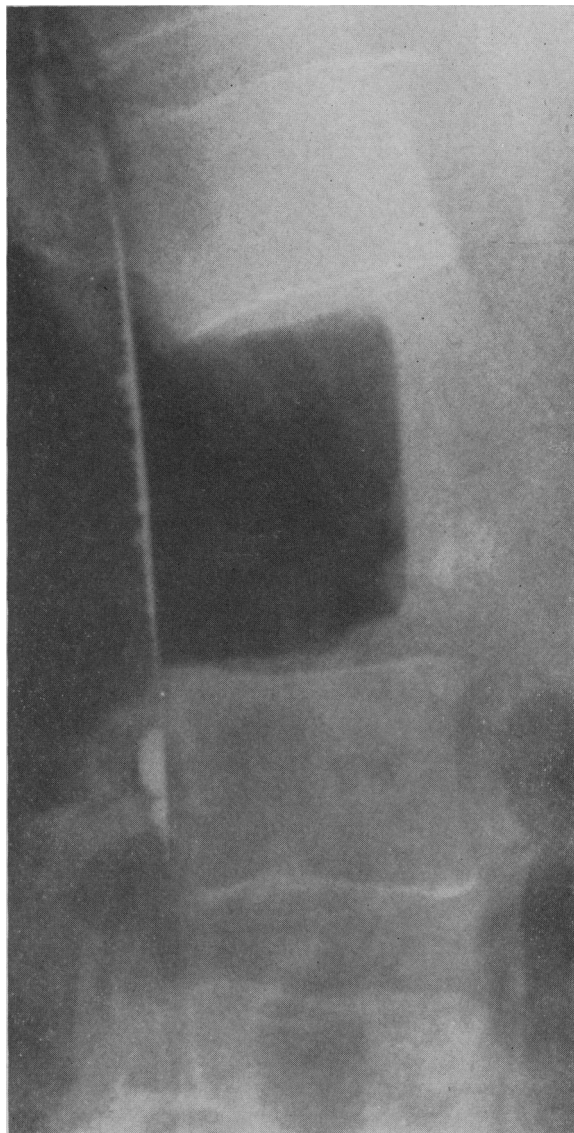


Fig. 5.—Case 1. Radiograph taken during the procedure when the excision is almost completed (lateral view). The remains of radio-opaque substance in the dural sac can be seen as a straight line.

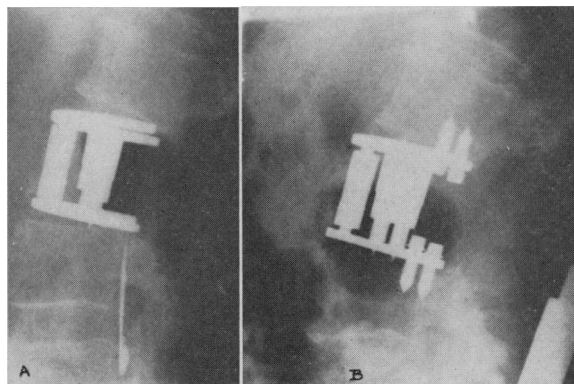


Fig. 6a.—Case 1. Showing the anterior component of the prosthesis just introduced into the cavity during the operation.

Fig. 6b.—Case 1. Radiograph taken the day after the operation with the patient in the prone position, showing the metal screws in place.

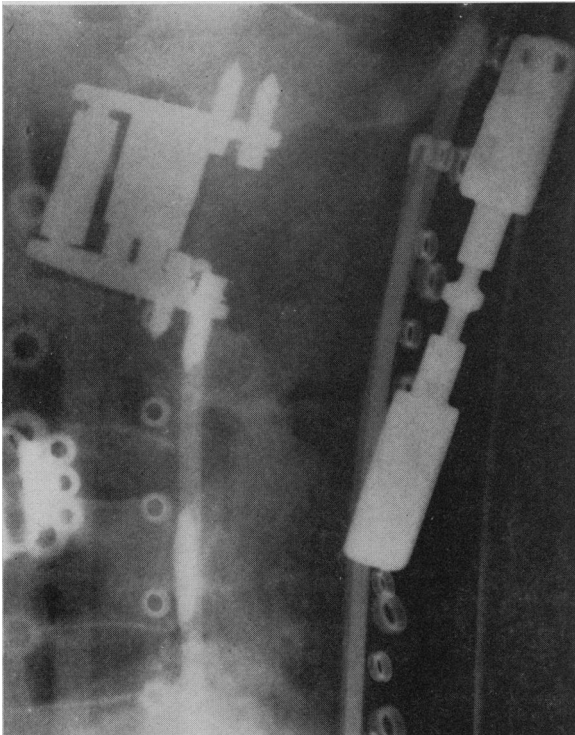


Fig. 7.—Case 1. Radiograph taken on the eleventh day with the patient sitting.

5. The anterior part of the inserted prosthesis before the screws were applied is shown in Fig. 6a; Fig. 6b shows the screws in place.

Pathological examination showed an atypical tumour; it was composed of large masses of rather featureless syncytial cells, but in other large areas

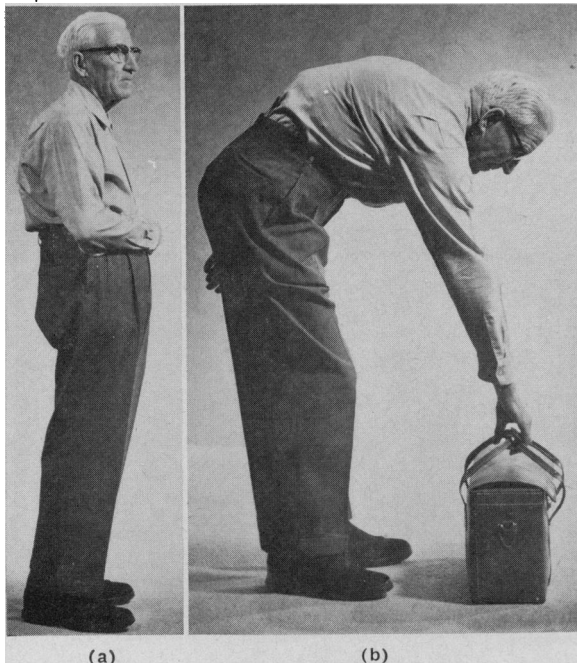


Fig. 8.—Case 1. (a) Patient standing; (b) patient bending forward to pick up an object.

of the sections examined the cells were of plasma cell origin. The consensus of many pathologists was that the tumour was an atypical solitary myeloma (plasmacytoma).

On the first postoperative night the patient complained of pain in his back and right leg, but thereafter he was free from pain and remained comfortable. Motor, sensory, bladder and bowel functions were unaffected and no neurological deficit was evident. A lumbosacral support was applied when the patient was allowed to sit up on the ninth postoperative day. An x-ray film taken while the patient was sitting up on the eleventh day is shown in Fig. 7. He gradually increased his activities and was allowed to climb steps before he was discharged from hospital. During the eighth postoperative week he went for walks around his house, and by about the eleventh week he was able to walk about a mile a day. He also started to do some gardening. About the same time, he was able to flex his legs to tie his shoes while he was in a sitting position, and also was able to pick up objects from the floor from a standing position (Figs. 8a and 8b). He soon drove his car and went back to his job, which does not involve any heavy lifting but does require a considerable amount of driving.

Serum protein electrophoresis three months after the operation showed complete disappearance of the abnormal protein previously present; a normal gamma band persisted. This result was confirmed by immunoelectrophoresis. This patient has occasional discomfort in his back muscles but requires little sedation and is still working full-time. When last seen on January 25, 1969, he appeared to be well.

CASE 2.—A 75-year-old man was seen in June 1966 because of severe low back pain. At that time his spine movements were limited in all directions. No abnormal neurological findings were recorded. He was admitted to hospital for further investigations, including radiographs of the lumbosacral vertebrae; only degenerative changes were reported. His symptoms improved while in hospital and he was discharged.

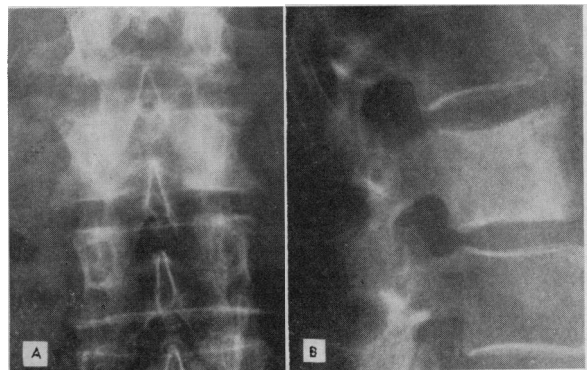


Fig. 9a.—Case 2. Anteroposterior view of lumbar spine showing sclerotic lesion at L2.

Fig. 9b.—Case 2. Lateral view of lumbar spine showing sclerotic lesion of L2.

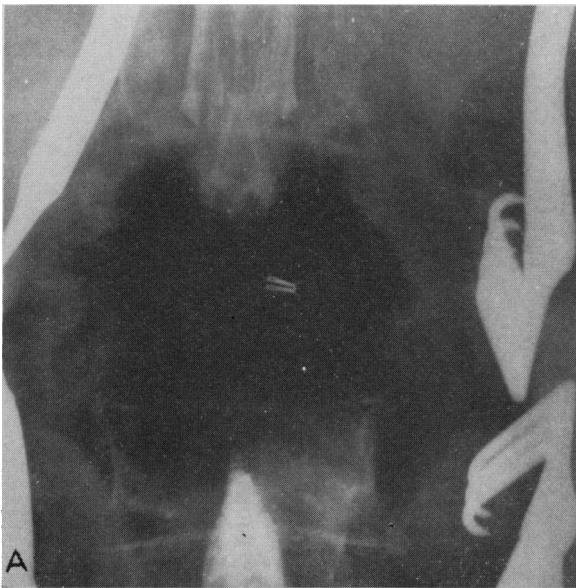


Fig. 10a.—Case 2. Radiograph taken during the operation towards the end of excision (A.P. view).

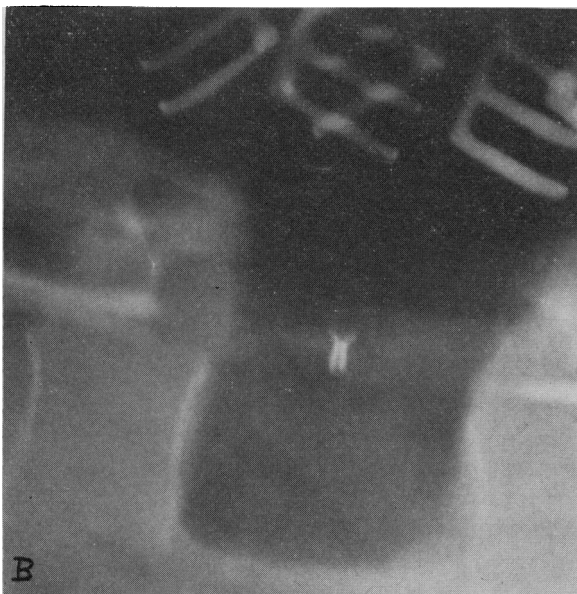


Fig 10b.—Case 2. Lateral view.

In December 1965 a retropubic prostatectomy had been performed, but the pathological report could not be obtained. However, as far as we could ascertain, a malignant growth had not been found. In March 1966 he had again been admitted to hospital, on this occasion for a modified radical mastectomy because of a right breast tumour; after pathological examination this was reported to be epithelial hyperplasia (mazoplasia).

In July 1967 his back pain increased and radiographs of the lumbar vertebrae showed a sclerotic lesion involving the body of L2 (Figs. 9a and 9b). This was diagnosed as a metastatic lesion, possibly from an overlooked malignancy of the prostate or

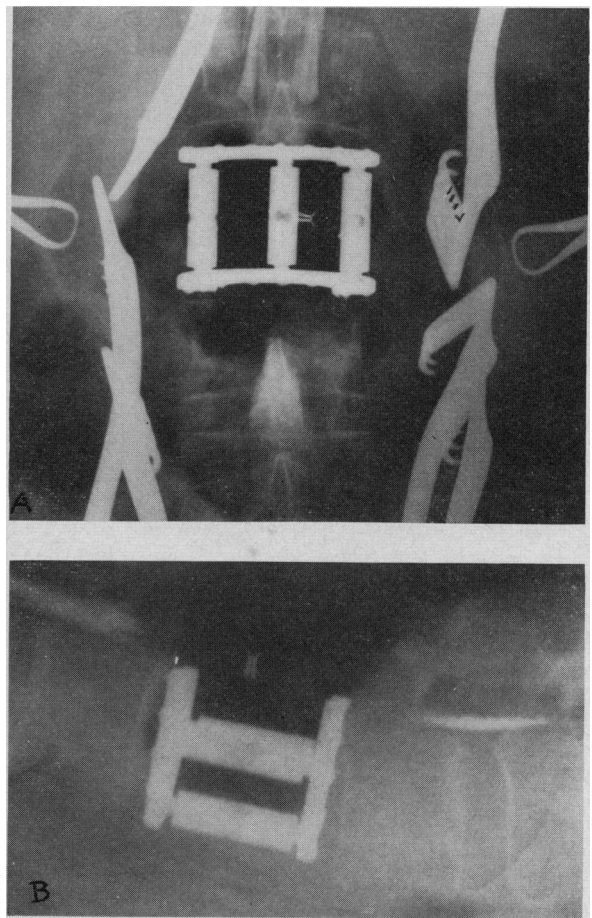


Fig. 11.—Case 2. Showing the anterior component of the prosthesis just introduced: (a) A.P. view; (b) lateral view.

breast. Because of this uncertainty, diethylstilbestrol was not used. No other treatment was given until the patient's back pain increased to a degree that readmission to hospital was required, in August 1968.

The neurological examination still did not show any gross motor or sensory impairment and in spite of his age the patient appeared to be in fairly good physical condition. The cerebrospinal fluid showed a protein content of 25 mg. per 100 ml. but no leukocytes. Myelography showed narrowing of the dural sac of L2 both in the anteroposterior and lateral views. It was decided that the lesion could be removed and the whole vertebra replaced with a prosthesis. On October 28, 1968, a laminectomy was performed at the L2 level which disclosed that the tumour extended from one side to the other in front of the dura. The infiltrated body of L2 was excised along with the discs above and below, and the right nerve root was sectioned between two metal clips (Figs. 10a and 10b). The intervertebral prosthesis was then introduced, and afterwards the posterior prosthesis was applied (Figs. 11a and 11b).

Postoperatively the patient exhibited extreme mental confusion which was thought to be due to his age and/or cerebral ischemia. However, he did

not seem to be in any severe pain; he retained his motor, sensory, bowel and bladder functions; no other neurological deficit was apparent. A few days following the operation and before any decision had been made about his activities, he got out of bed one evening and walked to the bathroom without any assistance. Radiographs of his lumbar spine were obtained immediately to see if this very early mobilization might have displaced the prosthesis. Fortunately no abnormality was detected and his activities were encouraged from then on. He needed support and reassurance when walking, and this was achieved with the help of the physiotherapist; he soon walked alone without any assistance. His mental condition also improved and he was rational enough to be discharged to a rehabilitation hospital where he stayed for a few weeks before going home. When last seen in the first week of February 1969 his condition appeared satisfactory.

The pathologist's report on the lesion described a fibrin base with some attached connective tissue in which were numerous small round eosinophilic cells; some of these were arranged in a glandular pattern. The lesion was considered to be an adenocarcinoma, metastatic from an undetermined primary growth.

DISCUSSION

This is a preliminary report of treatment of two patients who had progressive infiltration of vertebral bodies by tumour, with increasing pain and disability. Detailed clinical descriptions have not been included. Because the involved vertebrae can be removed and a prosthesis used successfully, these unfortunate patients were able to avoid being immobilized in bed in a plaster cast or with traction. This type of management may offer a means of preventing severe neurological impairment with all the misery (in addition to immobility) which this causes such patients. Despite the progress of a malignant process elsewhere in the body and the shortening of life expectancy, the possible palliation offered by this procedure is valuable in my opinion. The sacrifice of one nerve root poses no problem for the patient.

The performance of the procedure using the posterior approach may help in decompressing the dural sac, in the removal of any intraspinal extension of the tumour and in the decompression

of nerve roots. The access to the body of the vertebra in the lumbar region is not too difficult by such an approach. Perhaps for a similar procedure in the cervical region one should consider the anterior approach for the removal of the vertebral body and, if necessary, a posterior approach as well in order to remove any tumour in the canal or involving the nerve roots.

Although metal plates applied along the sides of spinous processes or over anterior surfaces of vertebral bodies have been used extensively in fixation of spine fractures and/or dislocations, they have never been used in this manner in tumour cases. Until recently attempts to remove a vertebra have been rare. In 1967 Scoville *et al.*¹ reported two cases in which the threatened collapse of a vertebra because of metastases was treated by wiring the laminae and spinous processes of the vertebrae above and below the lesions, followed by the application of acrylic plastic over the wired mesh. The spinal column was thus stabilized but there was no attempt to remove the vertebra. However, they also described another case in which they excised the bodies of the fourth and fifth cervical vertebrae and replaced them with acrylic plastic;¹ this patient was immediately relieved of his neurological symptoms but died on the 15th post-operative day from pneumonitis.

I believe that a metal prosthesis has distinct advantages over an acrylic one. When the latter is used, the heat of polymerization can damage sensitive nerve structures and vessels if the acrylic comes in contact with these without being constantly cooled.¹ If a complication such as infection were to occur, acrylic plastic could not be removed, whereas it should be possible to remove a metal prosthesis, at least temporarily. The use of these prostheses could be considered for traumatic cases in which severe crushing of a vertebra is produced.

I wish to acknowledge the assistance of Richard Alexander, Vice-President of Kenna Metals of Canada. Without his knowledge and skill as a metallurgist the development of the prostheses might not have been possible.

REFERENCE

1. SCOVILLE, W. B. *et al.*: *J. Neurosurg.*, 27: 274, 1967.