

Ceramic Prosthesis of the Cervical Vertebra in Metastatic Tumor of the Spine

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Abstract

Vertebral body replacements with newly-designed ceramic prostheses were successfully applied in eight patients with metastatic tumors and multiple myelomas of the cervical vertebrae. All patients suffered from severe neck pain and/or paralysis due to a collapsing of the vertebral body in the preoperative state. As a result, seven patients had an improvement of their severe neck pain and neurological deficits for at least more than 2 months. The remaining one had some relief of complaints, but for only a short period. It was concluded that this surgical procedure seemed beneficial for the patients, in order to live the rest of their limited life comfortably even if it is only a palliative method.

Introduction

The prognosis of patients with metastatic tumor of the spine is poor. The principle thought, regarding the treatment of these patients lies in how they can prolong the remainder of their life expectancy and live a comfortable life. Even by palliative treatment, it is beneficial to relieve temporarily unbearable pain or paralysis symptoms and to enable the patients to leave their beds as soon as possible and then to improve activities of daily life. Acrylic plastic prosthesis was first used for vertebral body replacement in cases of metastatic disease of the spine by SCOVILLE, et al.⁶⁾, and several other materials such as metal or acrylic cement has been tried as a cervical vertebra prosthesis. We are reporting on eight cases in which a newly designed ceramic prosthesis was successfully replaced for the collapsing vertebra caused by metastatic tumors and multiple myelomas.

Materials and Methods

Vertebra Prosthesis (Figure 1.)

The ceramic prosthesis which was originally designed by ONO et al.⁴⁾ was re-designed and

Key words: Vertebral prosthesis, Ceramic prosthesis, Cervical tumor, Metastatic tumor, Vertebral body replacement

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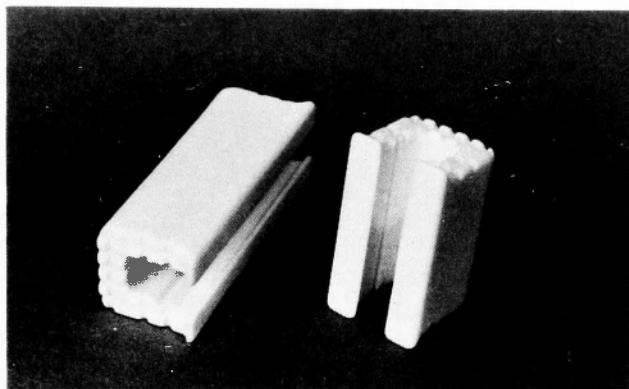


Fig. 1. Ceramic prosthesis
Various size of height, width and depth of the prosthesis is available in the operating room.

improved according to our specifications, and was manufactured by Kyoto Ceramic Co., Ltd. It is a vertical U- and box-shaped structure with sufficient space inside. Ditches are made on the upper and lower surface to get a bony ingrowth from the vertebral body and to acquire more stability. Flanges are attached to prevent the sinking of the prosthesis backward into the spinal canal and also to greater stabilize the acrylic cement anchoring in the prosthesis and vertebral body. The prosthesis has been prepared for various sizes of height (for every 0.5 cm), width and depth (two types) in the operating room to fit in the most adequate way for each individual.

Surgical Procedure (Figure 2.)

Laminectomy should be carried out in proceeding if necessary. The operation of the prosthetic replacement is performed by the anterior approach. The collapsed vertebral body is removed with rongeurs and curettes, exposing the posterior longitudinal ligament. Annulus and discs were also removed from the upper and lower disc space of the affected vertebra. The pedicle and articular process should be remained. otherwise massive bleeding will be encountered. Then the anchor hole was made in the lower and upper surface of the adjacent vertebrae. A ceramic prosthesis was inserted under the skull traction and anchored in place by filling the space with methyl methacrylate as an anchoring cement. The spinal cord was protected by application of cold saline irrigation for several minutes from the brief heat during polymerization of the cement. Assuring that the stability was regained, the wound was then closed. Within a week after the operation, the patients were allowed to walk around with a neck brace which was worn for at least one month.

Indication

All patients, who suffered severe radiating pain of the neck and extremities with or without radiculo-myelopathy (paraplegia) were examined roentgenographically to find if they had a collapsing cervical vertebra. ^{99m}Tc -bone scannings were also employed as a routine examination to show whether further spreading of the metastatic lesion had occurred. Evaluation was thus carried out for the operative indication in the cases where the lesions were limited to one, two or

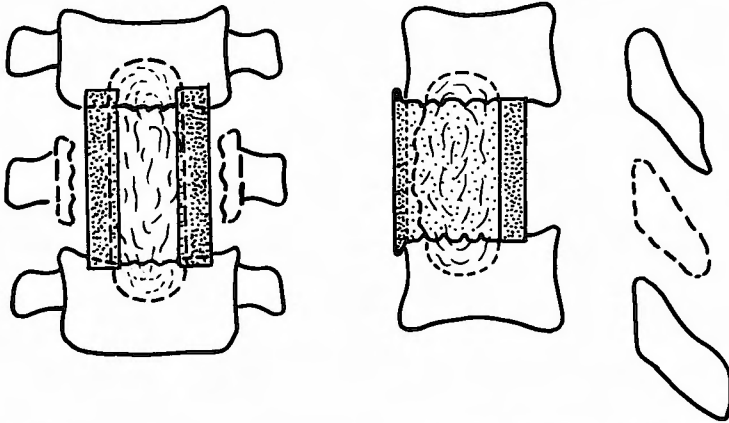


Fig. 2. Schema of ceramic prosthetic replacement (frontal and lateral view)
Following removal of the collapsed vertebral body, the prosthesis is inserted and anchored with acrylic cement in place.

three consecutive vertebral bodies in the cervical spine and that the patient's activity demanded more than only bed rest. Cases of more than four consecutive vertebra had been damaged, were not included for the indication because the lesion was too big an area to regain enough support.

Case presentation

Case 1: Multiple myeloma (76 year-old man)

The patient visited our hospital with gait disturbance on November 22 in 1982 with a history of severe pain for a period of five months.

Physical examination revealed motor disturbance in the left limbs and right hemihypesthesia below the fourth cervical dermatome. Examination of blood showed the increases of erythrocyte

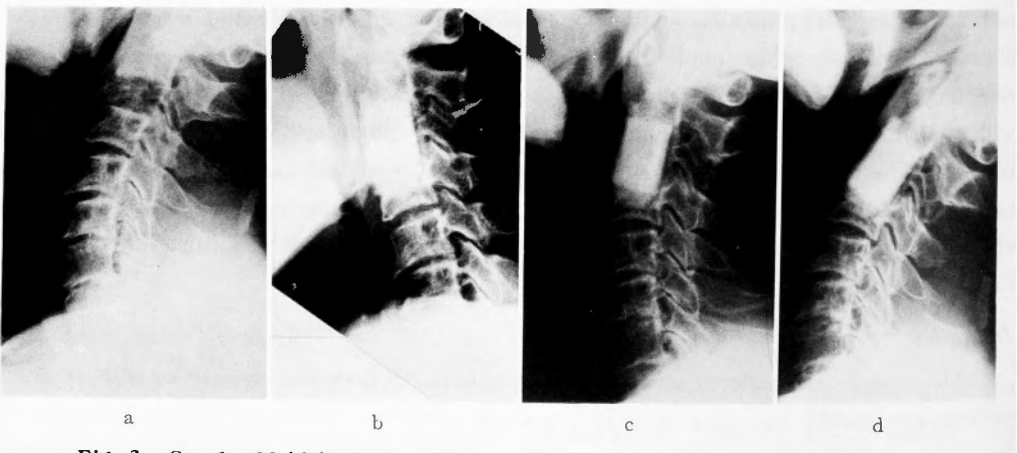


Fig. 3. Case 1. Multiple Myeloma (76 year-old man)
Lateral view of the preoperative X-ray shows collapsing of the C3 vertebrae (a). X-ray on flexion (b), natural (c) and extension (d) revealed a good stability of the cervical spine, 4 months postoperatively.

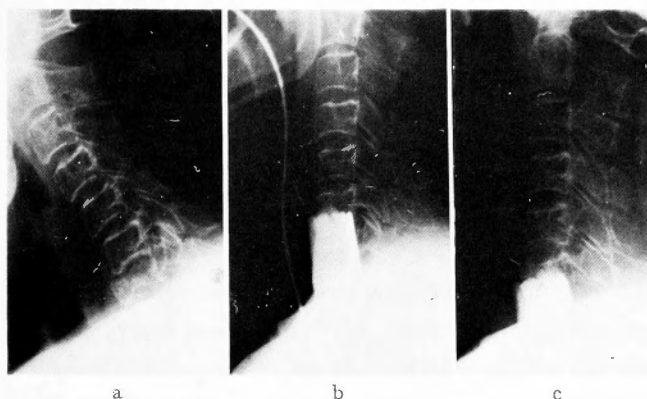


Fig. 4. Case 2. Metastatic breast cancer
The collapsed C7 vertebra (a) was successfully replaced by ceramic prosthesis (b),
but another collapsing of C6 (c) were observed two months postoperatively.

sedimentation rate, serum protein, and IgG.

Roentgenogram showed a destructive lesion of the third cervical vertebra (Fig. 3a). ^{99m}Tc -MDP scintigram showed a remarkable high uptake lesion at the same level of the spine. Myelogram demonstrated a complete block at the C2/3 level.

A two stage operation was indicated. First, a laminectomy for the decompression of the spinal canal was performed and then the affected vertebral body was anteriorly removed, and replacement with a ceramic spacer was performed. Right after the operation, the severe pain disappeared. One week later a brace was applied and gait exercise was allowed. Paralysis found in the preoperative state was remarkably improved. X-ray on flexion and extension revealed a good stability of the cervical spine, 4 months postoperatively (Fig. 3b, c, d). The patient lived a comfortable life without neck pain or neuralgia until he died 13 months later.

Case 2: Metastatic breast cancer (53 year-old woman)

She underwent mammectomy due to the breast cancer on March 23 in 1982. She visited our clinic on April 7 in 1983 with a history of increasing pain on the left shoulder and arm for one month prior to numbness in the left upper limb.

Physical examination revealed sensory disturbance of ulnar side of the left upper limb and motor disturbance in the left fingers.

Roentgenogram showed a collapsing of the C7 vertebral body (Fig. 4a). ^{99m}Tc -MDP scintigram showed no other significant findings.

After removal of the affected vertebral body, replacement with ceramic spacer was performed (Fig. 4b). After the operation, severe pain and numbness disappeared. One week later a brace was applied and gait exercise was begun. But one month later pain and paralysis recurred. Roentgenogram showed a collapsing of the C6 vertebral body at two months after the operation (Fig. 4c). It was suggested that this collapsing was due to a tumor invasion or more possibly a mechanical fracture between the hard consistency of ceramic and the osteoporotic vertebrae. She died of general deterioration 3 months after surgery.

Results

Cases for the operation and their results were summarized in table 1. Three were males and 5 females, whose ages ranged from 46 to 76. Level of the vertebral lesion were various and the number of vertebrae involved in each patient were one in 5 cases, 2 in 2 cases and 3 consecutive vertebrae in 1 case. Original primary lesion was clarified preoperatively in 6 cases, postoperatively in 1 case, and of unknown origin in 2 cases. Referring to symptoms and neurological findings, all patients had an unbearable pain in the neck as well as the shoulder and the upper extremity. The degree of paralysis varied, t.i. from a lesser degree of paralysis to a complete paralysis of the lower extremities. As a result, all of the patients benefited from the relief of pain right after the operation. 5 patients rarely had pain throughout the period of treatment. In two cases pain recurred at the end stage, and in one patient pain disappeared only one week after the operation, but then deteriorated gradually and steadily. Referring to paralysis symptoms, six cases recovered, but the second case recovered only for one month. In case 4, no improvement was observed but deteriorated gradually. The two surviving patients under chemotherapy at the present show no signs of recurrence of pain or paralysis which recovered markedly postoperatively. They are able to function in their daily life without any hindrances. Six patients died of deterioration of the systemic body condition in a period of 2 to 13 months.

Discussion

Our purpose for surgical treatment against the metastatic tumor of the cervical spine is to relieve pain, to regain a supportability and to improve a paralysis. It is difficult to expect a prolongation of life expectancy by this palliative treatment, but if good care is taken, the patient can live the rest of their lives without pain⁵⁾. This, we believe, is very beneficial for this type of patient.

There was a time when the posterior decompression and fusion had been used mainly for cases with metastatic tumor of the cervical spine, from a view point of a small aggression of this operation^{1, 2)}. Although, it is doubtful whether the sufficient decompression and enough supportability to improve complaints is possible through the laminectomy, which might accelerate furthermore the biomechanical fragility of the vertebral column. When the vertebral body is destroyed by the tumor, it seems reasonable to resect the tumor which might compress the spinal cord or roots to result in undurable pain or paralysis, and then to reconstruct the column to regain better supportability. This idea will be realized only when the best prosthesis is guaranteed for the reconstruction. Acrylic plastic was firstly applied by SCOVILLE, et al.⁶⁾ for replacement of a metastatic vertebrae. But since this material is only a filling material, it was not durable²⁾. After several trials and errors by metal prosthesis^{3, 4)}, ceramic prosthesis was employed by ONO because of its excellent tissue biocompatibility^{4, 7)}.

Ceramic prosthesis of our own modification has many advantages, such as the following;

- 1) The tissue biocompatibility is excellent and bone formation in the peripheral area for

Table 1. Cases of ceramic prosthetic replacement in cervical vertebrae

Case	Age	Sex	Vertebrae affected	Diagnosis	Symptoms	Neurological deficits	Pain after operation	Neurological function after operation	Survival
1	76	M	C3	Multiple myeloma	Neck pain	Gait disturbance; Motor disturbance in the lt. limbs; Rt. hemihypesthesia below the fourth cervical dermatome	Not a feature	Recovered	Died 13 months after operation
2	53	F	C7	Metastatic breast cancer	Lt. shoulder and arm pain	Sensory disturbance in the lt. upper limb; Motor disturbance in the lt. fingers	Relieved for 1 month	Deteriorated 1 month later	Died 2 months after operation
3	46	F	C3	Metastatic breast cancer	Neck pain	Motor disturbance in the bil. fingers; Weakness of grip	Relieved for 1.5 months	Recovered	Died 2 months after operation
4	68	F	C6	Metastatic lung cancer	Bil. shoulder and arm pain	Motor disturbance in the lt. limbs; Sensory disturbance in the lt. upper limb, rt. lower limb and trunk	Relieved for 1 week	Deteriorated	Died 2 months after operation
5	67	F	C4,6	Unknown origin (adenocarcinoma)	Bil. shoulder pain	Sensory disturbance in the lt. upper limb; Diminished power in the bil. upper limbs	Not a feature	Recovered	Died 2.5 months after operation
6	56	M	C6,7, T1	Unknown origin (adenocarcinoma)	Neck pain	Complete motor and sensory paraplegia; Anuria; Sensory disturbance below the eighth cervical dermatome	Not a feature	Recovered	Died 4 months after operation
7	57	M	C3	Multiple myeloma	Neck pain Bil. shoulder pain	Sensory disturbance in the rt. forearm; Weakness of grip	Not a feature	Recovered	Alive and well (15 months at present)
8	54	F	C3,4	Metastatic breast cancer	Neck pain	Sensory disturbance in the upper arm	Not a feature	Recovered	Alive and well (13 months at present)

better stabilization can be expected.

- 2) It has a low thermal conductivity in comparison with metals and can protect the spinal cord from the heat of polymerization of the bone cement.
- 3) Ditches and fringes on the ceramic prosthesis give better stability between the prosthesis vertebral bone and bone cement for anchoring.
- 4) The patients will not be interrupted the series of chemo- and radiotherapy, since he does not need to wait for the bony union in such as a case of bone graft. And also he can wake up right after operation.

In some patients who survived more than 3 months after the operation, a new bone formation could be observed by roentgenograph in an adjacent area to the ceramic prosthesis. Neither foreign body reaction nor infection was noted. This ceramic prosthesis was easy to handle, and reliable than imagined. Its use should be indicated to those patients whose general condition is relatively good enough to accept an operation and whose life expectancy will be at least more than 1 month.

References

- 1) Fielding JW, Pyle RN and Fietti VG: Anterior cervical vertebral body resection and bone-grafting for benign and malignant tumors. *J Bone Joint Surg* **61-A**: 251-253, 1979.
- 2) Lesoin F, et al: Use of acrylic prosthesis for a giant-cell tumor of the cervical spine. *Surgical Neurology* **17**: 358-362, 1981.
- 3) Ma YZ, et al: Radical resection of dorsolumbar vertebra and prosthetic replacement in giant cell tumor. *Chinese Medical Journal* **95**(7): 537-542, 1982.
- 4) Ono K and Tada K: Metal prosthesis of the cervical vertebra. *J Neurosurg* **42**: 562-566, 1975.
- 5) Raycroft, JF et al: Metastatic tumors involving the cervical vertebrae: surgical palliation. *J Bone Joint Surg* **60-A**: 763-768, 1978.
- 6) Scoville WB, et al: The use of acrylic plastic for vertebral replacement or fixation in metastatic disease of the spine. Technical note. *J Neurosurg* **27**: 274-279, 1967.
- 7) Tsuji A, et al: Problems of ceramic spacer replacement in metastatic tumor of the cervical spine. *Orthopaedic Ceramic Implants* **1**: 181-186, 1981. (Japanese)

和文抄録

セラミックプロステーゼによる頸椎転移癌の治療

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頸椎体の転移癌と骨髄腫の8例に対して改良型のセラミックプロステーゼによる椎体置換術を行った。何れの症例も術前に、椎体破壊を伴い、激しい項部痛や脊髄麻痺症状を呈していた。手術により7名に少くとも

2カ月以上の症状の改善をみた。残りの1例は症状改善をみたものの、ごく一時期のみであった。本手術は姑息的治療とはいえ、限られた人生をより良く生きるうえで有用であると考えられる。