นิพนธ์ต้นฉบับ

Acrylic fusion for cervical spine metastasis : Technical note

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Of six patients with cervical spine metastasis and cord compression, two had atlanto-axial dislocation and four had distruction of the body of the middle or lower cervical spine. After successful reduction by skeletal traction, the C_{1-2} fusion was achieved by wiring, reenforced, in two patients, with acrylic in lay. For 4 patients with destruction of the vertebral body; anterior decompression of the spinal cord was achieved by total removal of the destructed body and extradural tumor, and stabilized by filling the intervertebral space with acrylic after inserting screws into each vertebral body. Ambulation and local radiation therapy were started in the immediate postoperative period. At 2 to 2 1/2 years after surgery, stability of the cervical spine and recovery of the myelopathy were still being obtained in all 6 patients. The good results obtained in this small series were definitely due to benefit of the acrylic fixation which allowed early ambulation and full doses of local radiation therapy.

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จเร ผลประเสริฐ, สมบุญ ทรงศักดิ์เกษร. เทคนิคการเชื่อมกระดูกต้นคอที่เป็นมะเร็งกระจายมาจากที่อื่น. จุฬาลงกรณ์เวชสาร 2531 พฤษภาคม; 32(5) : 447-455

มะเร็งจากอวัยวะอื่น (5 รายจากเต้านม. 1 รายจากไต) กระจายไปที่กระดูกคอในผู้ป่วย 6 ราย ซึ่งทำให้มีอาการกดทับไขสันหลัง 3 ราย และรากประสาทสันหลัง 3 ราย การรักษาผู้ป่วยประเภทนี้จำเป็นต้องเอากระดูกคอส่วนเป็นมะเร็งและตัวมะเร็งเองออกให้มากที่สุด และทำการเชื่อมกระดูกคอให้แข็งแรงอย่างรวดเร็ว เพื่อที่จะได้ให้รังสีบำบัดได้ทันที ทั้งนี้เพื่อลดอัตราการเกิดมะเร็งใหม่ตรงบริเวณผ่าตัด ในผู้ป่วย 6 ราย นี้ได้ใช้เมทิลเมแทครีเลทเชื่อมกระดูกคอและมีลวดหรือตะปูควงเสริม ทำให้กระดูกคอที่เป็นมะเร็งแข็งแรงดีทุกราย

ในผู้ป่วย 6 รายนี้ 2 รายทำการเชื่อมกระดูกคอส่วนบน (ระหว่างข้อที่ 1 และ 2) และอีก 4 ราย ที่กระดูกคอส่วนล่าง การผ่าตัดเชื่อมกระดูกในผู้ป่วยประเภทนี้ไม่จำเป็นต้องใช้เครื่องมือผ่าตัดที่ยุ่งยาก และเมทิลเมแทครีเลทเป็นสารที่ใช้เชื่อมกระดูกคอได้รวดเร็วและดีที่สุดในปัจจุบัน

The principle in the management of spinal metastasis comprises of 3 successive steps : 1) decompression of the spinal cord and nerve roots, 2) stabilization of the spine, and 3) radiation therapy to the local lesion in order to prevent local recurrence of the malignancy. After decompression, either anteriorly or posteriorly, stability of the spine which was already unstable by metastasis is further compromised. Stabilization by means of conventional bone graft fusion can be, but not always, achieved. Even when possible, it takes quite sometime. This results in a delayed commencement of radiation therapy. Methyl methacrylate introduced first by Scoville[1] has been popularly used for spinal stabilization and restoration of the height of the vertebral column when the affected vertebrae have to be resected. The immediate effect of stability has obviously made methyl methacrylate preferable to bone graft. The techniques for acrylic application are variable according to a surgeon's preference. Devices used to prevent displacement of acrylic mass include screws[2] pins,[3,4] wires,[4-6] metal prosthesis,[7,8] etc. This presentation is to demonstrate a simple technique of acrylic fusion in patients with cervical metastasis.

Summary of cases

Between January 1985 and February 1987, six patients with cord and or nerve root compression due to cervical spine metastasis underwent acrylic fusion, polymerizing in situ. Age ranged from 30 to 51 years with an average age of 42 years. Five patients who had primary breast carcinoma were female and one patient with carcinoma of kidney was male. Two had C_{1-2} metastasis causing atlanto-axial dislocation. Two each had C_5 and C_7 body destruction respectively. There was radiculopathy in 3 cases and myelopathy in another 3 (Table 1).

Table 1 Clinical data in 6 cases of cervical metastasis

Case No.	Age-Sex	Primary malignancy	Site of metastasis	Radiculopathy	Myelopathy
1.	37F	breast	C_2	yes	–
2.	51F	breast	C_{1-2}	–	–
3.	38F	breast	C_7	yes	–
4.	30F	breast	C_7	–	yes
5.	50F	breast	C_5	yes	yes
6.	45M	kidney	C_5	–	yes

Operative technique

Upper Cervical spine: For atlanto-axial dislocation, normal alignment of C_{1-2} by means of skull tongs traction was first obtained. (Fig. 1 A) After induction and then general endotracheal anesthesia, the patient was placed in prone position under skull tongs traction to keep the cervical spine in normal alignment. (Fig. 2) Posterior arch of C_1 and laminae of C_2 and C_3 were exposed by sharp dissection. Wiring of the posterior arch of C_1 to the spinous processes of C_2 and C_3 was done.[9] (Fig. 3) The mixture of methyl methacrylate and monomer in semiliquid form was poured to overlay the laminae and to encase the wire and spinous processes. It was left to polymerize in situ. (Fig. 4) When hemostasis was satisfactory, the wound was closed in layers. The patient was allowed to be up and to ambulate the next day with a soft collar support. Radiation therapy was begun on the fifth post operative day after the stitches were removed. (Fig. 1 B)

Middle and Lower Cervical Spine : The patient was placed in supine position after induction and general endotracheal anesthesia. Through anterior approach, the affected vertebra was exposed and confirmed with a portable x-ray in the usual manner. (Fig 5) In order to achieve good decompression of the neural tissue, the collapsed vertebra and adjacent discs, the tumor tissue, and also the posterior longitudinal ligament were entirely excised in a piece meal fashion. To prevent displacement of the acrylic block, the opposing vertebral end plates were undercut by a high speed air driven drill, into the cancellous bone of the vertebral body and screws were inserted

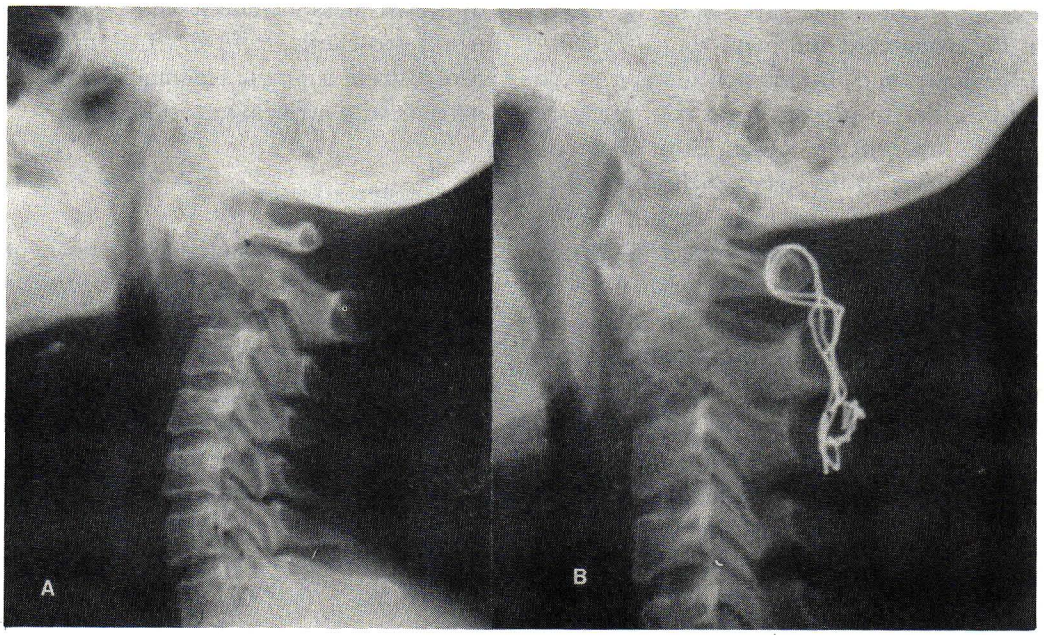

Figure 1 Lateral view of cervical spine x-ray, A. atlanto-axial dislccation B. post reduction and wiring fusion.

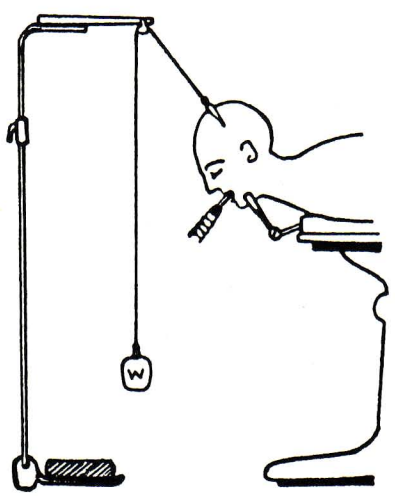

Figure 2 Schematic drawing, showing patient's position on the operating table.

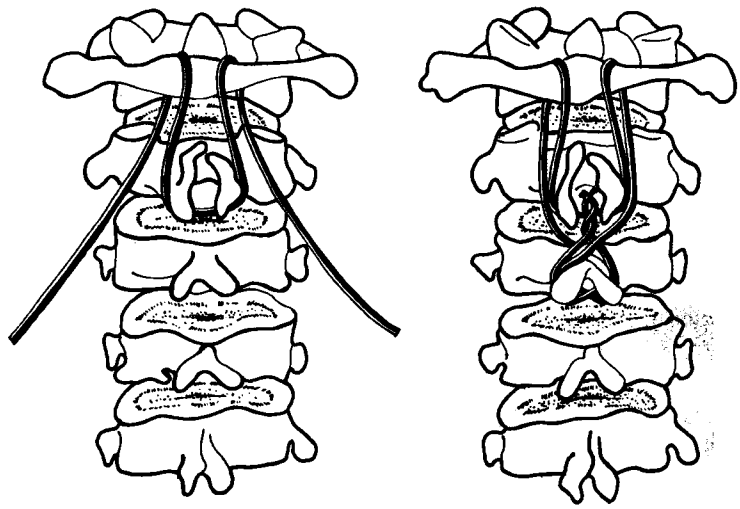

Figure 3 Schematic drawing to show wiring of the posterior arch of C_1 to the spinous process of C_2 and C_3.

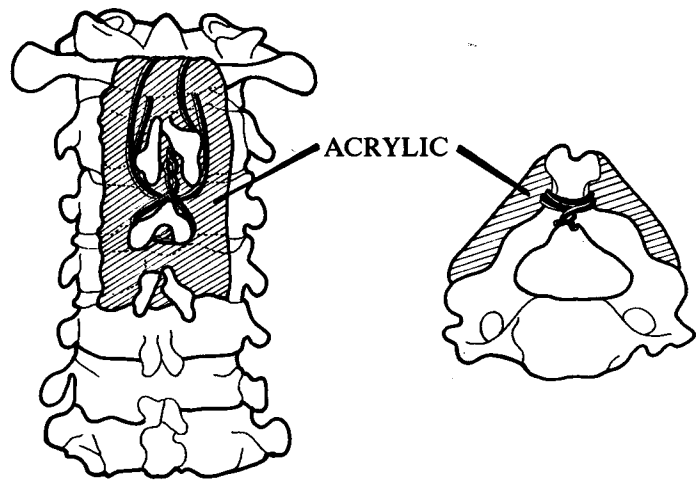

Figure 4 Schematic drawing showing acrylic on-lay fusion. Left; posterior view, Right; cross section view.

into each body. Screw insertion was facilitated by prior introduction of the owl. (Fig 6) The vertebral height was restored by either cervical traction or a vertebral spreader. After covering the dural sac with a gelfoam sheet, the mixture of methyl methacrylate and monomer in semiliquid form was poured to fill the empty space and left to polymerize in situ. (Fig. 7) When hemostasis was satisfactory, the wound was closed in layers. The patient was allowed to be up and to ambulate the next day with a soft collar support. Radiation therapy was begun on the fifth post operative day after stitches were removed. (Fig. 8)

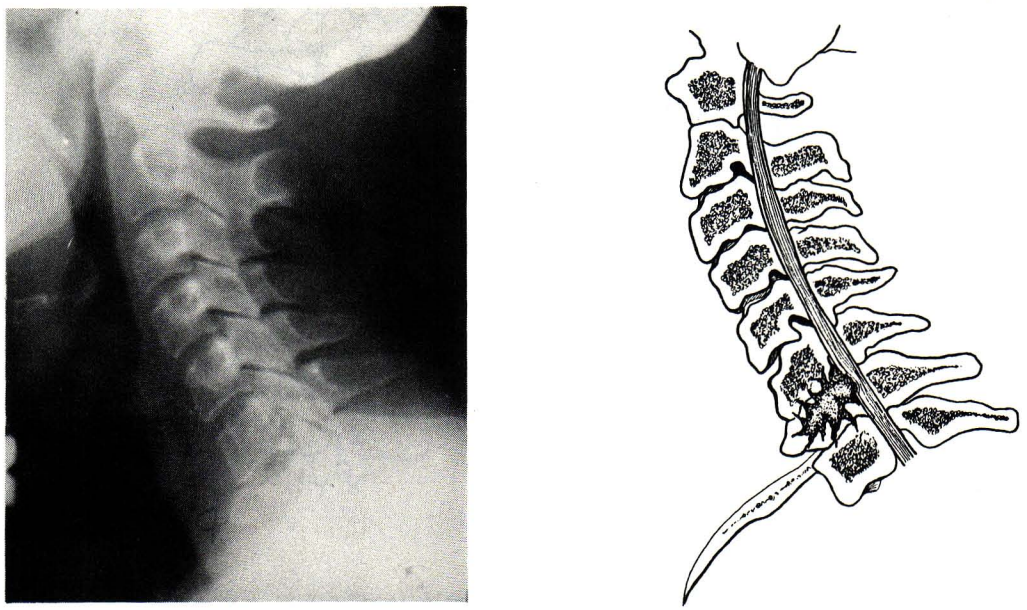

Figure 5 Lateral view of cervical spine showing destruction of the C_7 vertebral body (left), and and schematic drawing (right).

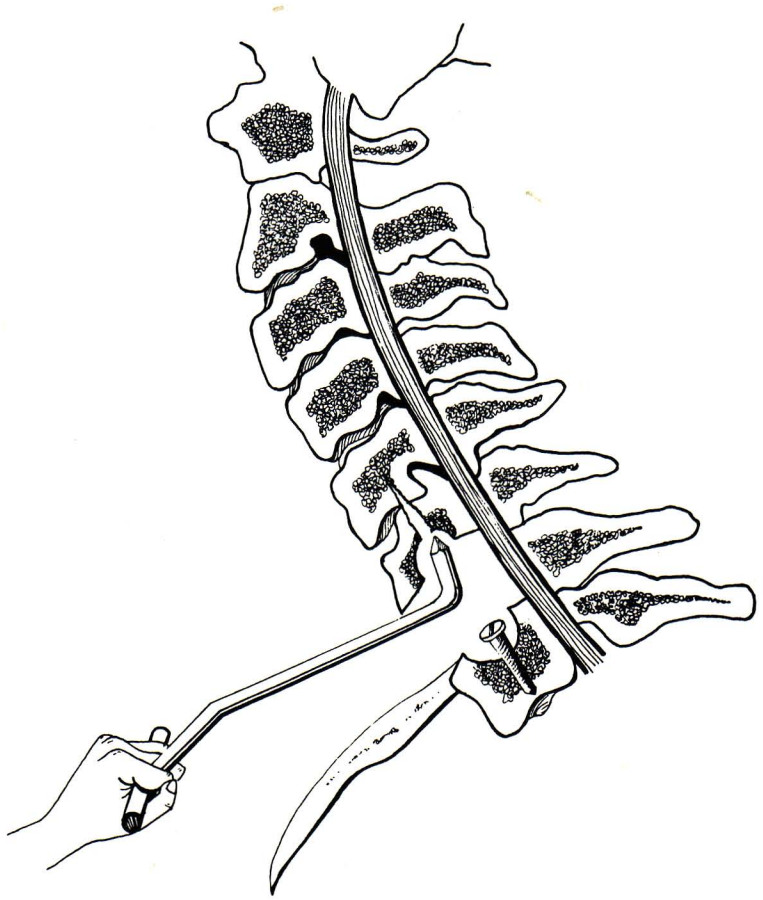

Figure 6 Schematic drawing showing the undercut vertebral end plates and the insertion of the screw.

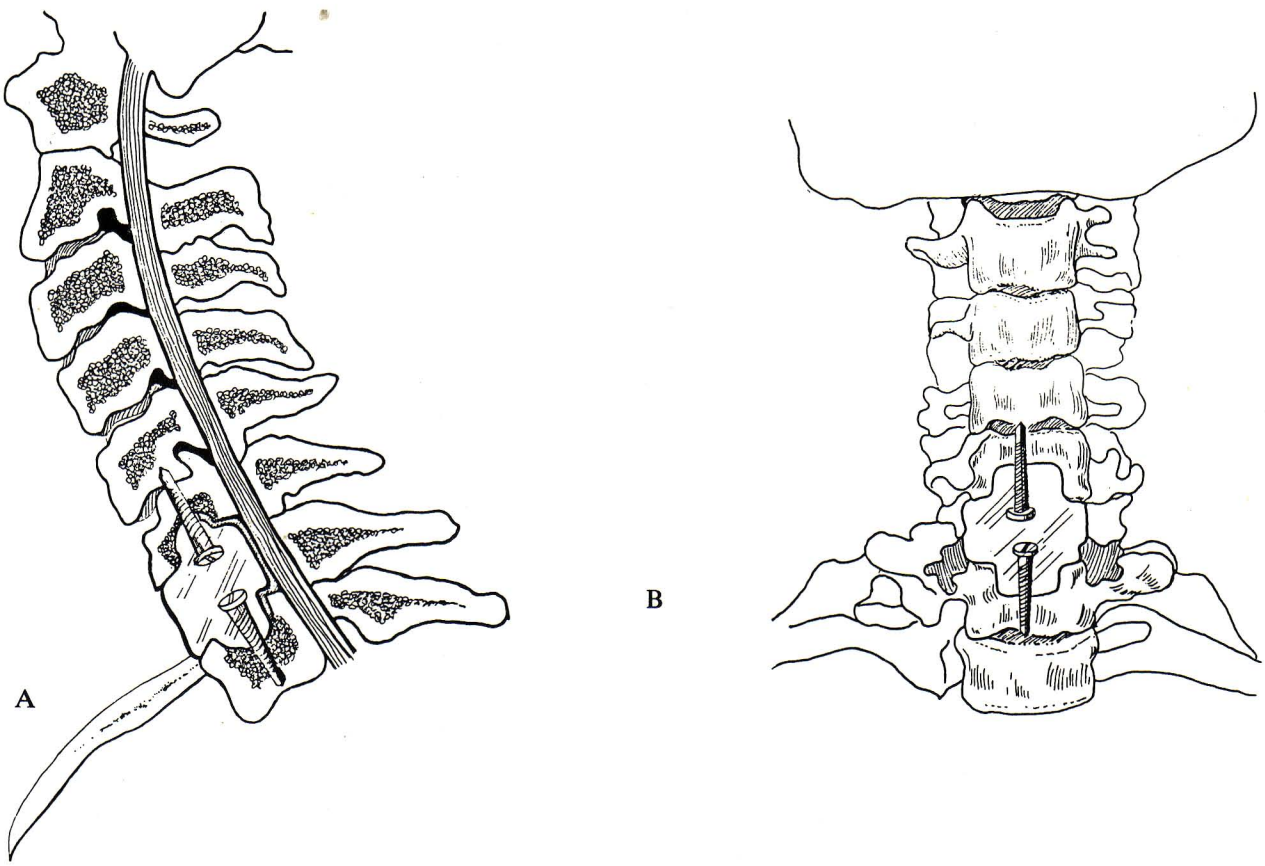

Figure 7 Schematic drawing showing acrylic fusion; A. lateral view, B. antero-posterior view.

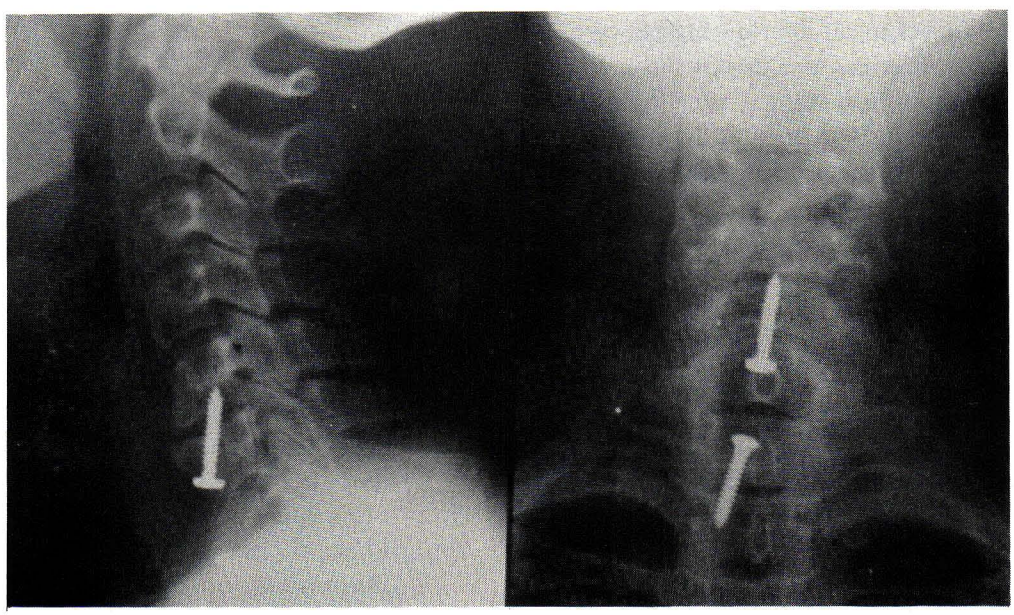

Figure 8 X-ray film of cervical spine showing interbody acrylic fusion between C_5 and C_7. Left : lateral view; Right : antero-posterior view.

Results

Two patients underwent posterior C_{1-2} wiring and acrylic fusion. Four patients, 2 each with C_5 and C_7 metastasis respectively, underwent vertebrectomy and interbody acrylic fusion. After 2 to 2 1/2 years follow up, all 6 patients were alive and doing well. Pre-operative neurologic deficits all disappeared. The stability of the cervical spine still remained and no tumor recurred up to the day of the last visit. (Table 2)

Table 2 Results of acrylic fusion of cervical spine metastasis

Type of stabilization	No. of cases	Follow up yrs.	Radiculopathy & myelopathy	Stability
Postertor C_{1-2-3} wiring and acrylic on-lay	2	2	Recovered	good
Anterior vertebrectomy with acrylic replacement	4	1½-2	Recovered	good

Discussion

The benefit of methyl methacrylate in spinal stabilization has been reported in literatures[2,3,5,10,11] Due to its immediated effect of stability, the long cumbersome period of hospitalization and immobilization can be avoided. The mechanical properties of acrylic cement which is a mechanical binding agent had been studied by many investivators.[12-14] It is not as strong as compact bone,[15] but its strength is not compromised by radiation, doses up to 20,000 rads.[16] If it is applied to the cancellous bone in semiliquid form and then polymerized in situ, fixation is achieved by mechanical interlocking between the cement and the trabecular structure of the cancellous bone.[17] Fixation between the acrylic mass and vertebral bodies is also augmented by the inserted screws and undercut surfaces of adjecent vertebral bodies. Elevation in temperature up to 80°C developing at the surface of polymerized acrylic mass will not damage the spinal cord and nerve roots because there is a gelform sheet between the acrylic mass and the dural sac as insulator and also the circulating cerebrospinal fluid to dissipate the heat effectively.[14] Radiation therapy, if started early enought after reducing the tumor bulk, will effectively control the local recurrence of malignancy. This results in prolonging the patient's survival. All of our six patients had early post operative radiation. Stability of fusion and no evidence of tumor recurrence were obtained up to 2 to 2 1/2 years follow up. It is our strong opinion that the methyl methacrylate is an ideal material for spinal stabilization in patients with spine metastasis. The technique presented above is simple and requires minimal instrumentation.

References

1. Scoville WB, Palmer AH, Samra K, Chong G. The use of acrylic plastic for verterbral replacement or fixation in metastatic disease of the spine: technical note. J Neurosurg 1967 Sep; 27(3): 274-279
2. Miles J, Banks AJ, Dervin E, Noori Z. Stabilization of the spine affected by malignancy. J Neurol Neurosurg Psychiatry 1984 Sep; 47(9): 897-904
3. Chadduck WM, Boop WC Jr. Acrylic stabilization of the cervical spine for neoplastic disease: evolution of a technique for vertebral body replacement. Neurosurg 1983 Jul; 13(1): 23-29
4. Nagashima C, Iwasaki T, Okada K, Sakaguchi A. Reconstruction of the atlas and axis with wire and acrylic after metastatic destruction: case report. J Neurosurg 1979 May; 50(5): 668-673

5. Clark CR, Keggi K, Panjabi MM. Methylmethacrylate stabilization of the cervical spine. J Bone Joint Surg (Am) 1984 Jan; 66 A(1): 40-46
6. Hansebout RR, Blomquist GA Jr. Acrylic spinal fusion: a 20-year clinical series and technical note. J Neurosurg 1980 Nov; 53(5): 606-612
7. Harrington KD. The use of methylmethacrylate for vertebral body replacement and anterior stabilization of pathological fracture-dislocations of the spine due to metastatic malignant disease. J Bone Joint Surg (Am) 1981 Jan; 63 A(1): 36-46
8. Ono K, Tada K. Metal prosthesis of the cervical vertebra. J Neurosurg 1975 May; 42(5): 562-566
9. Phonprasert C, Suwanwela C. Management of chronic atlantoaxial dislocation. Surg Gynecol Obstet 1979 Oct; 149(4): 534-538
10. Harrington KD. Anterior cord decompression and spinal stabilization for patients with metastatic lesions of the spine. J Neurosurg 1984 Jul; 61(1): 107-117
11. Hansebout RR, Blomquist GA Jr. Acrylic spinal fusion: a 20-year clinical series and technical note. J Neurosurg 1980 Nov; 53(5): 606-612
12. Haas SS, Brauer GM, Dickson G. A Characterization of polymethyl-methacrylate bone cement. J Bone Joint Surg (Am) 1975 Apr; 57A(3): 380-391
13. Meyer PR Jr, Lautenschlager EP, Moore BK. On the setting properties of acrylic bone cement. J Bone Joint Surg (Am) 1973 Jan; 55A(1): 149-156
14. Wang GJ, Reger SI, Shao ZH, Morton CL, Stamp WG. Comparative strength of anterior spinal fixation with bone graft or polymethylmethacrylate: experimental operations and observations on dogs. Clin Orthop 1984 Sep; 188: 303-308
15. Greenwald AS, Wilde AH, Matejczyk MB. Clinical application and properties of acrylic bone cement. Orthoped Dig 1977 Jan; 5(1): 2, 16
16. Scullin JP, Greenwald AS, Wilde AH, Beck RD. The effect of radiation on the shear strength of acrylic bone cement. Clin Orthop 1977 Nov-Dec; 129: 201-204
17. Greenwald AS. Properties and applications of acrylic bone cement. Bull Hosp Joint Dis 1979 Jan; 40(1): 72-83