Reconstruction of the atlas and axis with wire and acrylic after metastatic destruction

Case report

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The authors describe a method of C1-2 reconstruction by means of wires and acrylic in a patient with metastatic destruction from carcinoma of the rectum. A huge upper cervical tumor together with involved bone had been removed at an earlier operation.

KEY WORDS • acrylic • spinal cord • cervical spine • metastasic tumor

In 1967, Scoville, et al., reported the use of acrylic for vertebral reconstruction, using the anterior and posterior approach, in cases of metastatic disease of the cervical spine. Since then several authors have reported the use of acrylic for stabilization and replacement for both lytic and unstable lesions of the cervical spine. The majority of cases have been at the midcervical level, but some reports concern posterior fixation for atlantoaxial instability. The direct anterior exposure of the atlas and axis, via either the transoral or the transcervical approach, has been used in the treatment of tuberculosis, and in the removal of a clivus chordoma and a ventrally placed foramen magnum tumor. In these cases no reconstruction of the atlas and axis was required.

This communication describes the successful removal of a huge metastatic tumor together with involved bone from the atlas and axis, and subsequent reconstruction of the uppermost two vertebrae with wires and acrylic. To our knowledge, this procedure has not been previously reported.

Case Report

This 64-year-old man was first admitted to the Department of Neurology, Saitama Medical School Hospital, on March 26, 1977, with severe occipital headache. He had been operated on for carcinoma of the rectum 3 years previously in another hospital. The present symptoms began on October 25, 1976, with bilateral restriction of neck rotation, followed by a stiff neck, and paroxysms of pain in the posterior neck radiating into the right occipitotemporal region. The pain was elicited even on touching the hair over the right occipital area, or on extension of the neck to the right side.

Examination. On April 14, 1977, the patient assumed a forced knee-elbow position, cradling his flexed head in both hands in order to prevent an attack of severe occipital neuralgia. He had an artificial anus and midline abdominal scar. There was right C-2 root irritation without evidence of cord or cranial-nerve involvement. Cervical spine films showed lytic lesions in the C-2 body, with retropharyngeal soft-tissue swelling, on the lateral view (Fig. 1 left). Extensive dissolution of the intervertebral foramina and facets on the right side of the C1-2 vertebrae was noted on the oblique views and laminograms (Figs. 1 right and 2). Neurectomy of the right greater occipital nerve gave pain relief for 2 weeks.

The patient was transferred to the Department of Neurosurgery on May 13, 1977. At this time stability of the C-1 and C-2 vertebrae was completely lost, and he was forced to support his head by both hands to alleviate pain. Emaciation was marked. A smooth hemispherical tumor lay in the right retromandibular region. The tumor was firm, 4.5 × 4.0 cm in size, and fixed to the underlying deep structures. There was no
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Fig. 1. Left: Lateral cervical spine film showing lytic lesions in C-2 body (open arrowheads) and retropharyngeal soft-tissue swelling (white arrowheads). Right: Coronal section laminogram showing extensive dissolution of C1-2 articular facets and adjacent medulla extending into the center of the C-2 body (open arrowheads), and fragmented C-1 facet (white arrow) on the right side. Note the lower level of the right superior facet of C-2 compared with the left (open arrows). Soft-tissue shadow indicated the outline of metastatic tumor (black arrows).

Fig. 2. Cervical spine film, oblique views. Left: Extensive destruction of the right C1-2 facets and lateral masses reveal the posterior arch of C-1 and the spinal process of C-2. Part of the right C-3 pedicle and body appears also to be involved. Right: The left C1-2 articular facets (arrows) appear not to be involved.
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FIG. 3. Right retrograde brachial angiograms. Left: Early arterial phase. Both the carotid (large arrow) and the vertebral arteries (small arrow) are displaced laterally, with numerous feeders to the tumor. Feeders from the truncus thyreoervicalis are also shown. Right: Late arterial phase, showing a large tumor stain (arrows).

bruin. There were numerous lymphadenopathies behind the right ear, but no histological evidence of cancer metastases. In the right brachial angiogram (Fig. 3), both the carotid and the vertebral arteries were displaced laterally by an apple-sized, vascularized tumor involving the C1-2 vertebrae. A general survey with $^{99m}$Tc bone scan and x-ray films was reported to be negative except in the C1-2 area. This fact prompted one of us (C.N.) to excise both the tumor and involved C1-2 with tentative reconstruction of C1-2. Surgery was done in two stages due to the poor general condition of the patient.

First Operation. The first operation was performed on May 25, 1977, using the transcervical approach of Stevenson, et al. Transnasal endotracheal general anesthesia was given so that the jaws could be closed tightly providing the greatest access to the subman-
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by a Scoville clip. The tumor was well encapsulated and contained numerous engorged vessels; these vessels were coagulated. The lateral and inferior margins of the tumor were separated from the surrounding tissue, but the medial margin extended across the midline and its upper margin was beyond the confines of the operative field. The musculature was removed from the right lateral hyoid bone and resected between the greater and lesser horns. This allowed medial retraction of the soft tissue beneath the mandible.

A plane was first developed between the tumor and lateral aspect of the larynx and hypopharynx; and then between the buccopharyngeal fascia and the prevertebral fascia superiorly. The retropharyngeal space was opened exposing the superior margin of the tumor just in front of the anterior arch of C-1. All the muscles and fasciae covering the tumor were stripped off and cut. The capsule and vessels over the tumor were coagulated and the tumor was shrunk with the cautery and removed piecemeal, revealing grayish white, amorphous contents. The tumor was totally removed together with fragmented cancellous bone of the right Cl-2. Bleeding was not significant. The Scoville clip was then removed and the fragile bone and C2–3 disc were removed by curette and air drill, exposing the superior surface of the C-3 body. A tentative reconstruction of C1–2 was tried but proved to be unsatisfactory. A 1.0-mm Kirschner wire was inserted down into the C-3 body and up into the anterior tubercle of C-1 and the space around the wire was filled with acrylic plastic. The pathological report on the specimen confirmed metastatic adenocarcinoma from the rectum.

Postoperative Course. Following surgery, the patient was relieved of his pain. Thirteen days postoperatively he began to sit up with a neck brace, and he started to walk on the 14th day. However, throat pain developed and x-ray films showed anterior slipping of the top of the Kirschner wire from the anterior arch of C-1.

Second Operation. On June 14, 1977, emergency skull traction and reconstructive surgery aimed at greater stability of the head and neck was undertaken as a second step. The wound was re-explored with the patient in the same position but not fixed. No evidence of infection or unusual tissue reaction to the acrylic was found. The acrylic and wire that had been placed previously was removed and the space was irrigated with saline. The left inferior facet of C-1 was identified and seemed to be intact. A drill hole was made through the midportion of the facet in order to reach the occipital condyle (Fig. 5). The involved body of C-3 and remaining left C-2 vertebra were removed by air drill and curettes. Two drill holes were made into C3–4 and a hole made through the anterior tubercle of C-1 and the end of the clivus. Skull traction of 10 kg weight was added, and the space was enlarged. Traction greatly facilitated the insertion of 1.7-mm...
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FIG. 6. Postoperative x-ray films showing Kirschner wires supporting the skull. Two wires run from the C-4 body to the clivus through the anterior tubercle, and a laterally curved wire runs from C-4 to the left occipital condyle through the left lateral mass of C-1.

Kirschner wires down to C3-4 and up to the left occipital condyle through the left interior facet of C-1. A second 1.7-mm Kirschner wire was also inserted down to C3-4 and up to the end of the clivus through the anterior tubercle. A third, 1.5-mm, Kirschner wire was inserted into C3-4, up to the end of the clivus (Figs. 5 and 6). It was carried out under x-ray control. These wires were tied together with a stainless steel wire of 0.5 mm. The space around the wires was completely filled with creamy soft acrylic, forming a new C-1 and C-2 vertebral block. While the soft acrylic was polymerizing, it was constantly irrigated with saline.

Postoperative Course. The patient’s postoperative course was uneventful except for transient dysphagia and occasional ileus. On the 14th day he began to walk with aid, and on the 20th day he walked by himself (Fig. 7). After cobalt-60 irradiation with 4500 rads, with initial daily doses of 300 rads, he was discharged fully ambulatory on September 18, 1977.

Third Operation. One month later, the tumor recurred on the left upper neck, accompanied by severe pain. The patient was re-admitted. Further destruction of the C3-4 bodies and a large tumor stain behind the C-2 to C-5 vertebrae were noted. The three Kirschner wires were in the same position, supporting the occiput on C-4. With the patient in a sitting position and with vertical skull traction, a C-2 laminectomy was carried out, with posterior rhizotomy of the bilateral C-2 roots, and posterior fixation of the occiput, C-5, C-6, and C-7 with wire and acrylic. A large tumor was removed. In spite of vigorous attempts with anti-cancer chemotherapy, the patient died from respiratory failure, pleural effusion, pneumonia, and cachexia on January 29, 1978. No autopsy was obtained.

Discussion

Spinal cord compression from an extradural metastatic tumor usually occurs late in the course of metastatic cancer, and rapidly renders the patient paraplegic or tetraplegic, with a very poor prognosis. In Clain’s series of 136 paraplegic patients the average duration of life was 4.3 months.1

In recent years, both surgical decompression and radiation therapy have been advocated. In 1969, Rubin2 advocated initial high-dose irradiation, based
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FIG. 7. Photographs of the patient 20 days after reconstruction of C1-2 with removal of the tumor. Left: He is able to support his head. Arrowheads indicate the operative scar. Right: He can walk quite normally.

on both experimental and clinical trials. In 1970, Raichle and Posner reported a comparative study between patients who had undergone surgical decompression and those with radiation alone, and concluded that there is no significant difference between the two and both were equally effective. In our case, the tumor was radioresistant, with rapid recurrence within 4 months after the initial removal of all visible tumor and subsequent radiotherapy. Stevenson's approach was suitable for the tumor removal and C1-2 reconstruction. The most important and hazardous procedure was the insertion of three heavy Kirschner wires between the occipital condyle and the end of the clivus, and down to the C3-4 level. X-ray control is advisable to avoid stabbing the medulla oblongata, the hypoglossal nerve, the cerebellum, the basilar artery, or the cervical cord. After the first operation, stability between the head and neck was unsatisfactory; however, in the second operation perfect stability was obtained and the patient regained the power to support his head, and to walk quite normally (Fig. 7). This was the first time this method of C1-2 reconstruction was performed in man. The patient finally died 8 months after the first operation, due to the relentless aggravation of his general condition with pleural effusion. This procedure may be valuable in relieving a patient of severe pain, and in rapidly restoring to him the ability to walk.

References


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