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Case Report

Scapuloplasty Alleviates Scapular Pain Resulting from Lung Cancer Metastasis

Hey-Ran Choi, MD[1], Pyung-Bok Lee, MD, PhD[1], and Kyung-Hoon Kim, MD, PhD[2]

From: Seoul National University, Seoul, Korea; and Pusan National University, Korea

Dr. Choi is with the Department of Anesthesia and Pain Medicine, School of Medicine, Seoul National University, Seoul, Korea. Dr. Lee is with the Department of Anesthesia and Pain Medicine, School of Medicine, Seoul National University, Seoul, Korea. Dr. Kim is an Associate Professor in the Department of Pain Medicine, School of Medicine, Pusan National University, Korea

Address correspondence:
Kyung-Hoon Kim, MD, PhD
Associated Professor
Department of Pain Medicine
School of Medicine
Pusan National University
Korea
E-mail: pain@pusan.ac.kr

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Osteoplasty, a highly effective minimally invasive procedure that alleviates the painful effects of metastatic bone disease by injecting bone cement to support weakened bones, provides immediate and substantial pain relief. However, it is rarely performed in non-weight bearing flat bones such as the scapula.

Fractures of the body of the scapula are rarely treated surgically, except for cases of marked displacement of fragments that limit the function of the scapula. According to the reported incidences of operative treatment of different scapula fracture types, 99% of all isolated scapula body fractures are treated nonoperatively

A 54-year-old man had been experiencing metastatic bone pain in the lateral border, medial border, and medial infraspinatus fossa of the left scapula for the past 2 months; this pain originated from adenocarcinoma of the right lung. He could not sleep on his back even after completion of radiation therapy.

We decided to perform scapuloplasty. The patient was placed in the prone position on a radiolucent table with an inflatable adjustable axillary pillow. Three 13-gauge, 10-cm long bone biopsy needles were simultaneously inserted from the 3 different entry points to fill the osteolytic lesion with the bone cement with fluoroscopic guidance under local anesthesia and intravenous analgesia. After confirming needle placement and ensuring that no contrast medium was extravasated, a total of 8 mL of the cement was injected. Immediately after the operation, the patient could lie on his back without pain.

Scapuloplasty is a new variant of osteoplasty used to alleviate the painful effects of metastatic bone disease. It may be an option of shoulder motion-preserving minimally invasive procedure for alleviating intractable pain induced by lying on the back.

Key words: Fluoroscopy; lung neoplasms; neoplasm metastasis; polymethyl methacrylate; pain; palliative care; scapula; surgical procedures, minimally invasive; vertebroplasty.

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Percutaneous vertebroplasty was first performed for a vertebral hemangioma by Deramond in 1984 (1). It is more widely performed for the treatment of osteoporotic compression fractures and metastatic tumors from the C2 to the sacrum (2,3).

Intervention for pain in the scapular body is an unusual clinical challenge. Although maintenance of shoulder function should not take precedence over adequacy of resection, scapulectomy remains an excellent procedure for malignant disease that preserves hand, wrist, and elbow function (4).

Historically, 30–40% of patients with advanced lung cancer have developed bone metastases. Moreover, the median survival period for patients with ad-

vanced lung cancer has increased from approximately 6 months to 12 months, thereby extending the disease course and potentially increasing the risk of painful and debilitating complications from bone metastases (5).

Osteoplasty, a highly effective minimally invasive procedure that alleviates the painful effects of metastatic bone disease by injecting bone cement to support weakened bones, provides immediate and substantial pain relief even in patients with a poor general condition. This treatment is performed under local anesthesia and intravenous analgesia. Although it is common to perform osteoplasty in weight-bearing bones, it is rarely performed on non-weight bearing flat bones such as the scapula. We have successfully treated a case of painful metastatic scapular body fractures with scapuloplasty. To the best of our knowledge, such treatment has not been reported elsewhere in the literature.

Case Report

A 54-year-old man had been experiencing metastatic bone pain and tenderness on the body of the left scapula for the past 2 months; this pain originated from adenocarcinoma of the right lung (Fig. 1). He could not sleep on his back even after completion of 4 cycles of

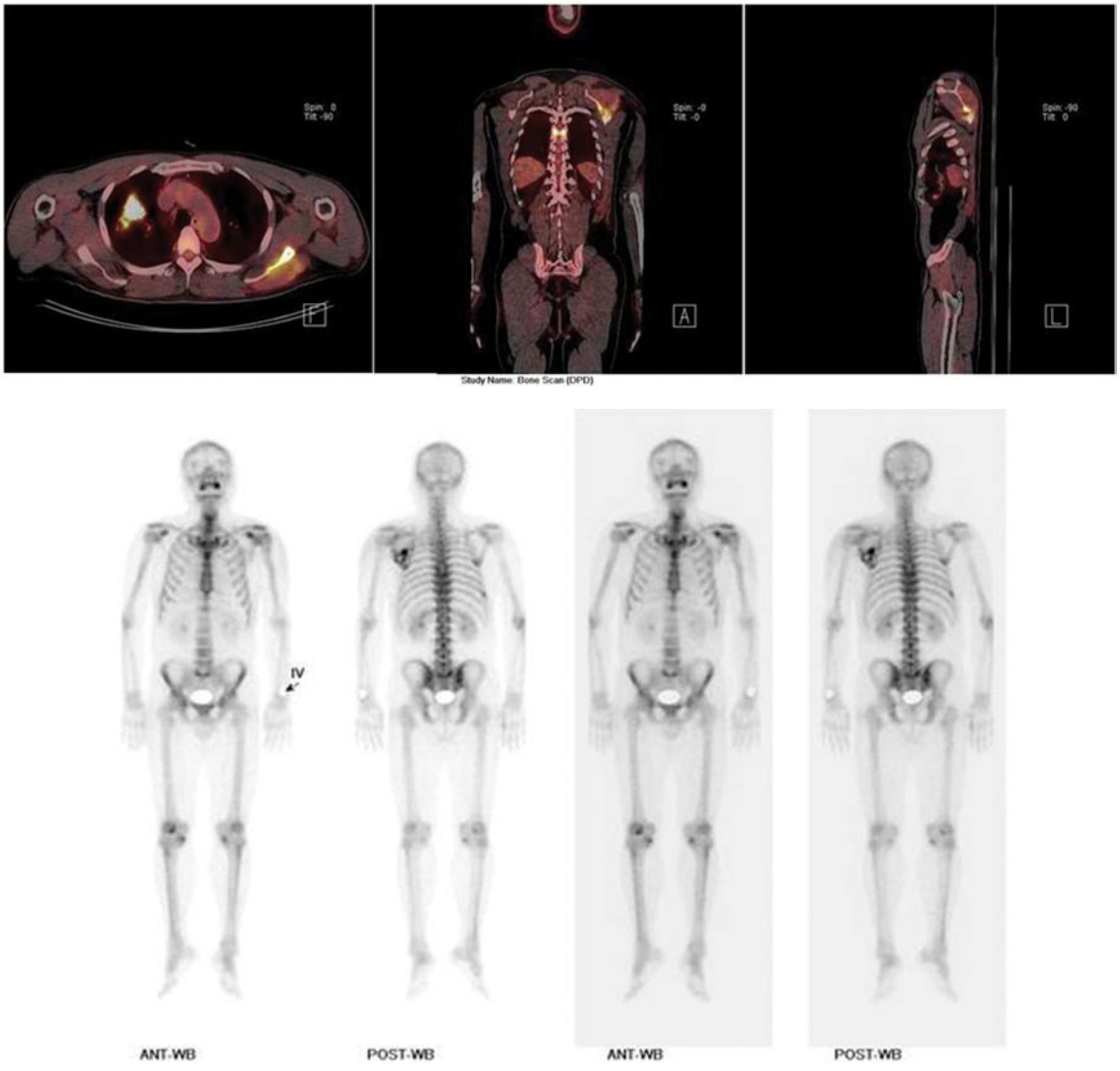

Fig. 1. Films showing right lung cancer with metastasis to the left scapula. (A) Upper 3 films, axial, coronal, and sagittal views of the positron emission tomography scan from left one, (B) Lower films, bone scan (increased uptake on the left scapula).

radiation therapy. The preoperative visual analogue scale (VAS) score was 10/10 for the supine position, and 6-8/10 for the sitting and erect positions according to the breathing patterns. There were 3 points tenderness on the medial infraspinatus fossa, the lateral border, and the medial border. There was little pain relief after performing suprascapular nerve blockage and administration of non-steroidal anti-inflammatory drugs and opioids.

We decided to perform percutaneous scapuloplasty. A permission of clinical trial was taken from Institutional Review Board from Pusan National University Yangsan Hospital and an informed consent about potential complications including nerve injury, pneumothorax, bleeding, wound infection, and embolism from the patient also taken. The patient was placed in the prone position on a radiolucent table with an inflatable adjustable axillary pillow. After aseptic draping, an outline of the left scapula, including the medial border, inferior angle, and lateral border, were drawn on the skin under fluoroscopic guidance. An additional inner line was drawn to indicate osteolytic bone defects confirmed by preoperative plain film and computed tomography, and 3 tender points were marked on the scapula as "X" (Fig. 2).

The procedure was planned with 3 different directions of approach (Fig. 3-Upper Left). Three 13-gauge, 10-cm long bone biopsy needles were simultaneously inserted from the 3 different entry points to fill the osteolytic lesion with bone cement under fluoroscopic guidance. The procedure was performed under conscious sedation with basic monitoring such as electrocardiography, pulse oximetry, and noninvasive blood pressure. Local anesthesia was provided with a total of 20 mL of 1% lidocaine and intravenous analgesia with 30 mg of ketolorac and 100 μg of fentanyl. After confirming needle placement and ensuring that there was no extravasation of contrast medium (Fig. 3-upper middle), a total of 8 mL of the cement was injected with withdrawal of the bone biopsy needles along the 3 directions (Fig. 3-upper right to lower right). To avoid suprascapular nerve damage, the C-arm was obliqued about 16° to the left and angled cephalo-caudad about 18°. The suprascapular notch lies at the 12-1 o'clock position (Fig 3-lower right). The time required for the operation was 55 minutes.

Immediately after operation, the patient could lie on his back without pain. The VAS score decreased to zero. Computed tomography and 3-dimensional computed tomography images were then taken to com-

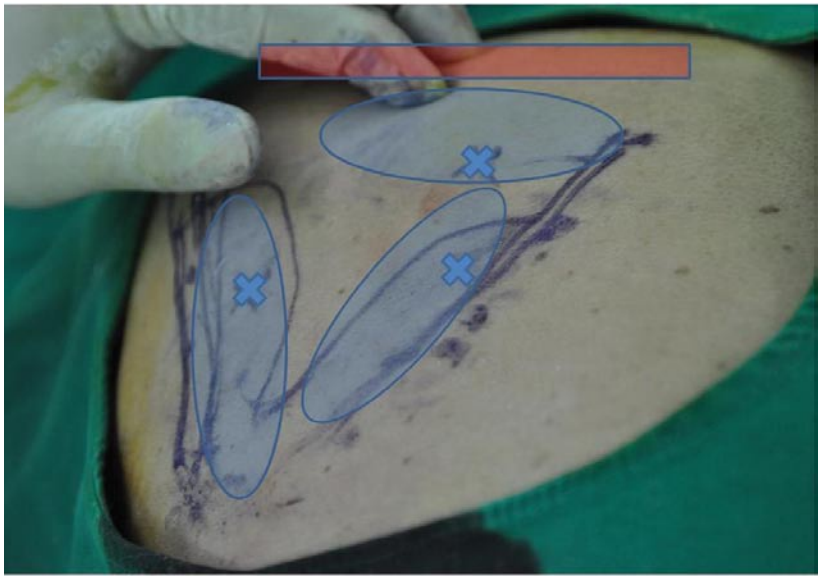

Fig. 2. *The red square between the 2nd and the 3rd fingers marks the spine of the left scapula. The "X" markers indicate tender points, and the 3 blue oval-shaped areas indicate the osteolytic lesions.*

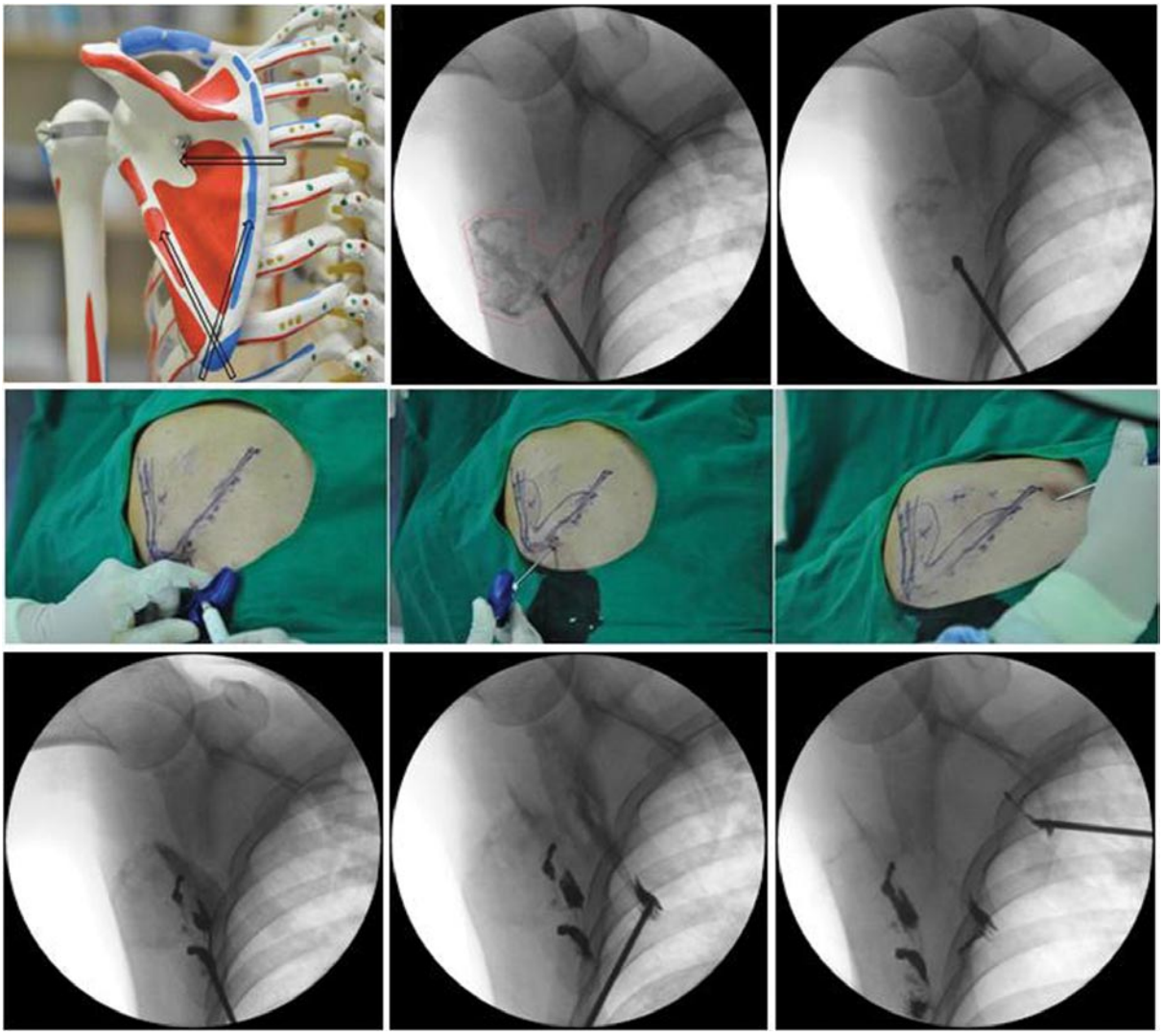

Fig. 3. *Upper left: The 3 different directions of approach in the procedure are indicated with arrows, Upper Middle: Insertion point of the inferior angle to the lateral border, and the contrast medium is injected to confirm the prevention of extravasation. The red polygon shows a stay within scapular shadow and no extravasation after injection of 3 mL of contrast medium before cement injection. Upper Right: First cement appearance, Middle Left to Right: Insertion point of the inferior angle to the lateral border, insertion point of the inferior angle to medial border, and insertion point of the medial border to the infraspinatus area. Lower left to Right: The cement was injected while withdrawing the bone biopsy needle from the 3 different directions.*

pare with the images obtained before scapuloplasty (Fig. 4-A and B). There were no complications such as suprascapular nerve damage, pneumothorax, bleeding, wound infection, and embolism. There was no pain and tenderness on the left scapular body and no limitation of shoulder motion 2 months after surgery.

Discussion

The scapula is a large, flat, triangular bone, which partly overlaps with the second to seventh ribs on the posterolateral thoracic aspect. It has costal and dorsal surfaces; superior, lateral, and medial borders; inferior, superior, and lateral angles; and 3 processes known as

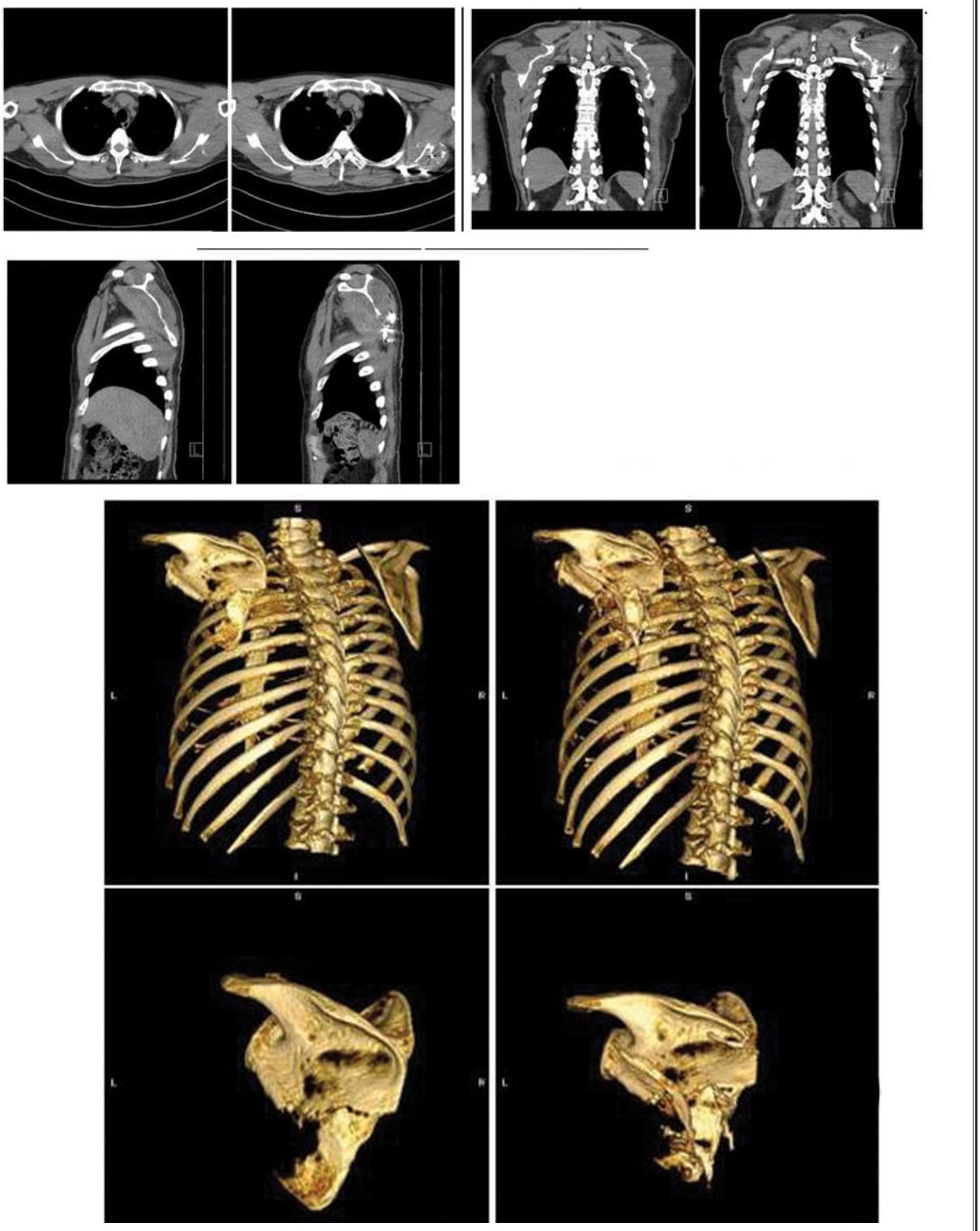

Fig. 4. *Images taken before and after scapuloplasty. (A) Computed tomography scan of the chest, axial (Upper), coronal (Middle), and sagittal (Lower) views before and after scapuloplasty, (B) Three-dimensional computed tomography scan of the chest and scapula before (Left) and after scapuloplasty (Right).*

the spinous, acromial, and coracoid processes. The lateral angle is truncated by the glenoid cavity for articulation with the humerus. This section, which is sometimes regarded as the head, is connected to the body by an inconspicuous neck (6).

With new treatments, median survival improves for patients with advanced lung cancer from approximately 6 months to 12 months, thereby extending the disease course and potentially increasing the risk of painful and debilitating complications from bone metastases (5).

Fractures of the body of the scapula are rarely treated surgically, except for cases of marked displacement of fragments that limit the function of the scapula. According to the reported incidences of operative treatment of different scapula fracture types, 99% of all isolated scapula body fractures are treated nonoperatively (7).

Among surgical treatment modalities, internal fixation was most often achieved with a plate and screws through a posterior approach. Postoperative complications were observed in about 31.1% of 212 cases in 15 studies. The most commonly reported complication was infection. Other complications include hematoma, nerve injury, implant failure, hardware failure, and posttraumatic arthritis (8).

Osteoplasty, a highly effective minimally invasive procedure that alleviates the painful effects of metastatic bone disease by injecting bone cement to support weakened bones, provides immediate and substantial pain relief. The various variants of osteoplasty including vertebroplasty, sacroplasty, and ilioplasty could help preserve patients' quality of life and functional independence, and could contribute to maintaining patients' performance status.

Ordinary osteoplasties have been performed on load-bearing bones. The scapula was not previously considered an appropriate target for osteoplasty. However, in this case, the pain of the patient was provoked by lying on the back and by respiration in sitting and standing positions.

The volume of injected cement was small and was not enough to fill the entire volume of osteolytic lesions on the scapular body. An alternative mechanism for the dramatic pain relief may be the denervation of in-growing nerves by chemical toxins and thermal ablation from polymethyl methacrylate (PMMA).

Possible mechanisms of pain relief following vertebroplasty are alteration in response to mechanical, chemical, thermal, and vascular stimuli after the injection of PMMA. First, even minimal amounts of PMMA appear able to improve bone strength and load bearing. The improved stability and strength of the motion segment are hypothesized to reduce the pain stimulus. In addition, fracture reduction following vertebroplasty may result in restoration of the anterior and posterior longitudinal ligament to more favorable anatomic position, with a resultant decline in pain from pain afferents. Kyphoplasty rather than vertebroplasty appears to provide this fracture reduction effect. Second, PMMA monomer is an organic solvent. Exposure of tissue to unreacted monomer is direct toxic to nerve endings with resultant diminished pain perception. This may also explain in part the effectiveness of vertebroplasty in local tumor control in terms of tumor necrosis. The ratio of monomer to powder during preparation, as well as the addition of an antibiotic, can affect the relative degree of tissue toxicity. Third, polymerization of PMMA is an exothermic reaction. Temperature as high as 50° to 57°C have been recorded at the bone cement interface during polymerization of PMMA. Temperatures of 42° to 47°C are sufficient to destroy several types of cells, including cartilage, embryonal tumors, carcinoma cells, and free nerve endings. Fourth, in addition, in case of metastatic spinal disease, the elevated temperatures results in destruction of tumor cells, and PMMA physically alters vascular supply. Thermal injury, reduction of vascular supply to tumors, and direct tumor thermal injury are all possible mechanisms of pain relief following use of PMMA (9).

To avoid suprascapular nerve damage, the anatomic and physiologic localization of nerve under the fluoroscopy. The C-arm was obliqued about 16° to the left and angled cephalo-caudad about 18°. The suprascapular notch was easily identified superior to the scapular spine, medial to the coracoid process, and lateral to the rib margins. Upon passing underneath the transverse scapular ligament and through the suprascapular notch, the suprascapular nerve enters the supraspinous fossa. The nerve terminates as articular and muscular branches in last fluoroscopic image (10).

Although painful metastasis to the scapular body is rare, scapuloplasty may be an option of shoulder motion-preserving minimally invasive procedure for alleviating intractable pain induced by lying on the back.

Conclusion

Scapuloplasty, a variant of osteoplasty, may be safe and beneficial for a select group of patients who have intractable scapular pain and who are not candidates for scapulectomy. It may provide immediate and sub-

stantial pain relief even in patients with a poor general condition with conscious sedation. It may be an option of shoulder motion-preserving minimally invasive procedure for alleviating intractable pain induced by lying on the back.

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