Recent Advances in the Treatment of Pathological Fractures

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Pathological fractures present challenging and difficult management problems. Conservative treatment frequently results in non-union, while open reduction and internal fixation usually involves prolonged immobilization and bed rest with attendant medical complications. The use of methylmethacrylate as an adjunct to conventional forms of internal fixation represents a recent advance in the management of unstable, pathological fractures. The hospital stay can be markedly shortened and the patient's functional capacity increased relatively early in the postoperative period. This paper reports the results of this approach to therapy in a series of over 75 patients, and outlines indications and timing of this procedure before pathological fractures occur in instances where early diagnosis of bone malignancy has been made.

In the past, one of the most difficult clinical problems the orthopedic surgeon had to face was that of a pathological fracture. By definition, a pathological fracture is a discontinuity in bone produced by factors other than trauma. In a broader sense this definition would also include fractures caused by endocrine dysfunction and vitamin deficiency diseases such as hyperparathyroidism and rickets. For the purposes of this discussion, pathological fractures will refer to those lesions caused by primary or secondary neoplastic lesions. This paper will briefly describe the problems of management of unstable pathological fractures and report the results of improved approaches to treatment in a series of over 75 patients.

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Problems of Management

There are many reasons why pathological fractures have presented problems in management. These fractures tend not to heal. This is because the neoplastic cells continue to proliferate within the bone and prevent the products of union from effecting continuity between the fragments. Unfortunately, most of the primary and secondary neoplastic lesions of bone are radio resistant. Radiotherapy is used primarily to diminish pain, but the course of the tumor is seldom affected by this modality. Thus, conservative treatment of pathological fractures was accompanied by an unusually high rate of non-union.[1]

Better results were obtained with open reduction and internal fixation followed by radiation.[2,3] However, another major problem existed. Frequently there was so much bone loss that stability was far from secure despite the fact that internal fixation was employed and supplemented by plaster immobilization. Very often this resulted in limited activity for the patient. Because the fracture was so unstable, the patient was relegated to spending his time in bed lest any activity cause disruption of the bone. This tended to have adverse physical and psychological effects. Prolonged bed rest contributed to the development of decubiti, aspiration pneumonia, renal dysfunction, and other complications which are well documented in the literature.[4] The morale of the patient tended to deteriorate, which is not surprising when one considers that the patient's longevity is compromised, and he frequently knows this. To face the reality of being afflicted with a fatal disease is a most difficult thing; to have the additional encumberance of spending most of one's remaining days in bed away from family and friends and in a hospital setting makes it even more depressing.

This problem did not go unnoticed by those physicians and surgeons whose lot it was to deal with these difficult situations, and as better and

stronger metals became available it was hoped that these would offer a solution. Indeed, the newer materials proved to be of great value in those fractures which were not comminuted and in which there was not an appreciable loss of bone. The degree of internal fixation achieved was such that postoperative morbidity was decreased and the patient was able to use the affected extremity sooner.[5] However, the problem of comminution and loss of bone still remained to be solved.

In the late 1950s John Charnley, a well-known orthopedic surgeon in England, began to employ a prosthesis which he developed to replace hip joints damaged by arthritis.[6] He reamed the diseased acetabulum and replaced it with a teflon cup which was later substituted for a high density polyethylene cup. He resected the femoral head, and into the femoral shaft he inserted a stainless steel prosthesis similar to the popular Moore prosthesis. In order to anchor these components he used a cold-curing acrylic cement called methylmethacrylate. His endeavors have literally revolutionized surgery of the hip and this operation is now employed widely. Methylmethacrylate was new in orthopedic surgery, but had been used extensively and for many years by dentistry to anchor prosthetic teeth.

Methylmethacrylate proved extremely useful as a cement in hip surgery, and it was only natural that with time other important uses would be found for it.[7] Thus, it was not surprising when reports began to appear in the orthopedic literature that this substance was being used as an adjunct to internal fixation in the treatment of comminuted, unstable pathological fractures. The first reports by Harrington[8] in 1972 and by Sim[9] in 1974 indicated that there were no failures of fixation and that no major complications occurred due to the use of methylmethacrylate. However, even more important was the fact that the patients were able to use their affected extremities in a relatively short period of time after surgery, and they were able to return home after a shortened stay in the hospital.

In 1968 the author began to use methylmethacrylate in the treatment of unstable pathological fractures and to date has treated more than 75 patients in this manner. It has been demonstrated that difficult, unstable pathological fractures may be made more stable by using methylmethacrylate in addition to the conventional forms of internal fixation. The results have been extremely satisfactory and have allowed the patients to lead a more normal and pain-free existence. Most important, their hospital stay has been decreased and they were able to spend more of their remaining time at home with their families.

Selection of Patients

Patients were selected on the basis of their particular lesion. The decision was influenced by the clinical course of their underlying disease, their rehabilitation potential, and the anticipation, based on clinical opinion, of a life-expectancy of more than three months. Methylmethacrylate was used where the conventional forms of internal fixation were thought to be inadequate to immobilize the fracture without the addition of postoperative plaster and traction. A strong team approach was used consisting of an oncologist, an internist, the orthopedic surgeon, physical and occupational therapists, a social service worker, and the family practitioner.

Surgical Technique

Parenteral antibiotics were begun 12 hours prior to surgery and were continued for five days postoperatively. Under appropriate anesthesia the fracture was exposed and reduced under direct vision. The neoplastic lesion was resected and methylmethacrylate was placed in the lesional cavity and in the intramedullary canal. If an intramedullary device was to be used, such as a Kuntcher rod or Smith-Petersen nail, the device was driven in place as the cement hardened. If it was decided that bone plates were to be employed, the cement was allowed to harden and the bone plates were then applied. Methylmethacrylate can be drilled with a power-driven drill bit and can hold screws well. Large remaining defects in the bones were packed with methylmethacrylate to add to the stability. Methylmethacrylate cures via an exothermic reaction, so that heat is given off as the substance hardens. Temperatures as high as 90 C have been recorded and for this reason, during the curing process, the wound is constantly irrigated with cold saline. Because the methylmethacrylate would come in close contact with the spinal cord and radial nerve in fractures of the cervical spine and humerus, respectively, sterile crushed ice was used to dissipate the heat and to prevent thermal damage to these vital structures. After the cement had hardened, which took anywhere from 8 to 12 minutes, the bone was tested for stability. If this was found to be satisfactory, the wound was closed in the usual manner over a hemovac drain.

The patients were encouraged to start active motion of the operated extremity as soon as possible after surgery and were seen by the physiotherapist within 24 hours when assisted passive movements were begun. Active motion was started as soon as soft tissue pain decreased, usually within two to four days, and this was followed by anti-gravity and mild resisted activity. In the lower extremities, weight bearing commenced with the use of a walker, which was discarded as soon as the patient could bear weight comfortably.

Results

There were no failures of fixation. The patient began to bear weight with the assistance of a cane or walker in an average of 16 days. They obtained independent useful function of the upper extremity within an average of 13 days. There were no instances in which progression of the original neoplastic lesion was noted, but three patients sustained a pathological fracture in the same bone at a different site. One patient suffered a traumatic fracture at a different site in the same extremity after a fall.

Discussion

The methods which were previously available to treat unstable pathological fractures included internal fixation using plates or intramedullary rods and nails, resection and replacement arthroplasties, such as the Moore prosthesis for the hip and the Neer prosthesis for the shoulder, and amputations. In instances where a portion of a joint was destroyed by the tumor a homograft was occasionally used.[10] Thus, a lesion which completely destroyed the distal femur

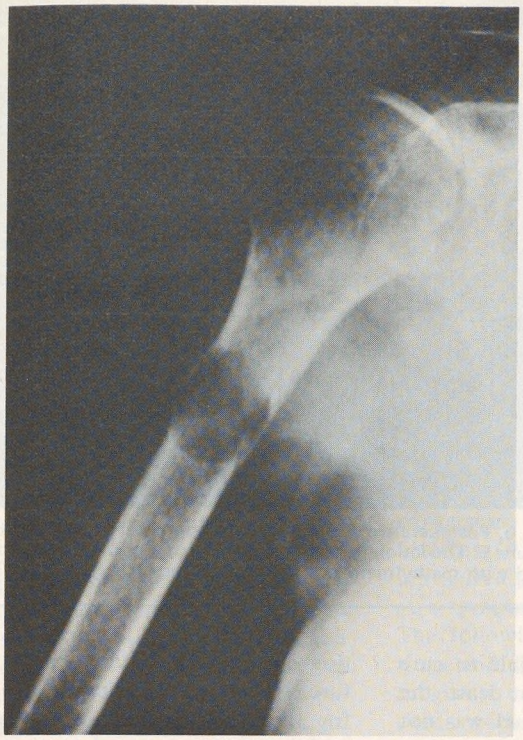

Figure 1. AP radiograph of right humerus of a 63-year-old female suffering from breast carcinoma. There is a large lytic lesion involving the upper quarter of the humerus. This is an impending pathological fracture.

Figure 2. Postoperative AP radiograph of humerus of patient described in Figure 1. The metastatic lesion has been curretted and the defect replaced with methylmethacrylate (arrow). A rush rod has been inserted down the medullary canal for added stability.

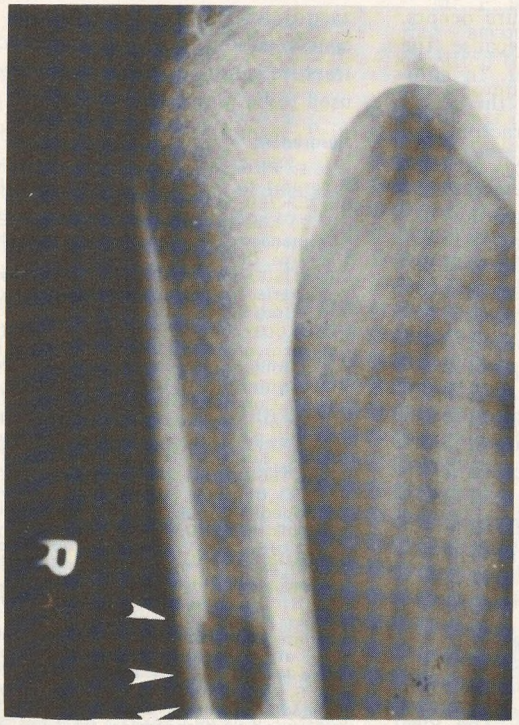

Figure 3. AP of middle third of right femur of a 72-year-old male suffering from a carcinoma of the lung. There is a large metastatic lesion which is eroding the lateral femoral cortex (arrows). The strength of the bone has been weakened predisposing it to early fracture.

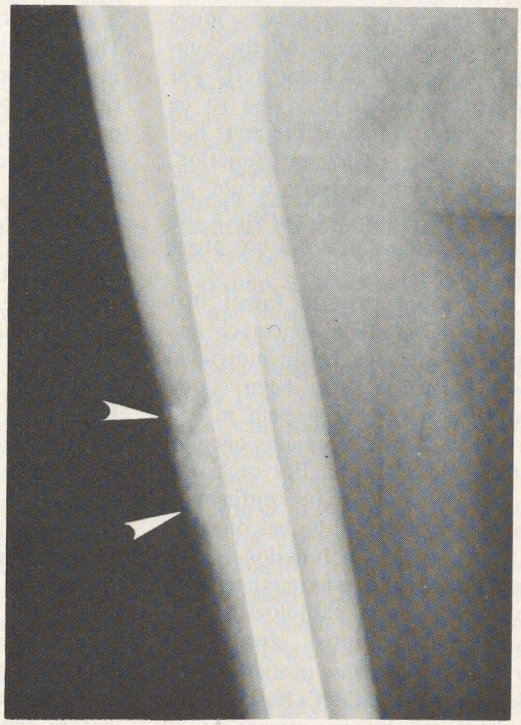

Figure 4. Postoperative AP radiograph of femur of patient described in Figure 3. The lesion has been curretted and the defect filled with methylmethacrylate (arrows). A Kuntcher nail has been inserted down the medullary canal for added stability.

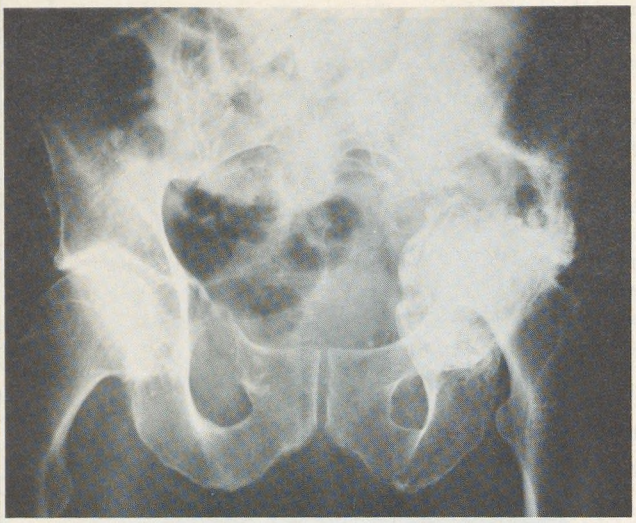

Figure 5. AP radiograph of pelvis of a 68-year-old male with a hypernephroma. There is a large metastatic lesion involving the left hip. There is widespread destruction of the acetabulum with a central dislocation of the femoral head.

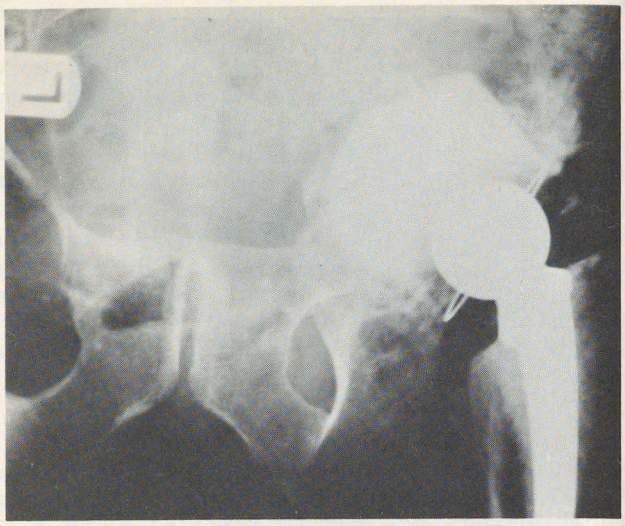

Figure 6. Postoperative AP radiograph of pelvis of patient described in Figure 5. The lesion has been removed and a new acetabular floor created with methylmethacrylate. A total hip arthroplasty has been done.

could be treated by resecting the lesion and replacing the distal femur with a fresh homograft obtained from a cadaver. All these methods involved major disadvantages in that while relief of pain or local eradication of the tumor was achieved, function was considerably impaired or delayed. With regard to the arthroplasties, many of the prostheses became loose due to the inadequacy of the supporting bone. If a homograft was performed, the extremity had to be protected until union of the graft had occurred, thus delaying function. Ultimately, such a graft would be rejected, but since the patient's life span was shortened this did not prove to be a problem.

It is perhaps easy to forget that each day of pain-free existence and function is precious to an individual whose longevity has been compromised. For each day spent in bed or in a hospital there remains one day less to spend at home. For each day that the patient must be confined in an immobile situation he has one day less in which to be functional. The adjunctive use of methylmethacrylate in the treatment of pathological fractures has contributed greatly in reversing this otherwise dismal picture. In this series the patient's hospital stay was shortened by an average of 20 days and his functional capacity markedly increased, since most were able to become ambulatory and to use their upper extremities. Despite the fact that it was not possible to cure the underlying disease, at least the patient was comfortable and was not an extreme nursing problem.

The family practitioner often becomes aware of metastatic bony lesions long before the orthopedic surgeon. Ideally, function can be preserved for a longer period if surgery is undertaken before fracture occurs. The morbidity is less because the surgical procedure is easier. In addition, the patient is spared the severe pain which precedes the fracture and the great discomfort which follows. Successful treatment depends on successful team work among the physicians who come in contact with the patient. A patient with a known malignancy who complains of bone pain should have this complaint investigated very carefully. Generally, x-rays will reveal a lesion. If these are negative, a technicium bone scan can often indicate early areas of bone involvement. Surgery is not indicated at this point but, rather, supportive therapy in the form of radiation, protected weight bearing, and chemotherapy is recommended. The important thing, however, is that a lesion has been detected and its progress can be carefully monitored at regular intervals. Surgery should be undertaken before the bone fractures. The ideal time is when the lesion becomes large enough to erode a portion of the cortex of the bone, rendering it less able to withstand the stresses of function and making it vulnerable to fracture. It is only by being on the alert for these signs and by referring the patient at the appropriate time that the ultimate benefit of treatment may be derived. It is hoped that with these newer and promising methods of treating this unfortunate disease, primary care physicians will become aware that hope does exist for their cancer patients and that a pathological fracture is not the catastrophic event it used to be.

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