Acta Orthop Scand 55, 209–214, 1984

# Favourable results of acrylic cementation for giant cell tumors

A consecutive series from two university hospitals of 50 patients with giant cell tumors was reviewed and histologically reconfirmed. The patients treated with curettage and acrylic cement were re-examined concerning function. Two of 14 cemented tumors had recurred but could be treated by additional cementation, so that no final failure of this method had occurred, compared to one of 19 radically resected and 12 of 22 with bone-graft after curettage. Joint function was normal in 11 and radiographic arthrosis of low grade was found in only two of 14 patients. It is concluded that this method gives a minimum of recurrence and a maximum of function. It is suggested that the old name of "giant cell sarcoma" should be reintroduced, bringing the tumor into the group of low-grade sarcomas where it belongs.

Key words: acrylates; bone neoplasms; giant cell tumors.

**Björn M. Persson, Leif Ekelund[1], Ronny Lövdahl & Björn Gunterberg[2]**

Departments of Orthopaedic Surgery and [1]Diagnostic Radiology, University Hospital, S-221 86 Lund, Sweden and [2]Department of Orthopaedic Surgery, Sahlgrenska Hospital, Gothenburg, Sweden

When the pathologist Virchow, in 1863, first described the giant cell tumor of bone, he used the name "giant cell sarcoma". The name osteoclastoma was introduced later, but currently the name "giant cell tumor" is most commonly used, although the tumor metastasizes in about 10 per cent of cases (Larsson et al. 1975) and thus behaves like a low-grade sarcoma. It has been repeatedly shown that the clinical behavior does not correlate well with the histologic grading of malignancy (Dahlin et al. 1970). It has also been repeatedly shown that curettage with bone-grafting involves about a 40 per cent risk of local recurrence (Lorentzon 1978). Therefore, radical resection has often been advocated especially for recurrent tumors (Enneking & Shirley 1977). A wide local en-bloc resection of a giant cell tumor, however, in most cases makes sacrifice of the joint function necessary. Because most giant cell tumors occur in women of young or middle age, other possibilities have been sought, such as cryosurgery (Marcove et al. 1978) and curettage with acrylic cementation (Persson & Wouters 1976). This paper reports our continued experience with curettage and acrylic cementation, which has become the preferred method in most cases.

## Material and methods

All cases of giant cell tumor of bone recorded and histologically reconfirmed at University Hospital in Lund since 1947 and at Sahlgren's Hospital in Gothenburg since 1965 were included. There were in total 50 patients of whom 29 had been operated on in Lund and 21 in Gothenburg. Of these, 46 had been observed for at least 3 years (Tables 1 and 2). Treatment varied from biopsy to amputation. Curettage and filling with bone was the most commonly used method, and filling with acrylic cement the second most common. During the last 8 years, acrylic cement has been used most often. Special interest was paid to the 16 cases treated with curettage and acrylic cementation, a surgical procedure that was first introduced in Lund in 1972 (Persson & Wouters 1976).

*Curettage and acrylic cementation* were performed in a bloodless field when possible. The opening of the tumor wall was made wide enough to allow inside inspection and to permit digital palpation of the inner tumor walls to verify complete curettage. Parts with cortical penetration or fracture were especially carefully cleansed. Saline and hydrogen peroxide solutions were used to rinse the cavity. The acrylic cement contained barium contrast medium to facilitate radiographic follow-ups and, in some, an antibiotic, such as gentamicin. The cavity was dried by packing with swabs. Digital pressure was used so

*Table 1. Type of therapy for primary giant cell tumors*

| Therapy | No. of patients | Local recurrence |
|---|---|---|
| Biopsy + radiotherapy | 2* | 2 |
| Curettage only | 2 | 1 |
| Curettage + bone-graft | 18 | 9 |
| Curettage + acrylic cement | 10 | 2 |
| En-bloc excision only | 5 | 0 |
| En-bloc excision + arthrodesis | 5 | 2 |
| En-bloc excision + endoprosthesis | 3 | 0 |
| Amputation | 1 | 0 |
| Total | 46 | 16 |

* One case had metastases.

*Table 2. Type of therapy for recurrent tumor*

| Therapy | No. of patients | Local recurrence |
|---|---|---|
| Curettage only | 1 | 0 |
| Curettage + bone-graft | 4 | 3 |
| Curettage + acrylic cement | 4 | 0 |
| En-bloc excision + bone | 3 | 0 |
| En-bloc excision + endoprostheses | 3 | 0 |
| Amputation | 5* | 0 |
| Total | 20 | 3 |

* One case had metastases.

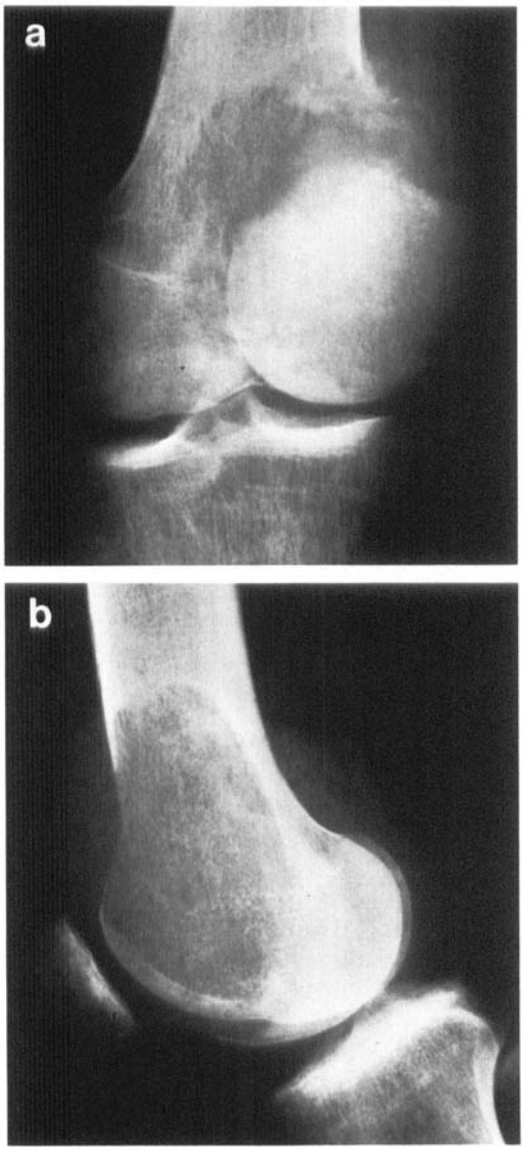


Figure 1 a and b. Preoperative AP (a) and lateral (b) radiographs of a typical osteolytic epiphyseal giant cell tumor in a 28-year-old woman with a pathological fracture (Case 4).

that the filling would reach all corners of the cavity. When the heat of polymerization was at a maximum, the tourniquet was released. After closure and soft dressing of the wound, immediate postoperative mobilization, ambulation and weight-bearing were normally allowed.

Among the 16 cemented cases, 14 were followed for at least 3 years, and ten of these had been operated on in Lund (Table 3). The mean age among the cemented cases was 31 (15–66) years, and 12 were females. Ten of the tumors were located in the knee region. Three had been detected by roentgen examination because of sudden pain due to a fracture through the lesion (Figure 1). Follow-up radiographs of the knees were classified regarding grade of osteoarthrosis, including examination during weight-bearing (Ahlbäck 1968). Clinical function was recorded as regards deformity, range of motion, stability, walking, occurrence of pain and patient's occupational status.

*Table 3. Final results according to type of surgical procedure*

| Therapy | No. of procedures | Recurrence | Change of procedure |
|---|---|---|---|
| Curettage + bone-graft | 22 | 12 | 12 |
| Curettage + acrylic cement | 14 | 2 | 0 |
| En-bloc excision | 19 | 2 | 1 |
| Amputation | 6 | 0 | 0 |

## Results

The rate of tumor recurrence was 12 of 22 with bone-filling, two of 14 with acrylic cement (Table 3) and two of 13 following en-bloc excision. Metastatic spread was observed in only two of the 46 cases. Among the cemented cases, all had a nearly normal range of motion, two had some pain, one had some swelling and two had some osteoarthrosis (Table 4).

In two of the cemented cases, the giant cell tumor recurred after 2 and 5 years, respectively (cases 3 and 14) and was repeatedly treated by additional curettage and acrylic cement, followed by another 3–4 years of observation. This means that the method was not a definite failure in any of our cases. The observation time was 3–11 years, on average 6.5. It should be added that one patient (case 7) was curetted and cemented in two stages. When the postoperative radiograph disclosed incomplete filling, a second operation was performed with additional cementation after 2 weeks.

All patients were able to walk without canes or crutches. One was able to take part in jazz-ballet (case 4) and one was active in cross-country skiing (case 3). None of the patients had changed occupation or retired because of the tumor disease. The grade of osteoarthrosis was evaluated in the series of knee radiographs, including examination during weight-bearing in four patients. Incipient osteophyte formation and slight narrowing of the joint space were observed in cases 1 and 4. Case 4 had been explored surgically because of recurrent effusion of the knee joint with negative bacterial culture, but there were no signs of recurrent disease, though slight osteoarthrosis was visible. This patient was the one doing jazz-ballet and working full time as a taxi driver, now 9 years after surgery. She was also one of the three cases with a pathological fracture at diagnosis. It was stabilized by cementation and followed without recurrence, including this second-look biopsy. In five of the 14 cases, there was a non-progressive zone of a few millimeters surrounding the cemented cavity (Fig. 2a–b), but without major irregularities, such as "scalloping" or cysts, suggesting recurrent disease, as in cases 3 and 14.

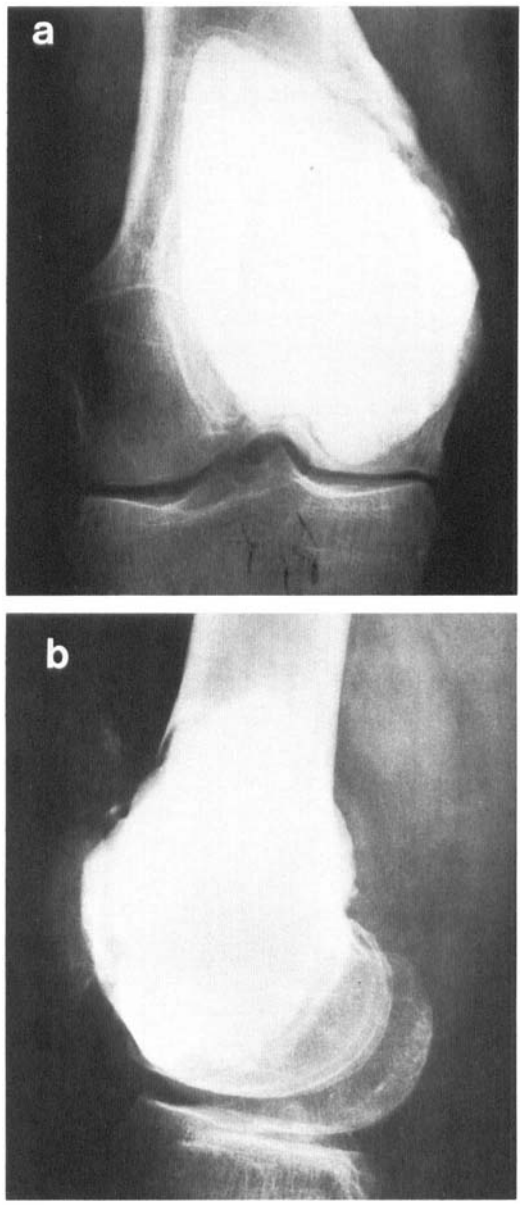


Figure 2 a and b. Postoperative radiographs 9 years after curettage and cementation showing well-demarcated radiolucent zone and Grade I osteoarthrosis medially.

## Discussion

The giant cell tumor of bone remains controversial by its semimalignant nature and its biphasic cell content. Using tissue culture, Feng Shun Han (1982) could demonstrate how tritiated thymidine was taken up only by the stroma cells and not by the giant cells,

*Table 4. Giant cell tumors curetted and cemented*

| Case | Age | Sex | Location | Size of cemented lesion (cm) | Symptoms (months) | Pathological fracture |
|---|---|---|---|---|---|---|
| 1 | 66 | F | P–TIB | 7×6×7 | 8 | – |
| 2 | 31 | F | T–Isc | 7×3×3 | 5 | – |
| 3 | 45 | F | P–TIB | 8×8×6 | 5 | – |
| 4 | 28 | F | D–FEM | 10×6×6 | 5 | + |
| 5 | 29 | M | P–HUM | 9×6×6 | 15 | + |
| 6 | 40 | F | D–FEM | 12×6×6 | 24 | – |
| 7 | 36 | F | D–RAD | 5×3×2 | 6 | + |
| 8 | 30 | M | D–FEM | 8×6×6 | 5 | – |
| 9 | 26 | F | D–FEM | 6×4×5 | 2 | – |
| 10 | 15 | F | P–TIB | 7×6×6 | 6 | – |
| 11 | 38 | F | P–TIB | 7×6×5 | 18 | – |
| 12 | 33 | F | D–FEM | 7×5×5 | 2 | – |
| 13 | 27 | F | P–HUM | 7×5×6 | 3 | – |
| 14 | 23 | F | P–TIB | 6×4×4 | 10 | – |

P = proximal; D = distal; T–Isc = tuber ischii.

suggesting that the latter are terminal. It was never observed that giant cells were formed by fusion of stroma cells or by division of their nuclei; however, it was found that Grade II and III tumors were easier to grow. The lack of correlation between histologic grading and clinical behavior has been proven (Dahlin et al. 1970). Sissons (1982) has shown that giant cell tumors, even without prior radiotherapy or surgery, can be frankly sarcomatous with a capacity to metastasize. This aggressive nature of giant cell tumors makes it reasonable to reintroduce the name "giant cell sarcoma", bringing it into the group of low-grade sarcomas with a similar behavior.

Lorentzon (1978) reported in a Swedish national material a higher recurrence after filling with bone than after curettage only, as suggested also in our series.

Acrylic cement has been used in reconstructive surgery for more than 30 years (Blum 1944) and has shown good compressive strength but a low bending strength, making it suitable for defects at the end of long bones, as in giant cell tumors. Acrylic cement was first used for this purpose in an attempt to create stability after curettage in two cases with giant cell tumors (Vidal et al. 1969).

The method was first used in Lund in 1972 in a case recurring after bone filling where arthrodesis of the knee was in question. Initial results (Persson & Wouters 1976) were good. The advantage of the method is that loss of function is minimal and that the immobilization time is negligible. Radiographic controls after surgery easily reveal a possible recurrence adjacent to the cement (Laurin et al. 1980). There is no necessity to differentiate between a recurrence and a remodeling process as is the case when bone filling has been used. Finally, if a recurrence should result or if the function of the joint is impaired, the original alternative methods of treatment remain open.

The rate of recurrence in this material was 2/14 in patients followed for more than 3 years, during which period, statistically, most recurrences of giant cell tumors are to be expected (Goldenburg et al. 1970, Lorentzon 1978). Cryosurgical management of giant cell tumors does not result in the same low recurrence, except in cases with cement after cryosurgery where no recurrence was reported in 10 cases (Marcove et al. 1978). The heat generated at polymerization might affect tumor cells left in the curetted cavity. It seems that the recurrence rate following curettage and cementation is about half of that after bone filling (Lorentzon 1978, Kiviluoto et al. 1981). Further, none of our 14 cases and the 10 cases of Marcove et al. (1978) were resected or amputated for recurrence following cementation, which means that the cure rate with this method is far better than with bone filling and actually approaches the cure rate obtained with radical en-bloc resection.

The disadvantages with acrylic cement

| Follow-up (years) | Local recurrence | Movement (degrees) | Pain | Working | Grade of arthrosis |
|---|---|---|---|---|---|
| 11 | – | Flex 0–100 Stable | – | Retired | 1 |
| 10 | – | Normal | – | Yes | 0 |
| 10 (4) | (+) | Normal | – | Yes | 0 |
| 10 | – | Flex 5–95 | – | Yes | 1 |
| 7 | – | Normal | – | No (Mb Down) | 0 |
| 6 | – | Normal | – | Yes | 0 |
| 6 | – | Dors flex 10, Vol flex 10 | + | Yes | 0 |
| 7 | – | Normal | – | Yes | 0 |
| 3 | – | Normal | – | Yes | 0 |
| 3 | – | Normal | – | Yes | 0 |
| 6 | – | Normal | – | Yes | 0 |
| 6 | – | Normal | – | Yes | 0 |
| 5 | – | Flex 40; Abd 40; ext normal | + | Retired | 0 |
| 4 (3) | (+) | Normal | – | Yes | 0 |

could be secondary osteoarthrosis, as in two of our cases. The fact that joint cartilage derives its nutrition from the synovial fluid might explain its tolerance of cement beneath it. Experimentally, however, in dogs, femoral-neck osteotomy produced more damage to the cartilage of the head when stabilization was created with acrylic cement to improve fixation at nailing (Manley et al. 1982). As used in our series, however, the cement seemed to be unexpectedly well tolerated.

If curettage with acrylic cementation now seems to be the method of choice for treating giant cell tumors, this is an exception to the basic principles of tumor surgery. The excision is neither compartmental nor wide. It is at best marginal and performed intralesionally. It is not suggested that other cystic, benign or low-grade malignancies should receive this treatment.

Probably radical en-bloc excision of giant cell tumors is necessary only for unusually large lesions. In the last consecutive series of 14 patients in Lund, for instance, 11 were cemented, two were resected en bloc and one was filled with bone. In our series infection has not been a problem, but prophylactic use of antibiotics in the cement will reduce the risk further, and in the future tumor-directed chemical agents might become available, as additives.

## References


Ahlbäck, S. (1968) Osteoarthrosis of the knee. A radiographic investigation. *Acta Radiol.* Suppl. 277.

Blum, G. (1944) Experimental observations of the use of absorbable and non-absorbable plastics in bone surgery. *Proc. R. Soc. Med.* **38**, 169–180.

Dahlin, D. C., Cupps, R. E. & Johnson, Jr., E. W. (1970) Giant cell tumor: A study of 195 cases. *Cancer* **25**, 1061–1070.

Enneking, W. F. & Shirley, P. D. (1977) Resection – arthrodesis for malignant and potentially malignant lesions about the knee, using an intramedullary rod and local bone grafts. *J. Bone Joint Surg.* **59**-A, 223–240.

Feng Chuan Han (1982) Tissue culture and cinemicrographic study on giant cell tumors of bone. *Am. Acad. Orthop. Surg. Bull.* **30**, 24–25.

Goldenburg, R. R., Campell, C. J. & Bonfiglio, M. (1970) Giant cell tumors of bone. An analysis of 218 cases. *J. Bone Joint Surg.* **52**-A, 619–664.

Kiviluoto, O., Salenius, P. & Santavirta, S. (1981) Acrylic cementation in treatment of benign bone tumors. *Acta Orthop. Scand.* **52**, 443.

Larsson, S. E., Lorentzon, R. & Boquist, L. (1975) Giant cell tumor of bone. *J. Bone Joint Surg.* **57**-A, 167–173.

Laurin, S., Ekelund, L. & Persson, B. M. (1980) Late recurrence of giant cell tumor of bone: Pharmacoangiographic evaluation. *Skel. Radiol.* **5**, 227–231.

Lorentzon, R. (1978) *Genuine giant cell tumor of bone.* Umeå University Medical Dissertations no. **33**.

Manley, P. A., McKeown, D. B., Schatzker, J., Palmer, N. C. & Carman, S. (1982) Replacement of epiphyseal bone with methylacetatacrylate: Its effect on articular cartilage. *Arch. Orthop. Traumat. Surg.* **100**, 3–10.

Marcove, R. C., Weis, L. D. Vagihaiwalla, M. R., Pearson, R. & Huvos, A. G. (1978) Cryosurgery in the treatment of giant cell tumors of bone. *Cancer* **41**, 957–969.

Persson, B. M. & Wouters, H. W. (1976) Curettage and acrylic cementation in surgery of giant cell tumors of bone. *Clin. Orthop.* **120**, 125–133.

Sissons, H. A. (1982) Personal communication (New York).

Vidal, I., Mimran, R., Allieu, Y., Jamne, M. & Goalard, G. (1969) Plastic de comblement par metacrylate de methyle traitement de certaines tumeours osseuses benignes. *Montpelliers Tome* **XV**, No. 4.