Percutaneous autogenous bone marrow grafting in 20 cases of ununited fracture

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We grafted autogenous bone marrow percutaneously to stimulate healing in 20 ununited long bone fractures. 15–20 mL of bone marrow was injected twice, with an interval of 3 weeks. All cases were immobilized in a plaster cast. 17 cases united in 5 (3–7) months.

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In the rabbit we have found that percutaneous bone marrow grafting accelerated bone healing (Sharma et al. 1992). This method has now been applied in ununited fractures.

Patients and methods

Between January 1990 and May 1992, 20 patients were treated for nonunion of long bone fractures, 15 in the tibia, 3 in the humerus, and 2 in the ulna. The average age was 35 (18–65) years. All the cases were earlier treated by various conservative and/or operative methods (Table 1), either by us or referred to us by other doctors. We treated all patients by percutaneous bone marrow grafting and plaster cast immobilization. The average time from injury to bone marrow grafting was 10 (6–18) months (Table 1). Locally, skin was poor in 5 cases and not fit for open surgery without a skin flap.

The procedure was performed under general anesthesia. Under aseptic conditions bone marrow was aspirated from the posterior iliac crest. Simultaneously a 16-gauge spinal needle was inserted into the site of nonunion. At least 3–4 aspirations were made giving about 5 cm^3 of marrow each time. A total of 15–20 cm^3 of marrow was injected at the nonunion site immediately after aspiration, and the limb was immobilized in a plaster cast. This procedure of percutaneous bone marrow injection was repeated after 3 weeks in all cases. Radiographs were taken monthly. The limb was kept in plaster until there was clinical and radiographic evidence of union. Patients were kept non-weight bearing for 6 weeks postoperatively followed by protected weight bearing until union. Prophylactic antibiotics were not used.

Table 1. Tubular bone pseudarthrosis treated by percutaneous bone marrow grafting

A	B	C	D	E	F	G
1	C	1	1	7	1	3
2	1	1	1	8	1	4
3	C	1	1	12	1	3
4	2	1	2	14	1	6
5	C	2	1	6	1	3
6	C	1	1	8	1	6
7	C	1	1	10	1	4
8	1	1	1	8	1	7
9	1	1	1	7	1	6
10	2	1	2	18	2	–
11	C	3	1	9	2	–
12	C	2	1	9	1	4
13	3	1	2	15	1	6
14	1	3	1	7	1	4
15	3	1	2	10	2	–
16	C	2	1	8	1	4
17	C	1	1	10	1	6
18	1	1	1	12	1	6
19	C	1	1	8	1	5
20	1	1	1	9	1	7

A Patient
B Type of fracture
  C closed, open types 1–3
C Site of nonunion
  1 tibia
  2 humerus
  3 ulna
D Initial treatment
  1 plaster cast
  2 external fixator + plaster cast
E Time to marrow injection (months)
F Healed
  1 yes
  2 no
G Healing time (months)

Figure 1. Case 5

Nonunion distal end of left humerus.

Bridging of defect in 3 months after grafting.

Results

17 of the 20 nonunions healed in 5 (3–7) months.

Case 5 was a 30-year-old woman with fracture of the distal left humerus, treated with plaster cast immobilization but ununited after 6 months (Figure 1). No attempt was made to correct the deformity. The fracture united 3 months after bone marrow grafting, and the elbow regained full extension with 15° short of full flexion.

Failures with this technique were Cases 10 and 15, which were compound tibial fractures with bone loss and Case 11, a closed ulnar fracture.

Discussion

McGaw and Harbin (1934) were among the first to demonstrate the osteogenic activity of bone marrow. Burwell (1964) demonstrated that bone grafts containing bone marrow were more osteogenic. Since bone marrow has a liquid texture, it can be injected percutaneously. We have used this technique earlier in rabbits (Sharma et al. 1992), and found that it increased callus production, resulting in early healing of radial osteotomies and bony defects.

Our union rate was comparable with that of Connolly et al. (1991) who used a single injection of 100–150 cm^3 of bone marrow. We have also tried our method in 3 cases of congenital tibial pseudarthrosis; 1 healed and 2 did not. Although percutaneous bone marrow injection does not promote healing more rapidly than would standard operative grafting, it has many distinct advantages over the latter. It is safe, easy, practical, and time-saving. It is economical and involves minimal trauma. It avoids donor site problems and can be repeated easily. It can be done under local anesthesia and avoids the risks of general anesthesia, infection and surgery. It can be done in cases which are not fit for open bone grafting because of poor condition of the skin.

References

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