SOME METHODS OF ACCELERATING THE RECONSTRUCTION OF THE BONE HOMOGRAFT

L. M. Okuneva

UDC 612.6.02 : 612.75

After rejection of a homograft the animal becomes sensitized and a second homograft from the same donor is rejected sooner than the first [2, 6]. This accelerated rejection of the second graft may be obtained by using, instead of the primary graft, an injection of antigenic material from the cells of the same donor [6]. It was decided to make use of this phenomenon during homotransplantation of bone tissue.

In the present investigation an attempt was made to accelerate the reconstruction of a bond homograft by intensifying the immunologic reaction. To do this, homotransplantation of bone was accompanied by immunization of the recipient with various extracts of the donor's tissues (bone, blood, spleen, liver) before and after transplantation. The tissues of the same donor were used for both immunization of the recipient and transplantation.

EXPERIMENTAL METHOD

The experiments were carried out on 82 rabbits, including 15 donors and 67 recipients. The metatarsal bones of the donor rabbits were remobed and stored for 1 month at − 20°, and the tissues (bone, blood, spleen, and liver) were taken for immunization.

The tissue extracts were prepared as follows. By means of a homogenizer for solid tissues, 1 ml of fluid was obtained from 10 g of the metatarsal bones, and 10 ml of physiological saline was added to each, and the mixture was filtered through two layers of gauze. Blood was taken from the donor rabbit's heart into a 2% solution of sodium citrate.

The recipient rabbits were immunized 3 days before homotransplantation and 3, 7, 10, and 15 days after the operation. The tissue extracts of bone, spleen, and liver were injected subcutaneously in a dose of 1 ml, and the blood in a dose of 5 ml.

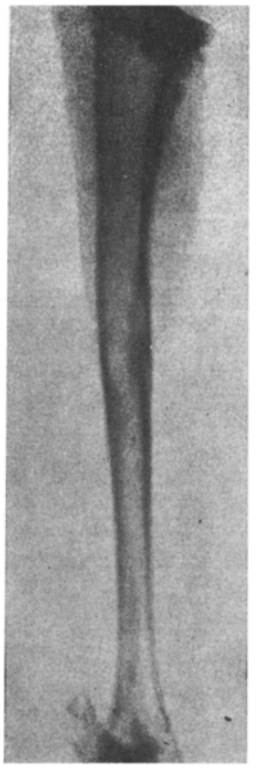
Homotransplantation of bone tissue was performed on all the recipients in I. M. Moiseenko's modification [1]. Under anesthesia (0.5 ml of a 1% solution of trimeperidine, subcutaneously), after treatment of the operation field with 3% tincture of iodine, the soft tissues were divided on the anterior surface of the leg to expose the tibia, the periosteum was stripped, and osteotomy performed with a circular saw operated by a dental drilling machine. The homograft (the metatarsal bone of a rabbit), after being frozen in physiological saline with antibiotics, was introduced into the medullary canal. The wound was clothed in layers with catgut. A plaster cast was applied to the limb on which the operation was performed, immobilizing the knee and ankle joints. In every case good apposition and firm fixation of the tibial fragments were obtained and the homogeneous structure and uniform size of the grafts facilitated observations on their reconstruction.

Depending on the tissue used for immunization, the recipient rabbits were divided into five series: the ten rabbits of series I were immunized with bone tissue homogenate, the 15 rabbits of series II were injected with blood from the donor rabbit, the 10 rabbits of series III were immunized with spleen extract, the 10 rabbits of series IV were immunized with liver extract, and the 7 rabbits of series V (control) underwent homotransplantation of bone tissue without any other treatment.

EXPERIMENTAL RESULTS

Roentgenograms of the rabbits of series I taken one month after the operation showed that the homograft could be distinguished over the whole of its length corresponding to the site of the fracture, its outlines were clearly defined, and signs of periosteal repair were clearly evident. Examination after 3 months showed that the graft was

Donetsk Research Institute of Traumatology and Orthopedics (Presented by Active Member of the Academy of Medical Sciences of the USSR S. R. Mardashev). Translated from Byulleten' Éksperimental'noi Biologii i Meditsiny, Vol. 63, No. 4, pp. 89-91, April, 1967. Original article submitted August 28, 1965.



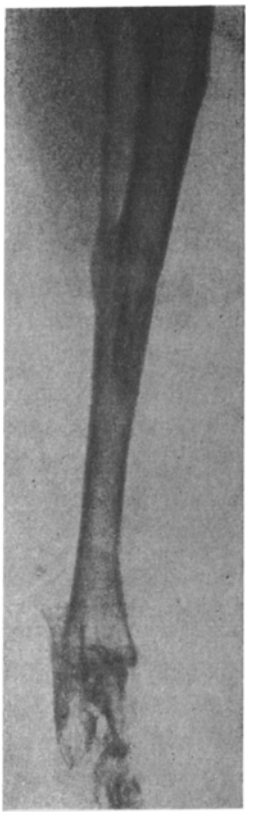


Fig. 1 Fig. 2

Fig. 1. Complete absorption of the homograft with restoration of the structure and the medullary canal of the tibia.

Fig. 2. Partial absorption of the homograft with well marked endosteal and periosteal reactions.

still visible but its outlines were less distinct and its shadow was much less dense, and the reparative changes in the tibia were well marked. After 4-5 months the homograft was still visible, although its outlines were indistinct because of absorption. The reparative phenomena were well marked. After 6 months the shadow of the graft could no longer be distinguished because of total absorption, and the reparative phenomena in the tibia, both periosteal and endosteal, were well marked.

The animals of series II differed from those of series I by the fact that the shadow of the graft could no longer be distinguished as a result of complete absorption 3-4 months after transplantation. The reparative phenomena were well marked. The best results were obtained in the experiments on the rabbits of series III: the homograft was completely absorbed after 2.5-3 months (Fig. 1). By this time the medullary canal was completely restored. The endosteal and periosteal reparative phenomena were well marked. The results obtained with the rabbits of series IV were almost the same.

The control animals (series V) and the experimental animals of series IV differed from the others in their longer period of reconstruction of the homograft. In contrast to the rabbits of series II and III, the shadow of the homocraft could still be distinguished throughout its length 3 months after the operation (Fig. 2). The homograft was completely absorbed 6-7 months after transplantation. The reparative phenomena were well marked.

The results of these roentgenologic examinations give evidence of the reconstruction of the bone and the development of reparative phenomena only in the presence of well marked morphological changes, whereas the description of the finer changes requires histological investigation. However, the results obtained show clearly that immunization of rabbits with bone tissue evokes a very slight immune reaction. This may be attributed to the fact that bone contains only 30% of immunologically active organic substances [5].

Immunization with spleen extract doubled the rate of reconstruction of the bone homograft. These results are clearly attributable to the well recognized fact of the high immunologic activity of this organ.

The shortening of the process of absorption of the homograft and its replacement by the recipient's tissue 2-3 months as a result of immunization with liver extract and whole blood also confirmed the immunologic activity of these tissues, which in this case was particularly important. It may be concluded from the results obtained that when cadaver blood and bone tissue from the same donor is used in clinical conditions, the reconstruction of the bone homograft may be accelerated, and the duration of the patient's treatment correspondingly shortened.

LITERATURE CITED

1. I. M. Moiseenko, in the book: Treatment of Injuries and Their Effects [in Russian], Kiev (1964), p. 81.
2. N. V. Shchedrakov, in the book: Problems in Transplantation and Conservation of Organs and Tissues [in Russian], Moscow (1959), p. 200.
3. N. V. Shchedrakov, Abstracts of Proceedings of the Second All-Union Conference on Tissue Incompatibility and the Conservation and Transplantation of Tissues and Organs [in Russian], Odessa (1961), p. 30.
4. R. E. Billingham, L. Brent, and P. B. Medawar, Proc. Roy. Soc., B., 143 (1954), p. 58.
5. M. Janeček and V. Horn, Beitr. Orthop. Traum., Bd. 11 (1964), p. 303.
6. R. D. Owen, in the book: Immunity and Virus Infection [Russian translation], Moscow (1962), p. 44.