Bone-Marrow Grafting Procedure

Bone-marrow harvesting was performed during the same operative session as the core decompression. About 400 mL of marrow was obtained from the anterior iliac crest with a standard needle employed for aspiration of bone marrow. The marrow was transferred directly into the bag of the bone-marrow collection kit (R4R 2107; Baxter, Deerfield, Illinois). Five hundred milliliters of a buffer solution containing 400 mL PBS (Nexell, Irvine, California), 25,000 U heparin (Braun, Jaen, Spain) and 100 mL of human albumin (Croix Rouge de Belgique, DCF, Brussels, Belgium) was used as an anticoagulant. The bone marrow was filtered to eliminate bone spicules, fat, and cellular debris. The bone-marrow cells were then gravity-filtered through a series of mesh filters with a successively smaller diameter and were collected in a sterile plastic transfer pack. Mononuclear cells were sorted on a Cobe Spectra cell separator (777006-300; Cobe, Lakewood, Colorado) and were concentrated to a mean final volume of 51 ± 1.8 mL. The 51 mL of mononuclear cells were injected through the trephine that was placed into the necrotic lesion. The injection of 51 mL was possible since the necrotic zone is not solid. The intertrabecular spaces of the necrotic zone are preserved as shown by Hauzeur et al.[15]. The injection was performed slowly and lasted a few minutes. In some cases, the pressure to inject the marrow was high, but it was never measured. Leakage of marrow might have occurred through the trephine site or through the circulation of the femoral head. However, for two hips, the bone marrow was mixed with Tc-99m-labeled leukocytes to evaluate the leakage of the bone marrow through the trephine. Two percent of the Tc-99m leukocytes leaked through the trephine, and 90% remained in the femoral head. Bacterial and fungal cultures were cultivated for each bone-marrow implantation. The mean number of leukocytes injected was $2.0 \pm 0.3 \times 10^9$, including 1.0% ± 0.2% of $CD34^+$ cells, which are precursors of hematopoietic cells. Fibroblast colony-forming units were used as an indicator of stromal cell activity[9]. The mean number of fibroblast colony-forming units was $92 \pm 9/10^7$ cells. The sorted bone-marrow mononuclear cells contained lymphocytoid cells (mean, 29% ± 2.2%), monocytoid cells (4% ± 1%), and myeloid cells (6% ± 1.3%).