MASSIVE BONE ALLOGRAFTS IN RECONSTRUCTIVE SURGERY

THESIS

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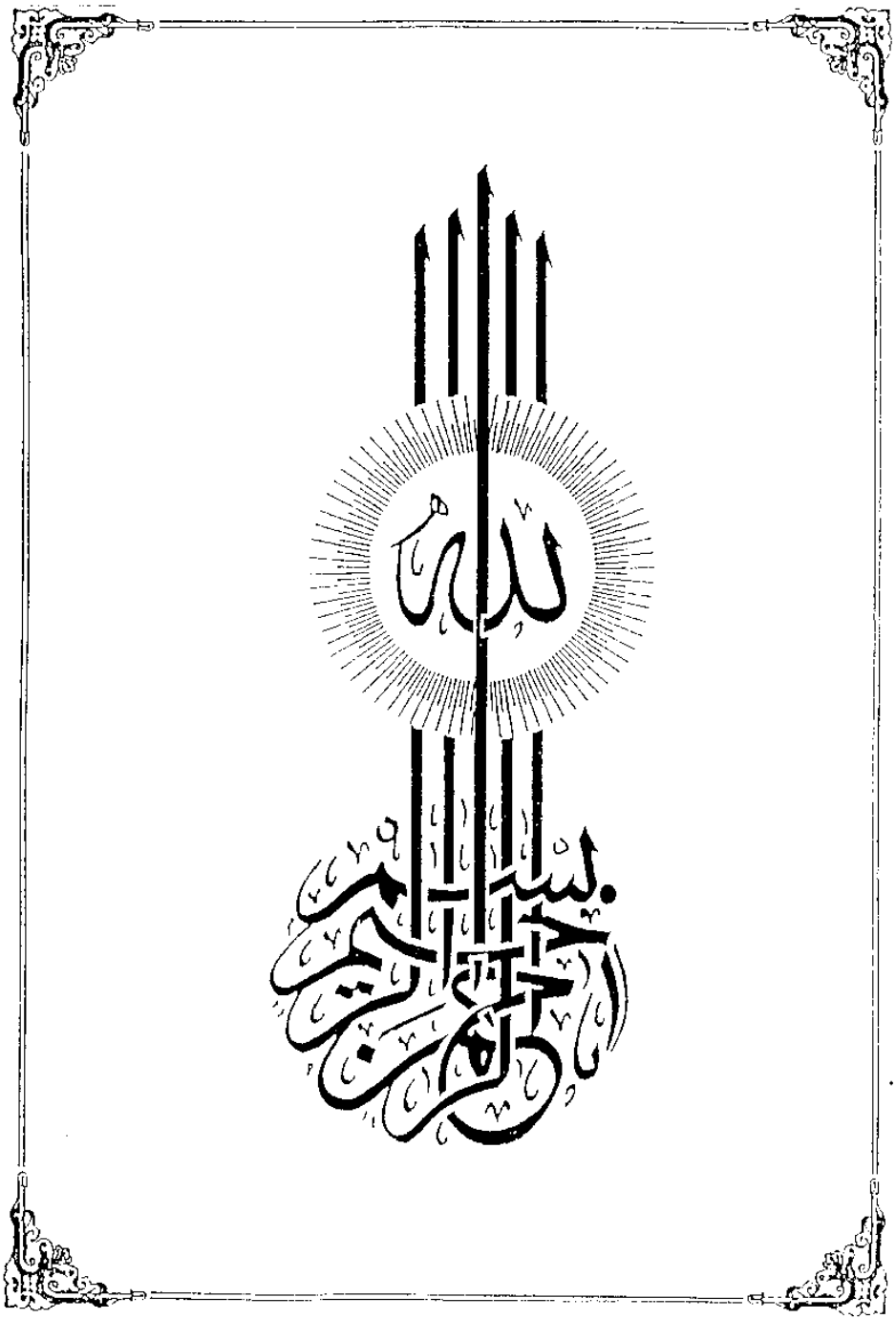

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INTRODUCTION

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Bone grafting has always played a prominent role in the treatment of various orthopaedic conditions. The availability of appropriate bone for transplantation remains an important surgical problem.

There are three types of bone grafts: autograft - bone transferred from one area to another in the same individual, allograft (formerly known as the homograft) - bone transplanted from one individual to another, and the xenograft (or heterograft) - bone transplanted between different species of animals. The term isograft refers to grafts from one identical twin to the other.

Traditionally, the orthopaedic surgeon has preferred to use autogenous bone graft due to its superior osteogenic capacity, ease of incorporation, and lack of immunological problems. However, the acquisition of an autogenous bone graft entails risks to the patient and there are

circumstances under which suitable autogenous graft material is unavailable, as in the replacement of massive bone defects or articular surfaces. In an effort to circumvent these problems, surgeons have turned to the use of allografts or even xenografts. The use of bone allografts in the reconstruction of skeletal defects has a long history in orthopaedic surgery.

In this retrospective study we are going to review the literature concerning history, vascular response, cellular behavior, immunological aspects, technique in donor grafts, indications, current prospectives and future directions of massive bone allografts in reconstructive surgery.

HISTORICAL REVIEW

Fig. 1 (after Mankin et al., 1983)

Historical Review

The history of the use of allograft goes back to antiquity, and in fact, to legend. The patron saints of allograft transplantation are Cosmos and Damian, twins born in the third century in Near Eastern Island of Celicia. Cosmos, a physician and Damian, a surgeon, performed many unusual medical feats in their lifetimes. But they angered the Roman emperor, Diocletian and were sentenced to death in 287 A.D. In the fifth century A.D., Cosmos and Damian performed a miracle in Basilica in Rome. A faithful church warden with a tumour of the leg, exhausted by his suffering, fell asleep during his prayers and the twin saints appeared to him in his dreams (fig. 1) and performed a surgical procedure. The saints first resected the diseased limb and then replaced it with a portion of the lower extremity from a man who had died the same day (Mankin et al., 1983).

Free plastic operations with the use of bone tissue were evidently connected with the work of Pirogov (1853) and the purposeful research conducted by Ollier (1867) who both applied the technique of introducing a contrast medium into vessels to study blood supply to the transplanted bone graft (Amamaliev, 1975).

The first reliable account of a successful allograft of human bone was that of MacEwen in (1880) in Glasgow (Watson-Jones, 1982; Friedlaender et al. 1984). MacEwen implanted a number of bone wedges excised during corrective osteotomies from six patients, for replacement of the entire humeral diaphysis of a 3 year old child which had been removed due to persistant osteomyelitis. The grafted wedges were laid as small chips into a prepared trough in soft tissue. The transplanted bone regenerated and the rebuilt humerus measured six inches. Twenty years later the young man had a humerus eleven inches with a function so good that he earned his living in a heavy manual work (Watson-Jones, 1982).

In more modern times, the first large series of allograft transplantations was reported in 1908 by Lexer, who performed 23 whole and 11 hemijoint transplants about the knee (Mankin et al. 1983; Friedlaender et al. 1984). Lexer subsequently evaluated the patients and in 1923 he declared that 50% had successful results (Lexer, 1925).

The use of stored frozen homogenous bone transplant was introduced by Bush and Garber, (1947) and by Wilson, (1947). These reports with that of Inclan, (1942) were the first noteworthy clinical advances in the use of homogenous bone since the publication of the work of Ollier, (1867) (Carr, C.R. et al. 1955; Friedlaender et al. 1984).

But it was not until (1960) that reports of several, large series appeared. The reason for the reawakened interest in this procedure was related to the discovery that the immunogenicity of graft could be reduced by freezing (Herndon and Chase, 1954, Curtiss et al. 1959; Mankin et al. 1983).

The long term follow up evaluation of patients by Parrish (1973) was the most important clinical contribution,since it demonstrated that grafts were subsequently partially replaced and incorporated by the host and that joints could be preserved for as long as 20 years after surgery.

VASCULAR RESPONSE

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Bone always dies when deprived of its circulation. However, the surface cells associated with bone - in the deep layers of periosteum, in endosteum and on the trabecular surfaces - are able to survive for short periods even in the absence of blood supply. They are apparently preserved by diffusion of nutrient fluids from the recipient. The evidence of such viability includes the ability of the surface cells to proliferate in tissue culture. A common physiological test: viable cells produce dehydrogenase which causes reduction of methylene blue and the cells fail to stain. If the bone is devitalized completely, the dead cells are intensely stained by the unreduced methylene blue.

The surviving surface bone cells possess the capability of laying down matrix, but the development of haversian systems depends on sufficient vascular ingrowth. Thus, some of the bone cells can survive temporary loss of blood supply and retain their bone-forming capacity, can be preserved by