BONE BANK

THESIS

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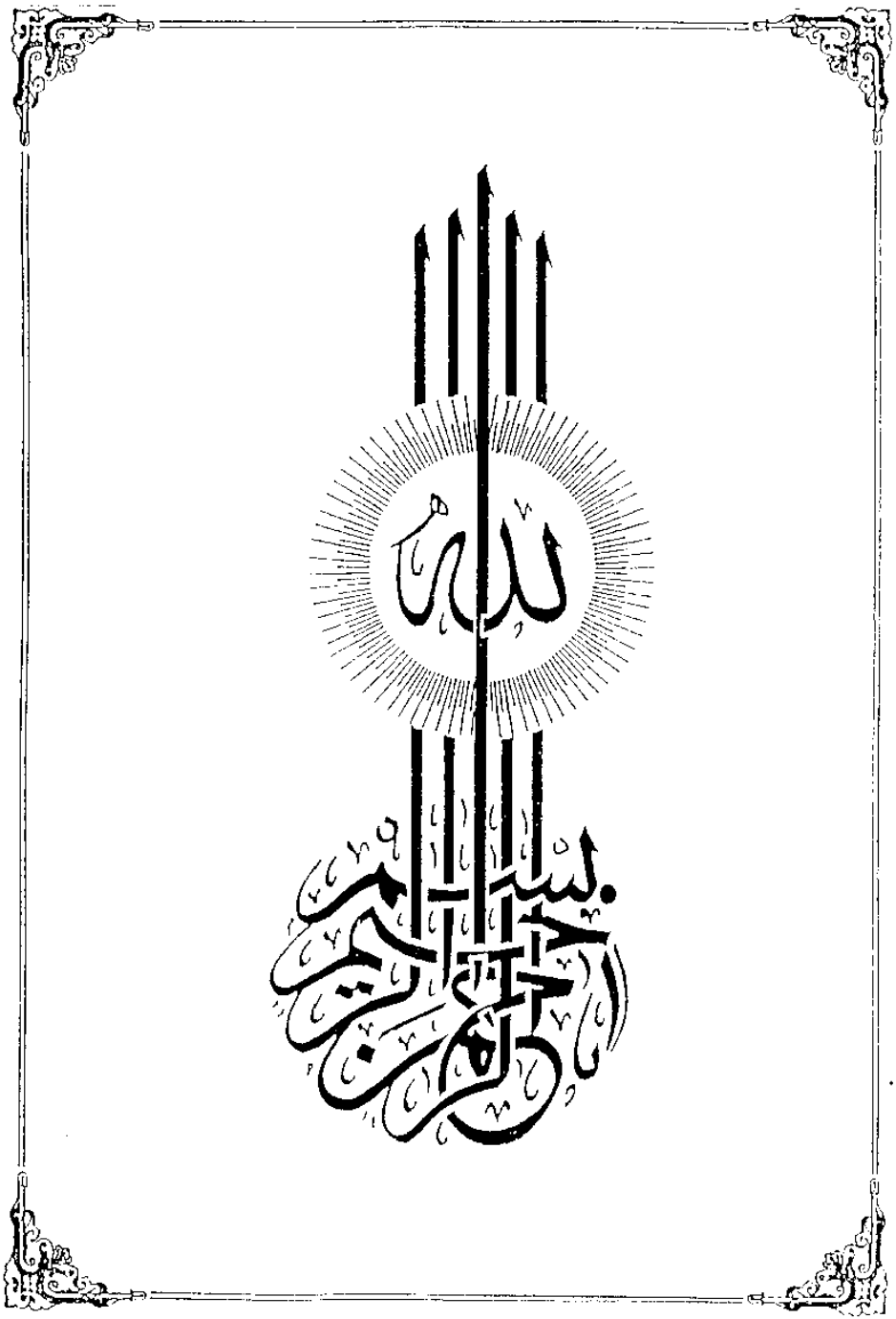

C O N T E N T S

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INTRODUCTION

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Bone grafting have been used in orthopaedic surgery with great clinical success. There are various types of bone transplants in current use: an autograft, isograft, allograft and xenograft.

It is generally conceded that bone autografts are far superior to any other type of bone grafts, therefore, the overwhelming majority of surgeons prefer autologous bone, due to its superior osteogenic capacity, ease of incorporation and lack of immunological problems. However, with the more widespread application of bone grafting particularly for spinal fusion and the replacement of large bony defects caused by trauma or wide resection of tumours, large amounts of bone are required and are not always available as autografts especially in children and elderly osteoporotic patients. Moreover, procuring autografts requires an additional surgical procedure on the same patient, heightening the risk of infection, increasing blood loss, lengthening the operation time and leading to possible increased morbidity. Consequently, extensive research and many methods of preparing preserved allografts and xenografts have been explored.

The most expeditious way of providing these grafts is through tissue bank (Malinin, 1965).

The actual clinical applications of human allografting, however, have occurred much more recently, awaiting not only improved surgical skills, methods of internal fixation, appropriate anaesthesia and satisfactory aseptic techniques, but also the availability of dependable banked bone.

In this study we are going to review the literature concerning legal environment , donor selection, procurement, preservation and storage, filing and record keeping , administrative consideration and immunological aspects of banked bone allograft.

HISTORICAL REVIEW

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It is essential to review the history of bone transplantation and to clarify the milestones of its development into a bone bank. This will help in appreciating the advantages of operating a bone bank.

The history of the use of the allograft goes back to antiquity and to legend. The legend of Cosmos and Damian dates back to 287 A.D.; it records the first alleged transplantation of a lower limb from a cadaver, within hours after death, to a man suffering from a tumour of the leg (Mankin et al., 1983) (Fig. 1).

In modern times, Ollier (1830 - 1900), is credited with the first clinical experiment. In 1859 he transplanted a rabbit's radius into an ununited fracture of the tibia (Burwell, 1983).

Macewen, in 1879 was the first to transplant bone from a human being to another successfully. It was a great achievement that opened a new field in bone surgery. He transplanted a number of wedges from

Fig. [illegible]: (After [illegible] et al., [illegible]).

tibial osteotomies on many patients into the humerus of a three years old boy with persisted osteomyelitis (Dick, 1946).

In 1908 Lexer replaced the proximal end of the tibia of a human subject with a corresponding bone from a recently amputated leg (Lexer, 1925).

Carrel reported in 1910, his extensive work on preservation and transplantation of various types of human tissues after storing them in Ringer's solution and plasma at temperature of 1 to 2 degrees centigrade.

Orell, in 1932, reported on the use of ospurum. This was bone from which the organic element had been removed by chemical treatment.

Inclan in 1942, was the first to report the use of autogenous bone grafts that were removed at one operation, then stored in sterile jars containing citrated blood or Ringer's solution at temperatures of two to five degrees centigrade, and then transplanted at a second operation.

In 1946, a deep-freeze units was installed at the hospital for special surgery in New York,and Wilson began to use refrigerated homogenous bone as a substitute for fresh autogenous bone in surgical procedures. The results were satisfactory. This was the beginning of what we now call the bone bank (Bush, 1948).

Weaver, in 1949, used refrigerated homogenous grafts which had been obtained from amputated limbs or from fresh cadavera.

Freeze-dried bone allograft was introduced for orthopaedic reparative surgery in the United States Navy Tissue Bank by Kreuz in 1951 (Kreuz et al.,1951).

It was only in the sixties that interest in transplantation was reawakened by the increasing knowledge in immunology of tissue transplantation, preservation and sterilization of tissues, internal fixation of the skeleton, and the control of infection (Burwell, 1970).

IMMUNOLOGICAL ASPECTS

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Sources of allograft immunogenicity:

A] Bone:

Bone is composite tissue containing cells, collagen, ground substance , and inorganic minerals. The sources of bone related immunogens are many.

There is no evidence to suggest that hydroxy-apatite crystals or other mineral molecules common to bone are immunogenic.

Collagen is a weak antigen, even in the presence of adjuvants (Friedlaender et al.,1983).

Recent studies showed that other matrix components, particularly proteoglycans, are capable of evoking significant immune responses. Cell-mediated immunity against the proteoglycan monomer was demonstrated after rejection of joint allografts in animals (Burchardt, 1983).

The cell population of bone is heterogenous and includs osteogenic, chondrogenic, fibrous, haemopoietic, vascular and primitive mesenchymal elements.

The cell surface possess many important transplantation antigens. It is also probable that many cellular antigens that are not considered part of the major histocompatibility system (MHS) are also capable of eliciting immunologic responses.

Studies have demonstrated that the most potent source of immunogenicity is in the bone marrow rather than in cortical bone. These marrow cells exist in all bone grafts and can not be eliminated by simple washing or irrigation. In addition to their role in stimulating immune responses, marrow-derived cells also participate in bone repair and graft incorporation.

Serum antibodies produced against bone allografts are reduced in amount if the graft was freed from marrow (Friedlaender, 1983).

Within about 2 to 3 months, the bone cells die and their antigen disappear, therefore, the major antigenic stimulus to the immune response occur primarily during the first few weeks following transplantation.