



Demand and supply of bone allograft and the role of orthopaedic surgeons

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This study assessed factors responsible for exclusion of patients from bone donation at primary hip arthroplasty in order to improve bone banking.

Fifty-five patients underwent screening in preoperative clinics assessing their suitability for femoral head donation. Records at the bone bank were then reviewed post operatively to check whether bone had been harvested from these individuals during surgery.

Overall, 95% of the patients screened did not proceed to bone banking. After the initial screening stage 60% of patients were excluded. The majority of exclusions (70%) were unacceptable as donors because of their potential risk of transmission of disease to recipients. Although 40% were consented for donation, femoral heads from only 5% were harvested and sent for storage in the bone bank during hip arthroplasty.

Orthopaedic surgeons must take an active part in bone banking and alternative sources of bone grafts require exploration in the future to meet the increasing demand.

Keywords : bone allograft ; femoral head ; bone banking.

INTRODUCTION

Bone allograft transplantation was first performed in human beings in 1880. However availability of bone allograft remained one of the major issues during the initial hundred years. When bone graft was required in this era it was predominantly autograft which was used (14).

During the past twenty years, bone allograft has been frequently transplanted, but the major issue related to the risk of communicable diseases such as Hepatitis B and HIV has always been a consideration.

Current practice of bone banking involves careful donor selection, stringent screening tests and internal safety systems in bone banks to prevent the transmission of communicable diseases (8).

During the last decade there has been a change in the clinical use of bone allograft (10). Previously bone allografts were mainly used for spinal fusion surgery, but presently the majority are used to reconstruct defects during revision hip arthroplasty (34%) and for fracture surgery (24%). Furthermore the need for bone graft has increased in the recent years as primary hip arthroplasty is being performed in younger patients, and the rate of revision hip surgery keeps increasing (11).

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Utilisation of large quantities of bone allograft in revision arthroplasties has created an imbalance between demand and supply (2, 5, 12).

Our study explored various factors responsible for the exclusion of patients undergoing primary total hip replacement surgery from bone banking, in order to improve the number of donors to meet the demands of bone grafting in the future.

METHODS AND MATERIALS

A prospective study of fifty-five patients was conducted at two hospitals in Portsmouth (UK) over a three-month period. The data was collected during the routine preoperative assessment clinic performed prior to primary total hip replacement surgery. Having ascertained whether an individual was amenable to femoral head donation, his/her suitability was assessed through interview, including the use of donor selection questionnaire and review of the individual's medical notes. The criteria set out by National Blood Service (NBS) for tissue donor selection was followed. All patients undergoing primary total hip arthroplasty were included. A standard pro forma was used to record the various reasons for exclusion from bone banking.

Patients considered suitable for bone banking were consented for this at the preoperative clinic. The records at the bone bank were then reviewed post operatively to check whether bone had indeed been harvested from these individuals.

RESULTS

A consecutive series of 55 patients undergoing primary hip arthroplasty were screened for their suitability as donors of bone.

Overall, 52 of the patients (95%) did not have bone harvested for allograft donation, leaving 3 patients (5%) who proceeded to bone banking (fig 1).

After the initial screening stage, 33 patients (60%) were deemed unsuitable. The majority of those excluded (23 patients) exhibited the potential of transmission of disease to the recipients (fig 2).

These included patients with a history of medical disorders with an unknown aetiology e.g. rheumatoid arthritis, as well as those with a known causative transmissible agent such as tuberculosis

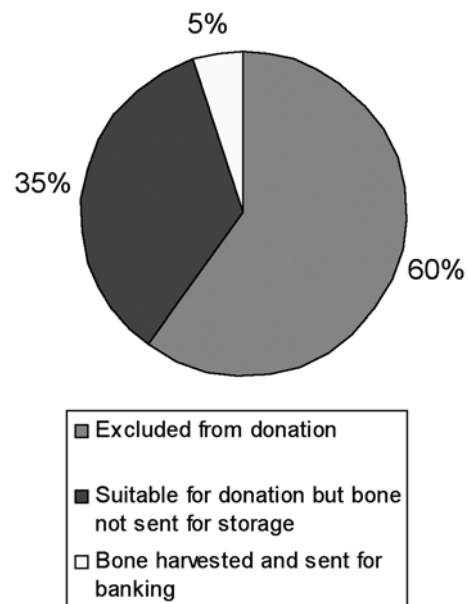


Fig. 1. — Percentage of outcome from screening to surgery

and diphtheria. Moreover, 4 patients (7.27%) had previously been diagnosed with cancer and this resulted in automatic exclusion for bone donation. Patients with orthopaedic disorders, dentition problems and blood transfusion before 1980 with the possibility of latent infection were also considered unsuitable (table I).

After assessment at the pre-operative clinic, 22 patients (40%) were consented for allograft donation. However it was found that femoral heads from only 3 patients (5%) were actually harvested and sent for storage in the bone bank during the course of their primary hip arthroplasty.

DISCUSSION

Bone grafts are used extensively in orthopaedic reconstructive surgery. Allografts, autografts and xenografts use have all been described in the literature (7).

The number of revision hip and knee arthroplasties has increased steadily in the past decade. According to one study, more than 10% of total hip arthroplasties are of revision in nature (6). The use

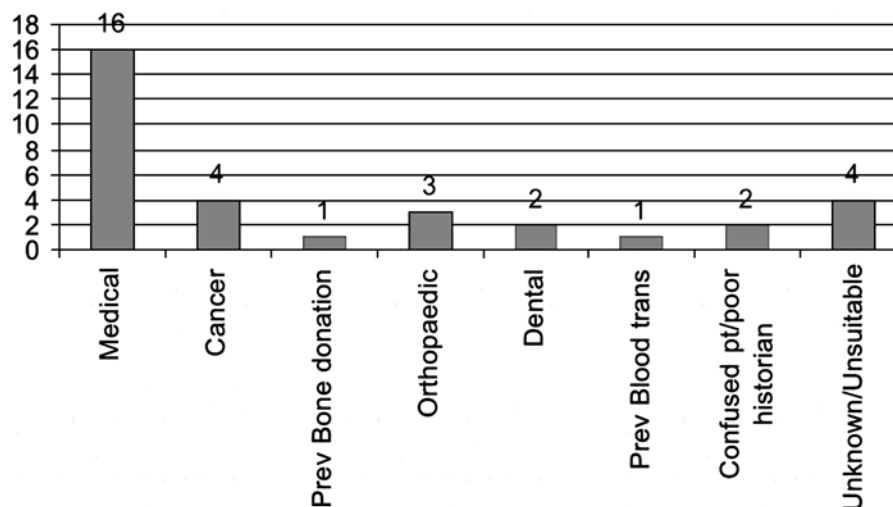


Fig. 2. — Contraindications to Bone Banking in Categories*

Table I. — Showing details of various categories of pre-consent donor exclusion

Category	Explanation
Medical disorder of unknown aetiology	Sero-negative arthritis, rheumatoid arthritis, antibodies of unknown origin, under investigation for anaemia and weight loss, unsuitable at previous screening, renal dysfunction
Medical disorder of known aetiology	Past history of tuberculosis, diphtheria, jaundice, cellulites both legs, foot ulcer, body piercing within last 12 months, UTI, fertility treatment post 1987, alcoholic liver disease, nitrates++ in urinalysis, high risk behaviour to sexually transmitted diseases, Turner's syndrome
Cancer	Carcinoma breast, CA head of pancreas, CA colon and CA prostate
Orthopaedic	History of osteomyelitis, hemiarthroplasty and DHS
Previous bone donation	Already donated bone during primary hip replacement and came for revision surgery
Dental	Need for dental treatment and recurrent gingivitis
Blood transfusion	Previous history of blood transfusion before 1980
Poor historian	Dementia and confused regarding past medical history
Unknown	Patient answered yes to 2 questions of bone bank questionnaire but no specification given and unable-not known why
Time limitations	Unable to go through screening due to clinic time limitations

of allograft bone for reconstructing bone defects has increased at similar rates (3, 13). Revision hip arthroplasty often presents surgeons with a large amount of bone loss which can sometimes be addressed using donated bone by an impaction-grafting technique. It has been estimated that on an average 2.4 femoral heads are required to reconstruct the proximal femur when bone stock has been lost due to osteolysis (15). Bone allograft is

also used in other procedures including spinal surgery, orthopaedic oncological procedures and in trauma surgery.

Lack of donors is one of the biggest problems faced by bone banks (9). Retrieval of femoral heads during the course of primary total hip arthroplasty and their later use is an important source of bone allograft and constitutes about 55% of the total bone donated to the National Blood Service (12).

Currently the exclusion rate of patients from bone donation at an early screening stage has not been established due to problem of under-reporting (12).

This study reported that 60% of the patients were excluded from donation of their femoral heads during the course of their primary hip replacement surgery at the screening stage. The majority of those excluded (23 patients) had the potential of transmission of disease to the recipients. The situation is likely to become worse in the future as the incidence of sexually transmitted diseases has nearly doubled during the last decade (1).

It was found during the current study that bone could only be retrieved and sent for storage in the bone bank from only 3 patients (5%). This reflects a loss of 19 femoral heads (35%) which could have been prevented through awareness of orthopaedic surgeons to the increasing need of bone grafts. The involvement of orthopaedic surgeons in the process of acquiring allograft has been studied in 340 hospitals in the USA (6). In about 15% of the hospitals, the surgeons were involved in the selection of the source of allograft. Moreover 34% of the surgeons were not aware of the processing methodology of the allografts they were transplanting and most surgeons did not know the allografts they used were secondarily sterilised.

Other factors which affected bone banking in this study were patient's willingness, time limitations in clinics and lack of a monitoring system in operating theatres.

We feel that, in order to meet the future requirements for bone grafts in orthopaedic and trauma surgery, the orthopaedic surgeon should be actively involved in the bone banking practice. Other measures to improve bone stock include more trained nurses employed to organise the selection of suitable patients and a monitoring system in operating theatres to record the reasons for not sending bone grafts during primary total hip replacement surgery. Lastly alternatives to human bone such as synthetic hydroxyapatite, bovine or coral xenografts and bioactive glass need to be explored.

Auto banking of patients' own femoral heads is another option, in a selected group of patients who would otherwise be unfit to donate their bone due to risk of transmission of their disease to recipients.

This technique has the advantage of providing a graft with osteoinductive potential as well as reduced risk of infection.

A patient's femoral head can be banked in a surgically fashioned subperiosteal iliac pouch during the primary total hip arthroplasty. This eliminates the need for a storage facility and provides a portable source of bone graft even when the patient moves elsewhere (4).

CONCLUSION

The demand for bone allograft is rising as the number of revision arthroplasties continues to increase. There is a need for a more efficient system for selection of potential donors, harvesting and processing of bone allografts and to prevent the wastage of valuable source of bone grafts. Alternative sources of bone grafting should also be explored in the future to meet the increasing demand.

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