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Editorial

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Bone Allografts in Orthopaedic Practice

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Bone Allografts versus Bone Autografts

In Orthopaedic Practice, autografts are the best bone grafts to use for bone defects. Allografts are second class bone graft materials – to be avoided if autografts can be used instead. Xenografts on the other hand should never be used (porcine, bovine bone grafts). There are risks of transferring viruses from animals to man.

Bone Autografts

Autografts are mainly procured from the patient's own iliac crest. There is considerable morbidity in this procurement process. Complications include wound infection, donor site pain, fracture of iliac bone, bleeding (superior gluteal artery) and even nerve injury (superior gluteal nerve). Donor site pain and wound problems are the commonest complications.

For massive bone defects in limb bones and in spine – it is not possible to procure such large bone grafts from the patient's own bones. Allografts are needed to do such massive reconstruction. It is also difficult to procure autografts in children when the iliac crest is mainly cartilaginous.

Bone Allografts: Advantages

The advantages of allografts include:

1. No limit to the size of bone graft needed.
2. No limit to the quantity of bone graft needed.
3. Morbidity of bone grafting operation is reduced.
    a. No need to perform 2 operations.
    b. Donor bone procurement is not needed and therefore no donor site pain.
4. The best reconstruction of bone defect is biological reconstruction using a bone allograft. Bone to bone reconstruction is better in the long term than bone-prosthesis reconstruction. The latter has long term problems of loosening of prosthesis and wear and tear of the prosthesis elements (polyethylene, metallosis).
5. Bone allograft reconstruction is also less costly than bone prosthesis option. An allograft is at least ten times cheaper than a prosthesis.

Bone Allografts: Disadvantages

The disadvantages of allografts are:

1. Immunogenicity

Allografts are immunogenic and increase the risk of infection in the reconstruction. Antibiotics should be administered until the wound has healed.

2. Risk of HIV Transmission

There is a 1 in 1,000,000 chance of HIV transmission by bone allograft transplantation. It is noted however that the risk of HIV transmission following a blood transfusion is 1 in 250,000–4 times higher.

Risk of Hepatitis C, Hepatitis B Transmission

There is also a risk of Hepatitis B and C transmission. The risk of Hepatitis C can be reduced significantly by subjecting the deep frozen bone allograft to gamma irradiation at a dosage of 25 Kilograys.

Need for Radiation Sterilisation

Deep frozen bone allografts stored at -80˚C is best subjected to further processing by gamma irradiation (Cobalt 60 Nuclear Reactor) at a dosage of 25 Kilograys because:

1. It guarantees sterility of deep frozen bone allografts procured and processed. In addition to sterile procurement checked by bone tissue culture test, irradiation ensures sterility of the bone processed (10-6) in the same way as prostheses are sterilised.
2. Irradiation inactivates the HCV Virus at a dosage of 25 Kilograys.

For lyophilised bones (freeze-dried bones), the risk of HIV transmission via the allograft is zero. In the freeze-drying process, chemical processing by alcohol inactivates the HIV virus. Another step, pasteurisation at +60˚C also inactivates the HIV virus.

Adoption of Good Standards of Tissue Bank Practice

In Asia Pacific Region, tissue banks conform to our own regional standards – ASIA PACIFIC ASSOCIATION OF SURGICAL TISSUE BANKS GENERAL STANDARDS to ensure minimum standards to achieve safe tissue transplantation practice.

"Allograft Bone Engineering"

To achieve the best results of clinical transplantation, allografts should not be used alone. They are best used in combination:

- Allografts plus Autografts.
- Allografts plus Growth Factors (Bone Morphogenetic Protein, Platelet Rich Plasma).
- Allografts plus Adult Mesenchymal Stem Cells (autologous).

"Bone Allograft Engineering" could be achieved using latest operative techniques to produce optimal results:

- Kumta "telescoping technique" to improve incorporation at bone junctions.
- Capanna "shell technique" to improve biological incorporation of the whole massive bone allograft – allograft plus microvascular "live fibula transfer".

Threat from Tissue Engineering

With the advent of "tissue engineering" in the 21st Century, bone banks took a back seat as stem cell centres bloom. The much needed research grant is lost to many banks as priorities were given to stem cell research. However, some bone banks survived. Tissue engineering after nearly two decades did not deliver their much promised results. They are still unable to fabricate a good scaffold for bone. Autologous Chondrocyte Implantation for cartilage also went into decline. Today because of failure to modulate antigenicity of adult Mesenchymal Stem Cells, only autologous MSCs can be used. BMPs were found to cause complications and PRP did not deliver the much desired outcome.

Bone allografts remain the best scaffolds for bone – "God's scaffolds". There is promise of combining bone allografts with adult MSCs to produce "tissue engineered bone".

The future of bone banks lies in forging strategic partnerships:

- Combining a stem cell centre with a bone bank.
- Combining a bone bank with a skin bank and a heart valve bank to form "composite tissue centre" with better administration, reduced manpower costs, improved facilities and better quality of all tissues produced (bone, skin and heart valves).

So long as the search for a bone scaffold continues, a bone allograft will remain to be the best scaffold (biological scaffold) to be used in combination with adult mesenchymal stem cells.

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