Bone grafts

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INDICATIONS FOR GRAFTING

1. To **enhance healing in delayed unions, nonunions, osteotomies, and arthrodesis** of joints by stimulating early formation of bridging callus
2. To **bridge major defects in multifragmentary** fractures by establishing continuity of bone segments and filling cortical defects, thereby stimulating and enhancing early formation of bridging callus
3. To **replace entire cortical segments** lost from fracture fragmentation or from excision caused by neoplasia
4. **To fill cavities or partial-thickness defects** resulting from excision of cysts or neoplasms

Grafts originate from the following three sources:

1. *Autograft* or *autogenous graft*—from the same animal

Advantage a. maximal osteogenetic potential b. earliest response

Disadvantage time and risk, and the bone available may be insufficient in quantity, shape, and size or may be mechanically unsuitable.

2. *Allograft*—from the same species. "homografts,"

donor animals, either used fresh or held in a bone bank (freezer)

- no direct osteogenesis occurs, delay in response of about 2 weeks Availability in sufficient quantity,
- shape, and size is the main advantage. Additionally, allografts are the only feasible source for large cortical grafts.

3. *Xenograft*—from a different species. "heterograft"

This graft has the least osteogenetic potential and is most likely to cause a foreign body reaction.

Structure

1. *Cancellous* grafts: the host's metaphyseal bone and used as fresh autografts.
2. *Cortical :* as frozen allografts.

3. Combination of both *corticocancellous:*. either fresh autografts or fresh or frozen allografts, from the ribs or dorsal iliac crests.

FUNCTIONS OF BONE GRAFTS

1. Osteogenesis
2. Mechanical support

طرق عمل الگرافت

First: **New bone** that is formed **on or about a graft** can be of **graft origin** (i.e., *directly from osteoblasts or osteoprogenitor cells* that survive the transfer). At best, **survival of cells** from the graft is estimated at **10%** when a fresh autogenous cancellous graft is used and handled under optimum conditions.

The second : the bone graft may function as a source of osteogenesis is by **recruitment of mesenchymal or pluripotential osteoprogenitor cells in the area**, which **then differentiate into cartilage-forming and bone-forming cells,** a process called ***osteoinduction.***

A third : osteogenic function of grafts is *osteoconduction,* the threedimensional process of ingrowth of sprouting capillaries, perivascular tissue, and osteoprogenitor cells from the recipient bed into the structure of a graft.
The graft acts as a scaffold or template for new-bone formation, then undergoes varying degrees of osteoclastic resorption and replacement *(creeping substitution)* by host bone.

Cancellous graft advantages, such as rapid stimulation of direct bone formation, early osteoinduction, and early vascularization.
Autogenous cancellous bone is the only bone graft that can be safely applied in contaminated areas.

Vascular invasion and osteoconduction occur much more slowly in cortical grafts, but these grafts have the advantage of affording some **immediate stability** to the area. They are prone to sequestration in infected areasمیال الی الانفصال فی المنطقه الموبو

Collection of Bone for Grafting

Autogenous Cancellous Bone

The lateral tubercle of the humerus, the subtrochanteric region or medial condyle of the femur, the proximomedial tibia, and the craniodorsal iliac spine.
In small container (covered with a gauze sponge moistened with Ringer's or saline solution)
The proximal humerus and tibia are the most frequently used collection sites.
The proximal humerus yields more bone than the tibia,

Approach
a 2- to 3-cm skin incision. The cortical bone is opened with a trephine or a trocar-pointed Steinmann pin (3/16-1/4 inch; 4.8-6.5 mm), and cancellous bone is scooped out with an oval curette (Figure 3-1, *E*). The graft is usually held in a small container (covered with a gauze sponge moistened with Ringer's or saline solution) until time for transfer to the new area

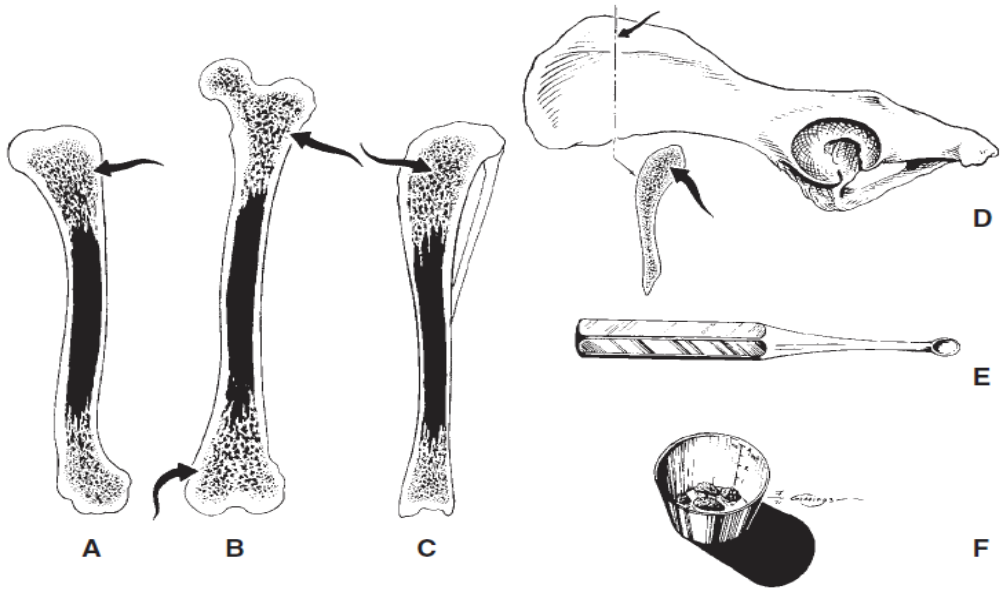

FIGURE 3-1. Collection of autogenous cancellous bone for grafting. A through D, Sections of a humerus, femur, tibia, and ilium indicating location for collection of bone graft. E, Curette used to scoop out cancellous bone. F, Receptacle used for temporarily holding collected graft.

Autogenous Corticocancellous Bone:

The ribs and craniodorsal iliac spine are the usual donor sites.
An incision through skin and muscle is made directly over the chosen rib. The periosteum is incised and carefully elevated to avoid opening the pleural cavity, and the rib is freed by cutting at both ends.
The iliac spine is also approached directly by a dorsal incision of skin and muscle, a suitable block of bone is freed by osteotome or bone saw. The graft can be either just the lateral cortex or a full-thickness piece of the iliac spine/crest containing both cortices.

Allograft /Bone Banking

Collection technique varies with the method chosen for preservation تختلف طريقه الجمع مع طريقئ الحفظ المختارة

The graft can be collected aseptically and preserved by freezing or collected under clean conditions, sterilized by ETO, and preserved by freezing.

For corticocancellous bone, it is preferable to use a donor from one of the large breeds approximately 4 to 6 months of age. Ribs are the most common source of bone because they have a relatively high proportion of cancellous bone, placed in an individual sterile container or wrap for convenient use, placed in a home-type deep freezer and held at 0° F (□18° C) or lower. Bone preserved in this manner may be held for approximately 1 year.

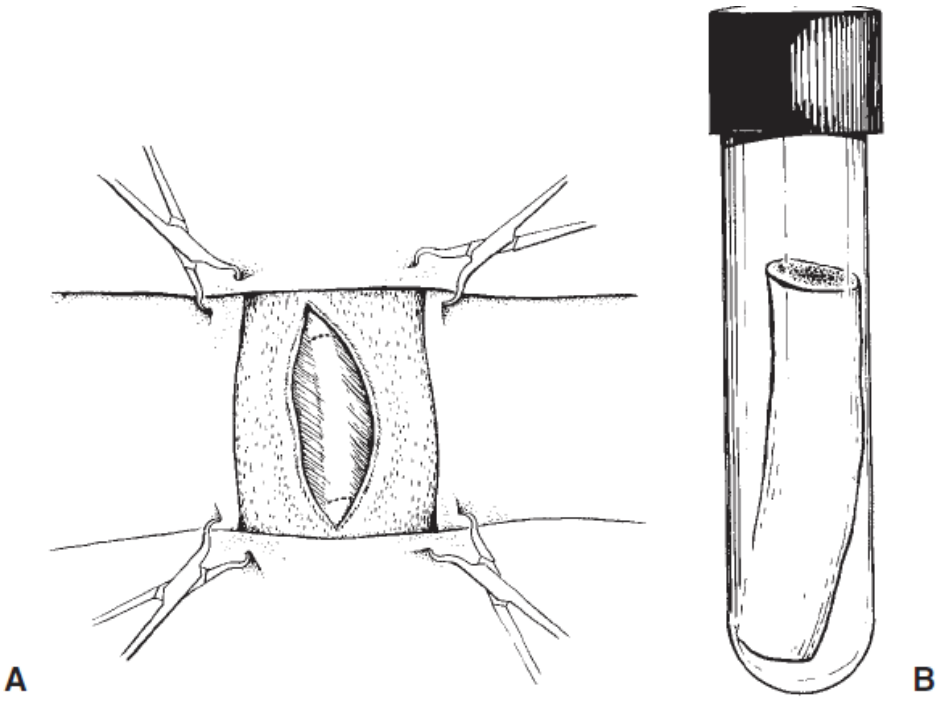

FIGURE 3-2. Collection of rib grafts for bone bank. A, Ribs are aseptically collected from a donor animal and cleaned of all soft tissue. B, Each rib is placed in a sterile test tube or similar container.

Cortical diaphyseal grafts are from all the **long bones**, cutting the diaphyseal portion free at each end **with a bone saw**. **The medullary canal is curetted** and **flushed to remove soft tissue elements**. **Packaging and freezing.**

ETO sterilization simplifies the collection process in that aseptic technique does not have to be used

After cleaning the graft they are double-wrapped in polyethylene instrument sterilization pouches or tubing

Sterilization is by 84% ETO (Anprolene, H.W. Anderson Products) for 12 hours, followed by 72 hours of aeration, all at room temperature. After this sterilization the bones are deep-frozen.

Such sterilization and storage up to 1 year appear to have no effects on cortical bone resistance to compressive, bending, and torsional loads when compared with fresh bone.

Types of Grafts and Placement

The graft types most often used are pure cancellous fragments, corticocancellous bone chips, cortical or corticocancellous onlay or inlay, and cortical tubular intercalary grafts

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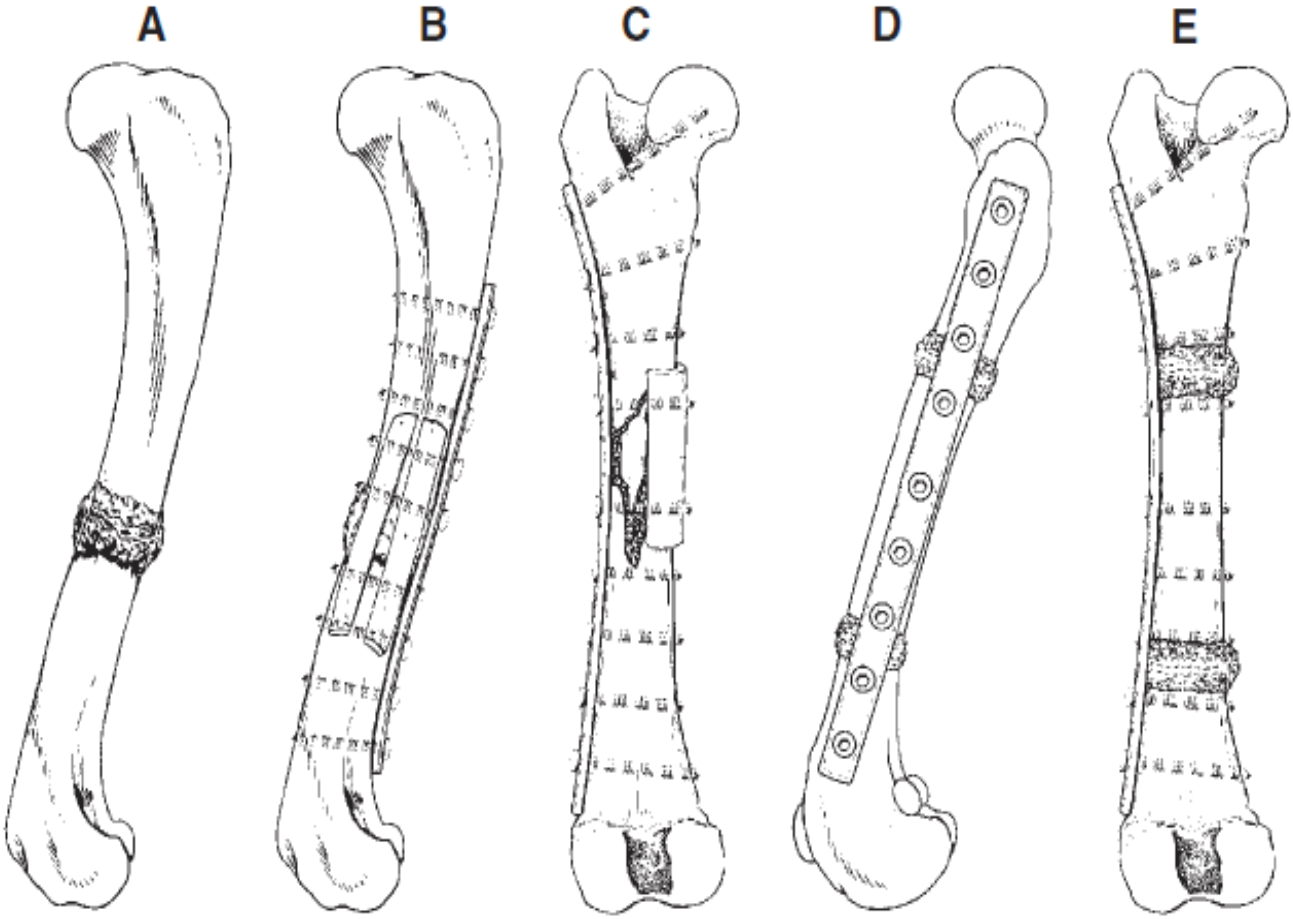

FIGURE 3-3. Types of bone grafts. A, Pure cancellous fragments or bone chips created by use of a rongeur are packed around the fracture site. B, Onlay graft (usually a split rib) spans the fracture, and cancellous fragments or chips are packed around the fracture site. C, Inlay cortical graft acts as a buttress to replace missing cortical bone in the compression cortex opposite the plate. The fragmented area under the plate is grafted with cancellous bone. D and E, Tubular intercalary allograft used to replace a section of the diaphysis. Autogenous cancellous bone is used at the graft-host junctions.

Pure Cancellous Fragments:

The bone segments are stabilized by a compression plate, and the graft is placed around the fracture site between the elevated periosteum and cortex.

Corticocancellous Bone Chips[2]:

Bone chips are usually prepared from banked allograft rib bone.

Bone chips of 2 to 5 mm in diameter نستخدمهه بطريقه مشابهه لل pure…..

او زياده حجم ال گرافت

او عندما لا تكون الحيوان الواهب لل pure غير جاهزه

The chips are created by using a rongeur to "nibble off" small bone pieces.

Onlay Bone Graft[2]

Treatment of a nonunion fracture, sclerotic tissue and periosteum are elevated and reflected off the host area. The bone segments are stabilized by a compression plate.

The graft is created by splitting a rib bone to expose the cancellous interior, and this side is placed against the recipient bone.

One or more onlay grafts are placed on the bone, spanning the fracture site.

The graft may be secured in place by bone screws, by cerclage wires, or by suturing the patient's tissue over the area.

Inlay Bone Graft

Most often cortical bone used as a buttress to replace a portion of missing cortex on the compression side opposite the bone plate. "bridging osteosynthesis". by bone screws placed through the plate.

Tubular Intercalary Diaphyseal Graft[5,7] indication

1. Severe multiple or comminuted shaft fractures that do not lend themselves to anatomical reconstruction
2. Fractures with missing bone segments; bone length can be restored
3. Replacement of surgically removed segments of neoplastic bone
4. Reconstruction of certain atrophic nonunion fractures

5. Correction of malunion

The advent of the concept of bridging osteosynthesis

The procedure :

1. Squaring off the ends of the viable bone segments, attaching the proper size and length of cylindrical diaphyseal allograft to the center section of the plate, and immobilizing it under compression at both ends by using a dynamic compression plate
2. Autogenous cancellous graft is used at each end of the graft.
3. There may be an advantage to perforating the graft with small drill holes to encourage vascularization of the medullary canal.
4. Screws should secure a minimum of four cortices in the graft and six cortices in each end of recipient bone to secure adequate stability.

New bone deposited on the surface of the graft creates clinical union, and plates can be removed in 18 to 25 months if indicated.

Autogenous Free Vascularized Bone Graft

Donor sites of the distal ulna, coccygeal vertebrae, fibula, and medial tibial cortex.

Maintaining vascular supply to the bone graft requires successful microsurgical anastomosis of the vascular pedicles of the graft to the recipient site vessels.