AUTOLOGOUS BONE GRAFT
IS THERE ANY LIFE LEFT IN IT?

DEDICATED TO MY MENTOR
HOWARD ROSEN, M.D.
(1925-2000)

WHY DO WE EVEN USE A BONE GRAFT?
- NONUNIONS
- BONE DEFECTS
- ARTHRODESES
Flourens conclusively showed that periosteum was osteogenic and was the chief agent in the healing of bone defects.

Flourens (1842)

**FIRST BONE GRAFT - 1858**

De la production artificielle des os au moyen de la transplantation de periste et des greffes osseux.

Ollier, L.X.
Comp Rend Soc de Biol 5: 145.
1858

**OSTEOPERIOSTEAL GRAFTS**

(Delageniere = 1921)

AKA “Judet Decortication”
INLAY GRAFTS

- NO PLATES AVAILABLE
- KANGAROO TENDON
Onlay with screws

Simple Inlay

Sliding Inlay

Diamond Inlay

Intramedullary Peg

TIBIAL CORTEX ONLAY BONE GRAFT

1946

Illustration of bone graft with titanium screws. As a rule, four screws are sufficient, two in each fragment. In this particular case: a double fracture necessitated an 8 in. graft, and six screws were used.
“ROBBING
PETER
TO PAY
PAUL”

1950’s

CORTICAL GRAFTS

- TOOK FOREVER TO HEAL
- OFTEN FRACTURED
- DONOR SITE PROBLEMS
CANCELLOUS GRAFTS

- Lack strength so used with plates
- Vascular invasion by host in 2 days

ILIAC CREST GRAFT

<table>
<thead>
<tr>
<th>TABLE I</th>
<th>Average Time of Union</th>
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<tbody>
<tr>
<td>Bone</td>
<td>Cortical Grafts Only</td>
</tr>
<tr>
<td>Hamate</td>
<td>10 weeks</td>
</tr>
<tr>
<td>Radius</td>
<td>15 weeks</td>
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<tr>
<td>Ulna</td>
<td>12 weeks</td>
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<tr>
<td>Fibula</td>
<td>12 weeks</td>
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HARVESTING ILIAC CREST
Moreover, it can be argued, from the results obtained using the other types of graft, that there are two main sources of new bone formed by a fresh bone autograft, namely: 1) quiescence on the surface of the grafted bone, and 2) cells contained within the marrow of the graft.

in the 1960’s the osteogenic potential of red bone marrow became known.

DEFINITION

A **BONE GRAFT** MATERIAL IS ANY IMPLANTED MATERIAL THAT ALONE OR IN COMBINATION WITH OTHER MATERIALS PROMOTES A HEALING RESPONSE BY PROVIDING **OSTEOGENIC**, **OSTEOCONDUCTIVE**, OR **OSTEOINDUCTIVE** ACTIVITY TO A LOCAL SITE

**MUSCHLER & LANE 1992**
OSTEOGENIC = contains living cells that can differentiate into bone

OSTEOGENIC (BOTH CONTAIN OSTEOPROGENITOR CELLS)

OSTEOCONDUCTIVE = promotes bone apposition to act as a scaffolding to allow bone formation
OSTEOCONDUCTIVE

ALLOGRAFT

TRICORTICAL GRAFT

OSTEOINDUCTIVE = induces cells to turn into osteoblasts

(TGF superfamily)

ILIAC CREST BONE GRAFT

REMEMBER:
- NO DISEASE TRANSMISSION
- NO IMMUNE RESPONSE
- AMPLE SUPPLY
ILIAC CREST BONE GRAFT

SIMPLY IS

THE GOLD STANDARD

MAJOR 2.5 – 10%
MINOR ~ 40%
PAIN 20%

Goulet et al.  CORR 1997 (339): 76-81
Arrington et al.  CORR 1996 (329):300-309
Banwart et al.  Spine 1995 (9):1055-1060

INTRAMEDULLARY REAMING

KÜNTSCHER:
- Extended the length of the isthmus by reaming
- Increased contact between nail and endosteum.
Potential disadvantages of reaming

- Thermal necrosis
- Medullary pressurization
- (Weaken the bone)
**REAMER IRRIGATOR ASPIRATOR SYSTEM (RIA)**
- Reduces medullary pressure
- Allows single-pass reaming
- Bone harvesting application

**UNIQUE HEAD DESIGN**
- Deep cut flutes
- Bullet tip
- Irrigation ports

**CANAL MEASUREMENT**
- Ruler for canal size
- Place ruler at isthmus
- Select head 1 – 1.5 mm above nail size
ONE PASS REAMING

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RIAN REAMING

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RIAN REAMING

IRRIGATION OBVIATES THERMAL PROBLEMS

DOES ASPIRATION PROTECT AGAINST MARROW EMBOLI?
RIAM REAMING

- IRRIGATION ASPIRATION PROTECTS AGAINST EMBOLIC PROBLEMS
- DOES IT PREVENT HEALING BY REMOVING ALL THE MARROW REAMINGS?

DOES “ASPIRATION” OF MARROW NEGATIVELY AFFECT HEALING?

- Frolke, Acta Ortho Bel 2000
  Reaming debris accumulate at fracture site
- Trinkaus, Unfallchirurg 2005
  Reaming debris a source of viable stem cells
NO EFFECT IN ANIMALS...

C Klein ARI, Vienna

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RIA AS GRAFT

CAN THE REAMINGS BE SAVED FOR GRAFT?

ARE RIA REAMINGS EQUAL TO ICBG ?

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RIA AS GRAFT

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Qualitative and Quantitative Differences Between Bone Graft Obtained from the Medullary Canal (with a Reamer/Irrigator/Aspirator) and the Iliac Crest of the Same Patient

J.B.J.S., December 2012

PEPTIDES IN REAMINGS > ICBG
RIA AS GRAFT

- Reamings similar to ICBG in volume & consistency
- RIA reamings are equal to ICBG biologically

Must be vigilant with size of reamer & technique

So how do we use RIA bone graft today?
Induced membranes secrete growth factors including vascular and osteoinductive factors and could stimulate bone regeneration

INDUCED MEMBRANE – EXPRESSION OF VEGF, TGF-B1 AND BMP-2 AT 2, 4, 6 & 8 WEEKS

The technique for bone reconstruction described by Masquelet combines the induction of a membrane by the means of a cement spacer with a later cancellous autograft [10,12,17]. The first role of the spacer is mechanical as it obviates fibrous tissue invasion of the recipient site. The second role is biological, by the induction of the surrounding membrane.

EDGES OF DEFECT
7 DAYS LATER,

- ANTIBIOTIC SPACER
- ANATOMIC PLATING
- FREE LAT FLAP
6 WEEKS LATER,

- SPACER REMOVED
- FLAP LIFTED
- ICBG PLACED
6 MONTHS LATER,

- BACK FROM MIAMI
- SLIGHT PROBLEM.....
3 MONTHS LATER
RIA
GRAFT
&
IM NAIL

6 MONTHS LATER

17 MONTHS FROM MCA

CONCLUSIONS
We have come a long way in our understanding of bone healing and defect treatment over the last century, and certain truths have appeared.

**RIA AS GRAFT**
- Reamings similar to ICBG in volume & consistency
- RIA reamings are equal to ICBG biologically

**MASQUELET TECHNIQUE**
- Cement spacer protects cavity from fibrous tissue
- Stimulates formation of a membrane that releases BMPs