Vascularised bone grafts in wrist surgery

Christian Dumontier
Institut de la Main & hôpital Saint Antoine, Paris
(With the help of C. Mathoulin & Y. Saint-Cast)
VBGs in wrist surgery

- Roy-Camille and Judet (1965)
- Kuhlman (1987) described the volar vascularisation of the distal radius
- Zaidenberg (1991) then the Mayo team (1995) described the vascularisation of the dorsal radius
- Experimental works gave some justification to their use
Experimental works

- In a dog radius model
- VBGs preserve circulation
- VBGs preserve viable osteoclasts and osteoblasts that allows primary bone healing without creeping substitution

6 wks
12 wks
Experimental works

- Immediate blood flow was 51% of the circulation in the controlateral radius.
- Hyperhemic response at 2 weeks doubles the flow (compare to controlateral wrist) and multiplies it by 54 compare to conventional grafts.
Experimental works

Animal works have shown their superiority compare to conventional grafts
Anatomical works

- Have shown that anatomy is quite constant
- Have shown that both cortical and cancellous bone were richly vascularised by those vessels
Anatomical works

- Have shown that anatomical landmarks make their dissection secure
- Have shown that it is possible to raise VBGs that can reach the carpal bones without undue tension
VBGs from the dorsal radius

Four vessels contribute to the vascularisation of the dorsal radius
VBGs from the dorsal radius

Multiple anastomoses allow mobilization of multiple VBGs
VBG using the 1,2 supraretinacular artery

VBG using the 4 compartment artery
Anatomy of the 1,2 supraretinacular artery

4 types have been described (Saint-Cast)
Surgical technique

- Lazy S incision
- Protection of the radial nerve
- Visualisation of the 1,2 supra-retinacular artery
Opening of the 1st and 2nd extensor compartments
The pedicle is raised and let attached to the capsule and periosteum.
The size of the graft is then measured.

The VBG is raised from the radius.
A styloidectomy is performed.
Graft is placed longitudinally if there is no bone loss.
K-wires are then introduced and their position controlled by direct vision in case of bone loss.
The graft is then introduced, transversally, into the defect.

And K-wires are pushed into the proximal pole.
VBGs from the volar radius

- The transverse carpal artery comes from the radial artery
- Is parallel to the distal fibers of the pronator quadratus
- And anastomoses with the anterior branch of the anterior interosseous artery and branches from the ulnar artery
Technique

Volar Henry’s approach

First spotting of F.C.R. and radial artery
The graft is fixed by a K-wire, parallel to the scaphoid screw that is removed at 3 weeks.
VBG from the volar radius for scaphoid non-union after failed conventional technique
Technique

Identical for Kienböck’s disease
# Scaphoid non-union

<table>
<thead>
<tr>
<th></th>
<th>Number of cases</th>
<th>% healing</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathoulin</td>
<td>87</td>
<td>93%</td>
<td>3 Südeck’s</td>
</tr>
<tr>
<td>Saint-Cast</td>
<td>38</td>
<td>95%</td>
<td>2 temporary paresthesiae</td>
</tr>
<tr>
<td></td>
<td></td>
<td>87% &lt; 12w</td>
<td></td>
</tr>
<tr>
<td>Steinman</td>
<td>14</td>
<td>100% (11 w)</td>
<td>2/3 good results</td>
</tr>
<tr>
<td>Malizos</td>
<td>22</td>
<td>100%</td>
<td>All improved</td>
</tr>
</tbody>
</table>
# Scaphoid non-union

<table>
<thead>
<tr>
<th></th>
<th>Number of cases</th>
<th>% healing</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathoulin</td>
<td>87</td>
<td>93%</td>
<td>3 Südeck’s</td>
</tr>
<tr>
<td>Saint-Cast</td>
<td>38</td>
<td>95%</td>
<td>2 temporary paresthesiae</td>
</tr>
<tr>
<td></td>
<td></td>
<td>87% &lt; 12w</td>
<td></td>
</tr>
<tr>
<td>Steinman</td>
<td>14</td>
<td>100% (11 w)</td>
<td>2/3 good results</td>
</tr>
<tr>
<td>Malizos</td>
<td>22</td>
<td>100%</td>
<td>All improved</td>
</tr>
<tr>
<td>Straw</td>
<td>22</td>
<td>27%</td>
<td>12% if AVN proximal pole</td>
</tr>
</tbody>
</table>
## Kienböck’s disease

<table>
<thead>
<tr>
<th></th>
<th>Number of cases</th>
<th>% Painfree</th>
<th>% “healing”</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathoulin</td>
<td>22</td>
<td>91%</td>
<td>72%</td>
<td>23% stabilized, 5% failure</td>
</tr>
<tr>
<td>Mazur</td>
<td>9</td>
<td>?</td>
<td>100% at 36 months</td>
<td></td>
</tr>
</tbody>
</table>
Other VBGs

Part of the head of the 2nd metacarpal based on the anastomoses between the deep and superficial intermetacarpal arteries (Brunelli, 1988)
Material

- 17 patients (1988-1999), 10 males
- Mean age: 34 y.o. (26 - 44)
- Union obtained in 16 cases (1 failure)
- Average delay of union: 3 months (range 2 to 6 months)
Complications

- No problem with II\textsuperscript{nd} métacarpeal
- Radio-scaphoid arthritis : 2 cases
- Lesion of radial nerve : 2 cases
- Secondary fracture : 1 case