Overview of the biomaterials usually use in alloplastic cranioplasty

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Definition

We denote by the term of **cranioplasty** all surgical techniques used to repair skull defects.
Types of bone defects

Small defect:  
< 25 cm$^2$

Large defect:  
entre 25 et 100 cm$^2$

Very large defect:  
> 100 cm$^2$
History of cranioplasty

- 3000 ans Av JC (Inca civilization) : golden plate.
- WALTHER (1821) : first bone autogreffe.
- ZANDER (1940) : acrylic cement (PMMA).
- SIMPSON (1961) : titanium plate.
Families of biomaterials

- Bone autografts
- Polymers
- Titanium alloys
- Phosphocalcic céramics
Bone autografts

Skull

Ribs

Pelvis
Limits of bone autografts

- They have a high level of resorption (up to 50%).
- Their ostéointégration is unpredictable.
- They are difficult to harvest and to model.
- They are responsible for an important morbidity rate of the donor site.
- They are responsible of the extension of the operating time and of the hospitalization duration.
- Specially for the skull the available quantities are too low.
Polymers

- Not easy to model.
- High rate of infection (up to 22%).
- Bad esthetic results.
- No osteointegration.
- Risk of cutaneous erosion with exposure of the plates.
Titanium alloys

- Not easy to model.
- Bad mechanical properties.
- Risk of cutaneous erosion with exposure of the plate.
- Thermoconductivity.
- Release of titanium ions toxic for the surrounding tissues.
CUSTOMBONE®

- Totally macroporous.
- Bad impact strength.
- Imperfect adaptation.
- Imperfect ostéointegration.
- Their use is difficult for defect over 100 cm².
MULTI-PARTS implants
Osteointegration

No fusion  Partial fusion  Complete fusion
## Osteointegration

<table>
<thead>
<tr>
<th>Setting-up deadline</th>
<th>Implants number</th>
<th>Contacts number</th>
<th>Complete Fusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 month</td>
<td>18</td>
<td>4368</td>
<td>39 %</td>
</tr>
<tr>
<td>12 month</td>
<td>14</td>
<td>2772</td>
<td>57 %</td>
</tr>
<tr>
<td>24 month</td>
<td>13</td>
<td>3276</td>
<td>72 %</td>
</tr>
</tbody>
</table>
surgical protocol

Small defect: < 25 cm²
surgical protocol

Large defect : entre 25 et 100 cm²
surgical protocol

Very large defect: > 100 cm²
Future

Osteogenics molecules

Mesenchymal Stem cells

Micro/macroporous Slowly resorbable scaffold
Future
Future
Conclusion

We must fight on.
The patients are counting on us.
THANK YOU

FOR YOUR ATTENTION