KEYHOLE APPROACH IN CEREBRAL ANEURYSM SURGERY

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Aneurysm surgery (% of keyhole operations)
Advantages of the keyhole concept

► smaller size of craniotomy with less surgical trauma
► fast and direct approach to pathology
► less brain exposure
► faster recovery
► excelent cosmetic results
## Experience with keyhole approach

<table>
<thead>
<tr>
<th>Condition</th>
<th>No of Patients</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aneurysm</td>
<td>551</td>
<td>(65%)</td>
</tr>
<tr>
<td>Hypophyseal tumor</td>
<td>65</td>
<td>(7.67%)</td>
</tr>
<tr>
<td>Orbital tumor</td>
<td>68</td>
<td>(8.02%)</td>
</tr>
<tr>
<td>Meningeoma</td>
<td>70</td>
<td>(8.26%)</td>
</tr>
<tr>
<td>Craniopharyngeomma</td>
<td>26</td>
<td>(3.1%)</td>
</tr>
<tr>
<td>Third ventricle tumor</td>
<td>16</td>
<td>(1.89%)</td>
</tr>
<tr>
<td>Temporobasal tumor</td>
<td>13</td>
<td>(1.53%)</td>
</tr>
<tr>
<td>Arachnoid cyst</td>
<td>10</td>
<td>(1.18%)</td>
</tr>
<tr>
<td>CSF fistula</td>
<td>5</td>
<td>(0.59%)</td>
</tr>
<tr>
<td>Other</td>
<td>23</td>
<td>(2.71%)</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>847</strong></td>
<td><strong>(100%)</strong></td>
</tr>
</tbody>
</table>
EXPERIENCE IN ANEURYSM SURGERY
1996-2006

823 aneurysms in 703 patients

2 SURGICAL TEAMS

KEYHOLE CONCEPT
551 PATIENTS
650 ANEURYSMS

STANDARD CONCEPT
152 PATIENTS
173 ANEURYSMS
Location of keyhole craniotomies in aneurysm surgery

<table>
<thead>
<tr>
<th>Type of craniotomy</th>
<th>No of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eyebrow keyhole</td>
<td>450 (81.66%)</td>
</tr>
<tr>
<td>Temporal keyhole</td>
<td>70  (12.70%)</td>
</tr>
<tr>
<td>Fronto-parietal keyhole</td>
<td>20  (3.64%)</td>
</tr>
<tr>
<td>Retrosigmoid keyhole</td>
<td>11  (2.00%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>551 (100%)</strong></td>
</tr>
</tbody>
</table>
Eyebrow keyhole (450 patients with 547 aneurysms)

ANTERIOR CIRCULATION

![Bar chart showing the number of aneurysms in the anterior circulation as follows:
- ACoA: 192
- ICA: 144
- PComA: 73
- MCA: 109]
left AComA, AChoA, PComA ; right A1
ACoA – right eyebrow keyhole
ACoA – post embolisation - GDC
ACoA – left eyebrow keyhole
left M1, M2, M3; right M1
MCA (M2) – right eyebrow keyhole
Left ICA and BA aneurysm
Eyebrow keyhole (450 patients with 547 aneurysms)

POSTERIOR CIRCULATION

![Bar graph showing posterior circulation with labels BA, P1, and SCA. The graph indicates a significantly higher number of aneurysms in the BA category compared to P1 and SCA.]
BA aneurysm - endoscopic control
Temporal keyhole (70 patients with 70 aneurysms)

MCA aneurysms

[Bar chart showing MCA aneurysms compared to P2-3]
Fronto-parietal keyhole

(20 patients/22 aneurysms)

pericallosal aneurysms
Retrosigmoid keyhole
(11 patients/11 aneurysms)
vertebrobasilar aneurysms
Clinical presentation

Keyhole

SAH: 446
asympt./neurol: 105

Standard

SAH: 128
asympt./neurol: 24

- keyhole craniotomy
- standard craniotomy
Preoperative clinical grading

Keyhole group- 551 patients

Standard craniotomy group- 152 patients
### Timing of operation

<table>
<thead>
<tr>
<th></th>
<th>Keyhole</th>
<th>No of patients</th>
<th>Standard</th>
<th>No of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>acute</td>
<td>188</td>
<td></td>
<td>acute</td>
<td>44</td>
</tr>
<tr>
<td>delayed</td>
<td>363</td>
<td></td>
<td>delayed</td>
<td>108</td>
</tr>
</tbody>
</table>

![Bar chart showing the timing of operation for keyhole and standard approaches.](chart.png)
## Results of surgery (GOS- Jenett B, Bond M: Lancet 1975)

<table>
<thead>
<tr>
<th>GOS</th>
<th>Key-hole</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>336</td>
<td>87</td>
</tr>
<tr>
<td>4</td>
<td>121</td>
<td>34</td>
</tr>
<tr>
<td>3</td>
<td>87</td>
<td>26</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>total</td>
<td>551</td>
<td>152</td>
</tr>
</tbody>
</table>

![Graph showing the percentage of outcomes for keyhole and standard craniotomy surgeries.](chart.png)
Mortality rate

overall mortality  
7/703 = 0.99%

• Key hole group mortality  
4/551 = 0.72%

• Mortality in key hole group with HH:0  
0/105 = 0%

• Standard craniotomy group  
3/152 = 1.97%
• The results of two experienced surgical teams shows that there is no difference in results and outcomes between patients treated with standard and keyhole approach

• According to minimally invasive principles we suggest use of endoscope during keyhole operations

• Lamina terminalis opening is recommended to create enough space for better exposure and to reduce the incidence of hydrocephalus
• Ventricular or lumbar drainage is useful especially during acute stage operations

• Evoked potential monitoring is obligatory procedure during aneurysm surgery

• Larger or standard craniotomies are still preferable for some complicated cases (giant, thrombosed aneurysms, bypass procedures, etc.)
• Considering the advantages of the minimally invasive principles and our results, we suggest keyhole concept as a very good and proper option for aneurysm surgery