Osteotomies around the Knee

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Head Joint Replacement
Stolzalpe & Abu Dhabi

Abu Dhabi Knee & Sports Center, UAE
not included complex 3-D deformities
Key Points

• Current status
• Biomechanics principles
• Patient selection
• Planning
• Results
Therapeutic Dilemma

- Active middle aged (40-60)
- Biological therapy?
  - NSAIDS, Suppl & Cartilage
- Arthroscopy?
  - Braces & Distraction
- Osteotomy
- Joint replacement
  - Partial, UKA & TKA

Waller et al, KSSTA 2011
Osteotomy Classical Techniques

- Varus $\Rightarrow$ Tibia
- Valgus $\Rightarrow$ Femur
- Wrong dogma
- Correction not at site of deformity $\Rightarrow$ new deformity $\Rightarrow$ inclined jointline $\Rightarrow$ disturbed biomechanics

Varus lat subtractive

Valgus med subtractive
Problems with Osteotomies

- Less predictable outcome
- Difficult surgical technique
- High complication rate
- 10 y survival $\Rightarrow 50 - 70 \%$ only
- EBM - No evidence but recommendation
- Concept needs to be improved

Brouwer et al, Cochrane Data 2005
New Concept for Osteotomies

- Biomechanical understanding
- Deformity analysis
- Patient selection
- Planning
- Standardized surgical technique
- Early functional rehabilitation

Hofmann et al, Orthopäde 2009
Hofmann et al, European IC Lectures 2011
Biomechanical Basics

• Deformity analysis
  ⇒ LDFA & MPTA

• Location deformity
  ⇒ femur and/or tibia

• Jointline

• Osteotomy not at
  ⇒ right side - jointline
  ⇒ CORA – translation

Paley, Orthop Clin NA 1994
Deformity Analysis
(100 consecutive cases)

• Varus
  59 % Femur
  31 % Tibia
  10 % Combined

• Valgus
  45 % Tibia
  22 % Femur
  33 % Kombiniert

Hofmann et al, Orthopäde 2009
Importance Joint line

• Normal $87^\circ$ (85 – 90)
• Max deviation $10^\circ$
  (Coventry, JBJS 1987)
• Inclined joint line $> 4^\circ$
  ➞ shear forces
  ➞ damage cartilage
  (Babis et al, JBJS Am 2002)
Patients selection

- Males < 65 & females < 55 y.
- Good joint functions
  \[ \Rightarrow \text{ROM 0-10-100°} \]
- Patients expectations
- Compliance
- Risc factors
  \[ \Rightarrow \text{RA, DM, ON, smoker} \]
- Prearthrotic deformities

Adipositas per magna

Hofmann et al, Orthopäde 2009
Prearthrotic deformities

- Malalignment > 4°
- Instabilities
- Cartilage defects
- Meniscal tears
- Stress bone marrow oedema
- Every knee with symptoms
  - Check alignment!
  - MRI

Felson et al, Ann Intern Med 2003
### Criteria Patient Selection

#### Table 4: Patient selection for osteotomies in mono-compartment arthritis

<table>
<thead>
<tr>
<th>Ideal candidate</th>
<th>Possible candidate</th>
<th>No candidate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isolated pain medial/lateral at joint level</td>
<td>Infection history</td>
<td>Contra-lateral arthritis and st.p. lateral meniscectomy</td>
</tr>
<tr>
<td>Age 40–60 years</td>
<td>Age &lt; 40 &gt; 60</td>
<td></td>
</tr>
<tr>
<td>BMI &lt; 30</td>
<td>BMI 30–40</td>
<td>BMI &gt; 40</td>
</tr>
<tr>
<td>Active patient but no running and jumping</td>
<td>Running and jumping sporting activities</td>
<td></td>
</tr>
<tr>
<td>Mal-alignment &lt; 15°</td>
<td>Mal-alignment &gt; 15° possible double osteotomy</td>
<td></td>
</tr>
<tr>
<td>Metaphyseal varus tibia and valgus femur</td>
<td>Metaphyseal varus femur and valgus tibia</td>
<td>Extra-articular deformity</td>
</tr>
<tr>
<td>Full ROM</td>
<td>Flexion contracture &gt; 15°</td>
<td>Flexion contracture &gt; 25°</td>
</tr>
<tr>
<td>No patello-femoral symptoms</td>
<td>Medium patello-femoral symptoms (grade 2–3)</td>
<td>Severe patello-femoral arthritis grade 4 and maltracking</td>
</tr>
<tr>
<td>Arthritis grade 1–3</td>
<td>Arthritis grade 4</td>
<td></td>
</tr>
<tr>
<td>Stable joint</td>
<td>Insufficient ACL or PCL</td>
<td>Medio-lateral instability</td>
</tr>
<tr>
<td>No smoker</td>
<td>Smoker</td>
<td></td>
</tr>
</tbody>
</table>

*Source: Modified according to ISAKOS guidelines*
Example Planning

• R.A. 46 y male active & sports
• Progressive pain
• Varus 12°
• Arthrosis grade 2-3
• Med. cartilage defect & degenerative meniscus
• Therapeutic options?

Long standing x-ray & arthroscopy
Analysis Frontal Alignment

- Varus 12°
- LDFA 96°
- MPTA 82°
- Tibiaplateau point 0°
- M-Joint line 90°
- JLCA 3°
Planning Joint Line

Med open Tibia

Lat closed Femur

Double Osteo
Surgical Options

- Closed Wedge  ➞ subtractive
- Open Wedge   ➞ additiv
- Theoretical 10 possibilities
  ➞ 4 x Femur (2+2)
  ➞ 4 x Tibia (2+2)
  ➞ double osteotomy
  ➞ dome or pendulum

Hofmann et al, Orthopäde 2009
Advantages Open Wedge Tibia

- No prox deformation & leg shortening
- No fibula problems
- No opening lat compartment
- No irritation lig patallae
- Only one osteotomy
- Balancing MCL
- Re-centration tibia

Lobenhoffer et al, Thieme 2007
Osteotomies around the knee
## Open vs Closed Tibia

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Closed</th>
<th>Open</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technique</td>
<td>Two correction cuts</td>
<td>One correction cut only</td>
</tr>
<tr>
<td>Precise correction</td>
<td>Difficult</td>
<td>Simple</td>
</tr>
<tr>
<td>Fibula problem</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Detachment of muscles</td>
<td>Tibialis loge</td>
<td>No</td>
</tr>
<tr>
<td>Nerve damage</td>
<td>Peroneal possible</td>
<td>No</td>
</tr>
<tr>
<td>Slope change</td>
<td>Reduction possible</td>
<td>Increasing possible</td>
</tr>
<tr>
<td>Ligament balancing</td>
<td>No</td>
<td>Medial possible</td>
</tr>
<tr>
<td>Patalla baja</td>
<td>Secondary possible</td>
<td>Primary possible</td>
</tr>
<tr>
<td>Deformity proximal tibia</td>
<td>Possible</td>
<td>No</td>
</tr>
<tr>
<td>Bone transplant</td>
<td>No</td>
<td>Exceptional cases only</td>
</tr>
</tbody>
</table>

Hofmann et al, European IC Lectures 2011
Femur Osteotomy

- Closed wedge (medial & lateral) ➞ Standard
- Open wedge (medial & lateral) ➞ exceptional cases only
- Osteotomy ➞ outside ligaments ➞ anatomical # mechanical axis
- Fixation ➞ angle stable plates

Hofmann et al, Orthopäde 2009
Technique Closed Wedge Femur

• Biplanar osteotomy
  ⇒ rotational stability
  ⇒ more bone contact

• Descending osteotomy
  ⇒ better fit fragments
  ⇒ more spongy bone

• Preserves suprapatellar fat pad and recessus

• Angle stable plates

Brinkmann et al, KSSTA 2011
Outcomes of osteotomy

- Cochrane – Silver Evidence
  - 70% benefit 10 years
- Classical survival rates
  - 5 years 73%
  - 10 years 52%
- Selected patients
  - Survival 10 y 90%
- New concept
  - promising results

Table 2

<table>
<thead>
<tr>
<th>Study</th>
<th>Number</th>
<th>Mean Follow-up (range)</th>
<th>Mean Age (yr)</th>
<th>Technique</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Niemeyer et al²⁵</td>
<td>45 pts</td>
<td>2 (9-24 mo)</td>
<td>47.3</td>
<td>Opening wedge, using plate and autogenous iliac crest bone graft</td>
<td>68% good or excellent</td>
</tr>
<tr>
<td>Ohori et al²⁶</td>
<td>57 pts</td>
<td>17 (14-24)</td>
<td>59</td>
<td>Closing wedge using threaded pins and figure-of-8 wiring</td>
<td>77% good or excellent</td>
</tr>
<tr>
<td>Akizuki et al²⁴</td>
<td>132 pts</td>
<td>16 (16-20)</td>
<td>63</td>
<td>Closing wedge using a plate</td>
<td>77% good or excellent</td>
</tr>
<tr>
<td>Gobbi et al²⁷</td>
<td>111 pts</td>
<td>12 (1-25)</td>
<td>54</td>
<td>Closing wedge using a staple</td>
<td>98% survival at 10 yr, 90% survival at 15 yr</td>
</tr>
<tr>
<td>Chang et al²⁹</td>
<td>10 pts</td>
<td>15 (13-16)</td>
<td>58</td>
<td>Dome-shaped, using external fixation</td>
<td>98% survival at 10 yr, 90% survival at 15 yr</td>
</tr>
<tr>
<td>Polyzos et al³⁰</td>
<td>95 pts</td>
<td>8 (5-11)</td>
<td>69</td>
<td>Closing wedge using plate</td>
<td>61% good/excellent</td>
</tr>
<tr>
<td>Tang and Hender- satter³¹</td>
<td>67 knees</td>
<td>8.5 (1-21)</td>
<td>49</td>
<td>Closing wedge using plate or staple</td>
<td>75% survival at 10 yr, 67% survival at 15 yr</td>
</tr>
</tbody>
</table>

Feeley et al, J Am Acad Orthop Surg 2010

Hofmann et al, European IC Lectures 2011
Results New Concept

- Prospective multicenter (3)
  369 knees @ 49 y (18-84)
- FU 3.6 years (2-5)
- 6 % Complications
- 98% Survival (3-5 years)
- No correlation OA stage
- Oxford Score 43 (8-48)
  ⇒ UKA 39
  ⇒ TKA 35-40

Floerkemeier et al, KSSTA 2013
Treatment Concept Stolzalpe

• All patients pre arthritic deformities
  ➔ long x-rays
  ➔ Deformity analysis

• Malalignment > 4°
  ➔ osteotomy ?

• Patellofemoral joint ?

• Tibia open & femur closed wedge angle stable plates

• 10% double osteotomies
Summary

- Osteotomy still „golden standard“
  - young & active patient
- Better understanding of
  - biomechanics & planning
  - patient selection
- Proper surgical technique & stable osteosynthesis allows early mobilisation
- Combined with cartilage & ligament repair
- New concept mid term results promising