Masterclass 4
Update in Management of Knee Osteoarthritis

High Tibial Osteotomy
A Buying Time Surgery?

Dr. Chung Kwong Yin
Team Head, Adult Joint Reconstruction Team
Department of Orthopaedics & Traumatology
Prince of Wales Hospital

Department of Orthopaedics and Traumatology, PWH, CUHK
Total Knee Replacement
Knee Preservation Surgery

Department of Orthopaedics and Traumatology, PWH, CUHK
The 16th Hong Kong International Orthopaedic Forum

16:15 - 17:30  Hip and Knee - Case Discussion & Debate
Moderator: Steve CHEUNG
Panelists: Lewis CHAN, Takafumi HIRANAKA, Quinn Jid LEE, Bryan SPRINGER
Debate: UKA is superior to HTO in treating medial compartment osteoarthritis
Affirmative: Henry FU vs Negative: Yuk Wah HUNG
Case Discussion

Department of Orthopaedics and Traumatology, PWH, CUHK
HTO Principle
HTO

• Surgical technique
  – lateral closing wedge osteotomy, medial opening wedge osteotomy, dome osteotomy

• Fixation
  – cast, staple, plate, external fixator

• Augmentation
  – bone graft, bone substitute, PRP, growth factors, bone marrow stromal cells

• Computer navigation

• Patient specific cutting guide
A Buy Time Surgery?

• Traditional thinking, HTO is to postpone the need of TKR, esp in young, active patients
A Buy Time Surgery?

1) Result of HTO
2) Result of conversion from HTO to TKR
3) Cartilage regeneration after HTO
Long Term Results of HTO
## Historical Publications

<table>
<thead>
<tr>
<th>Author</th>
<th>Journal</th>
<th>Year</th>
<th>No.</th>
<th>FU (y)</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vainionpaa</td>
<td>JBJSAm 1981</td>
<td>103</td>
<td>5-10</td>
<td>18% -&gt; TKR @ 7y</td>
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<tr>
<td>Insall</td>
<td>JBJSAm 1984</td>
<td>83</td>
<td>5-15</td>
<td>63%, 23% -&gt; TKR @ 9y</td>
<td></td>
</tr>
<tr>
<td>Hernigou</td>
<td>JBJSAm 1987</td>
<td>93</td>
<td>10-13</td>
<td>45% exc-good @ 10y</td>
<td></td>
</tr>
<tr>
<td>Holden</td>
<td>JBJSAm 1988</td>
<td>45</td>
<td>10</td>
<td>70% exc-good</td>
<td></td>
</tr>
<tr>
<td>Matthews</td>
<td>CORR 1988</td>
<td>40</td>
<td></td>
<td>50% @ 5y, 28% @ 9y</td>
<td></td>
</tr>
<tr>
<td>Ritter</td>
<td>J Arthroplasty 1998</td>
<td>78</td>
<td></td>
<td>58% survival @ 15y</td>
<td></td>
</tr>
<tr>
<td>Coventry</td>
<td>JBJSAm 1993</td>
<td>87</td>
<td>3-14</td>
<td>66% survival @ 10y</td>
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Results of high tibial osteotomy: review of the literature

Annunziato Amendola • Davide Edoardo Bonasia

Table 1  Survivorship of HTO in the literature review

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<td>65–74% at 10 years</td>
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<td>Papachristou et al. [34]</td>
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<td>No. of Knees</td>
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<tr>
<td>Papachristou et al(^\text{16})</td>
<td>Closing wedge</td>
<td>44</td>
</tr>
<tr>
<td>Flecher et al(^\text{2})</td>
<td>Closing wedge</td>
<td>372</td>
</tr>
<tr>
<td>Gstöttner et al(^\text{6})</td>
<td>Closing wedge</td>
<td>134</td>
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<td>Closing wedge</td>
<td>118</td>
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<td>Kolb et al(^\text{18})</td>
<td>Opening wedge</td>
<td>51</td>
</tr>
<tr>
<td>Saragaglia et al(^\text{19})</td>
<td>Opening wedge</td>
<td>124</td>
</tr>
<tr>
<td>DeMeo et al(^\text{20})</td>
<td>Opening wedge</td>
<td>20</td>
</tr>
<tr>
<td>Study</td>
<td>No. of Knees</td>
<td>Mean FU</td>
</tr>
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<td>-----------------------</td>
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<tr>
<td>Darees et al 2018</td>
<td>48</td>
<td>10.2</td>
</tr>
<tr>
<td>Ekeland et al 2017</td>
<td>52</td>
<td>8.3</td>
</tr>
<tr>
<td>Schuster et al 2018</td>
<td>79</td>
<td>10</td>
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Long Term Survivorship of High Tibial Osteotomy: 10 years Follow Up in PWH and AHNH

Chung KY, Cheung KW, Fan CH, Hung YW, Kwok KB, Ho KW, Chiu KH

PWH & AHNH  |  27 knees  |  12.4 yrs  |  85.2%
Satisfactory functional and radiological outcomes can be expected in young patients under 45 years old after open wedge high tibial osteotomy in a long-term follow-up.

Michael E. Hantes¹ · Prodromos Natsaridis¹ · Antonios A. Koutalos¹ · Yohei Ono² · Nikolaos Doxariotis¹ · Konstantinos N. Malizos¹

Received: 3 September 2017 / Accepted: 21 November 2017 / Published online: 30 November 2017
© European Society of Sports Traumatology, Knee Surgery, Arthroscopy (ESSKA) 2017

Conclusions MWOHTO with a locking plate is an effective joint preservation method to treat medial compartment OA in active patients less than 45 years. Clinical and radiological results are satisfactory and the survival rate is 95%, 12 years after the procedure.
Original Article

Patient reported outcomes after high tibial osteotomy show comparable results at different ages in the mid-term to long-term follow-up

Umito Kuwashima a, Ken Okazaki b, Kenyu Iwasaki c, Yukio Akasaki a, *, Hideya Kawamura d, Hideki Mizu-uchi a, Satoshi Harai a, Yasuharu Nakashima a

a Department of Orthopaedic Surgery, Graduate School of Medical Sciences, Kyushu University, 3-1-1, Maidashi, Higashi-ku, Fukuoka, 812-8582, Japan
b Department of Orthopaedic Surgery, Tokyo Women’s Medical University, 8-1, Kawada-cho, Shinjuku-ku, Tokyo, 162-8666, Japan
c Department of Orthopaedic Surgery, Japan Community Health Care Organization (JCHO), Kyushu Hospital, 1-8-1 Kishinoura, Yahatanishiku, Kitakyushu, 806-8501, Japan
d Masuda Orthopaedic Hospital, 1-1-1, Korimoto, Kagoshima, 890-0065, Japan

Results: The symptom, satisfaction, and expectation scores were not significantly different between the ≤64-year-old patients and ≥65-year-old patients. The functional activities score was significantly lower in older patients than in younger patients. The overall survival rates of HTO were 99.1 ± 0.4% at 5 years, 94.4 ± 1.2% at 10 years, and 84.6 ± 2.7% at 15 years. There was no significant difference in the survival rate after HTO between the two groups divided by the age (p = 0.602).

Conclusions: Pain relief and satisfaction after HTO in older patients were comparable to those in younger patients in the mid-term to long-term follow-up, although the functional activity was affected by age.
Long Term Results of HTO

- Survivorship varies
- Survivorship improved in recent studies
- Survivorship deteriorated with time
- Survivorship best with slight valgus over-correction
Why Osteotomy fails?

• Progression of osteoarthritis

• Loss of correction
Technical Challenges

• Prior incisions
• Retained hardware
• Joint line distortion
• Malunion / non-union
• Patella baja
• Offset tibial shaft
• Retropatellar adhesion
• Peroneal palsy
• Infection
### Table 4. Results of total knee arthroplasty after high tibial osteotomy compared with primary total knee arthroplasty.

<table>
<thead>
<tr>
<th>Result</th>
<th>Studies N</th>
<th>References</th>
</tr>
</thead>
</table>
Big data in Orthopaedics

International Society of Arthroplasty Registries
Total knee arthroplasty after high tibial osteotomy: a registry-based case–control study of 1,036 knees

Tuukka Niinimäki · Antti Eskelinen · Pasi Ohtonen · Ari-Pekka Puhto · Bhupinder S. Mann · Juhana Leppilähti

- Finnish Arthroplasty Register & National Hospital Discharge Register
- 1987-2008
- 1036 HTO -> TKR
- 4143 age & gender matched primary TKR
Table 3 Survival of study and control groups

<table>
<thead>
<tr>
<th></th>
<th>No. at risk</th>
<th>Survivorship (%)a</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study 5 years</td>
<td>1,036</td>
<td>95.3 (93.7–96.4)</td>
</tr>
<tr>
<td>Control 5 years</td>
<td>4,143</td>
<td>97.2 (96.7–97.7)</td>
</tr>
<tr>
<td>Study 10 years</td>
<td>599</td>
<td>91.8 (89.9–93.3)</td>
</tr>
<tr>
<td>Control 10 years</td>
<td>2,117</td>
<td>94.5 (93.8–95.2)</td>
</tr>
<tr>
<td>Study 15 years</td>
<td>244</td>
<td>88.4 (86.2–90.2)</td>
</tr>
<tr>
<td>Control 15 years</td>
<td>823</td>
<td>90.6 (89.7–91.5)</td>
</tr>
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The end-point was defined as revision when either the whole implant or one component was removed, exchanged, or implanted for any reason. 5-, 10-, and 15-year survivorships were obtained via Kaplan–Meier analysis (adjustment was made for operation year). The values are given as the mean percentage.

Fig. 1 Operation year-adjusted survival curves of 1,036 total knee arthroplasties after previous high tibial osteotomy (study group) and 4,143 total knee arthroplasties without previous osteotomy (control group). The end-point was defined as revision of whole implant or the removal, exchange, or implantation of one component for any reason. Patients in the study group had a significantly increased risk for revision as compared to the patients in the control group (HR 1.40; 95% CI 1.09–1.181; p = 0.010).
The risk of revision in total knee arthroplasty is not affected by previous high tibial osteotomy

A 15-year follow-up of 32,476 total knee arthroplasties in the Norwegian Arthroplasty Register

Mona BADAWY¹, Anne M FENSTAD², Kari INDREKVAM¹,³, Leif I HAVELIN²,³, and Ove FURNES²,³

¹ Kysthospital in Haagvik, Haagvik; ² The Norwegian Arthroplasty Register, Department of Orthopedic Surgery, Haukeland University Hospital, Bergen; ³ Department of Clinical Medicine, Institute of Medicine and Dentistry, University of Bergen, Bergen, Norway.
Correspondence: mona.badawy@helse-bergen.no

- 1994-2013
- 1399 HTO -> TKR
- 31077 primary TKR
• 10yr survival 93.6% (primary TKR) vs 92.6% (HTO)

• Adjusted RR 0.97 (p=0.08)
Prior High Tibial Osteotomy Does Not Affect the Survival of Total Knee Arthroplasties: Results From the Danish Knee Arthroplasty Registry

El-Galaly A, Nielsen PT, Jensen SL, Kappel A
J Arthroplasty. 2018 Jul;33(7):2131-2135

- 1997-2015
- 1044 HTO -> TKR
- 63763 primary TKR

- 10yr survival: 91% vs 94%
- Crude Hazard ratio 1.73
- Age and gender adjusted, hazard ratio 1.19 (P=0.09)
Will medial compartment cartilage regenerate after HTO?
• Kanamiya T. Arthroscopy 2002

• 58 HTO, rescoped at 18 mths

  • 55%: partial or even coverage with fibrocartilage
  • 34%: white scattered coverage with fibrocartilage
  • 11%: no regenerative change

• Correlation between improvement of articular surface, function score and degree of correction
• Wakabayashi S. Arthroscopy 2002

• 73 HTO, rescoped at 1 yr

1) Eburnation group
• (grade IV)
• Femur: 62% improved
• Tibia: 53% improved

2) Fibrillation group
• (grade III)
• Femur: 9% improved
• Tibia: 9% improved, 11% deteriorated

• Higher incidence of repair with pre-op grade IV cartilage

Department of Orthopaedics and Traumatology, PWH, CUHK
• Koshino T. Knee 2003

• 146 HTO, arthroscopy at time of removal of plate, average 2 yrs

• 13 knees no regeneration
• 86 knees partial regeneration
• 47 knees total coverage by new regenerated cartilage
• Jung WH. Arthroscopy 2014

• 159 HTO, rescoped at 2 yr

• Cartilage regeneration in femoral condyle: 92%

• Cartilage regeneration in tibial plateau: 69%
• Kim KL. Am J Sports Med 2017

• 104 HTOs, rescored at 2 yrs

• International Cartilage Repair Society grading
  – femur 51.9%, tibia 34.6%

• Macroscopic grading system of Koshino
  – femur 72%, tibia 55%
Factors favor regeneration

• Lower BMI
• Medial femoral condyle
• Advanced pre-op cartilage degeneration
• Over-corrected alignment
A Buy Time Surgery?

1) Result of HTO
2) Result of conversion from HTO to TKR
3) Cartilage regeneration after HTO
A Buy Time Surgery?

✓ Favorable long term survivorship
✓ Comparable to primary TKR
✓ Cartilage regeneration well proven
The principle a surgeon should keep in mind

An arthroplasty has an unknown but finite life whereas an osteotomy has the potential to last the patient a lifetime

- Wagner H.
My colleague with bilateral HTO
Thank you