3rd Annual Advanced Course on Knee Surgery
January 17-22 , 2010 , Val D'Isere ,

Results of High Tibial Osteotomy Osteotomy: Review of the Literature

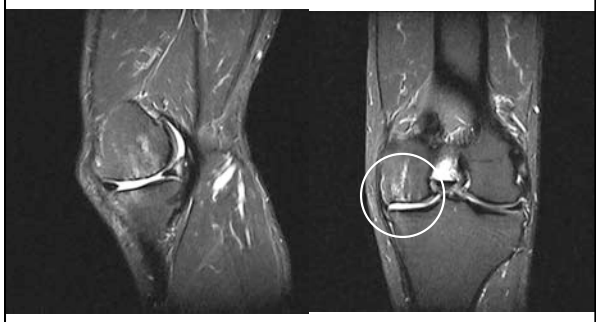
A Amendola MD
Professor, Dept of Orthopaedic Surgery
Director, UI Sports Medicine
University of Iowa Hospitals and Clinics

Disclosures

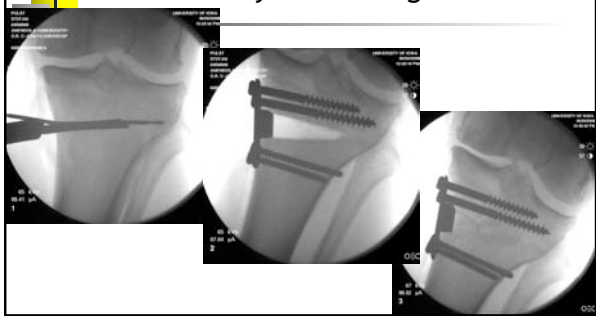
- Conflict of interest related to this presentation:
- Arthrex

Introduction

- 53 yo male, former competitive runner and soccer player
- S/P bilat. medial meniscectomy in 2001 and 2005 & left microfracture in 2005
- Confirmed grade 4 cartilage loss med comp
- Now increasing med knee pain L>R with exercise and at rest..
- On exam now, stable knee with complete ROM, minimal swelling.



OW osteotomy and bone graft



Unicompartmental OA in the Young Patient

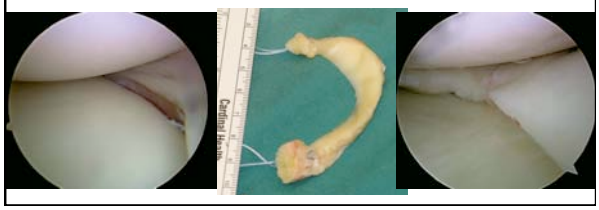
- Medial > lateral
- Varus > valgus
  - **Post meniscectomy**
  - **Post ACL injury**
  - ***Primary knee OA***

Early Knee OA

- Operative Considerations:
- Figure out the problem
  - ***Alignment, instability, meniscus, cartilage***
- Assess axial and sagittal plane alignment
- Goals of surgery will affect decision
  - **Decrease pain**
  - **Improve function for ADL's**
  - **Return to activity**

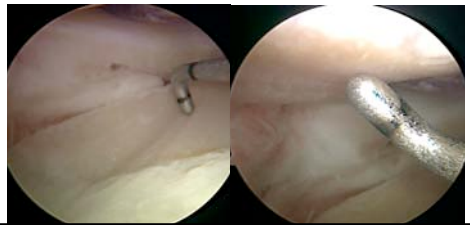
Early Arthritic Knee

- Often meniscal deficient
- Meniscal transplant?



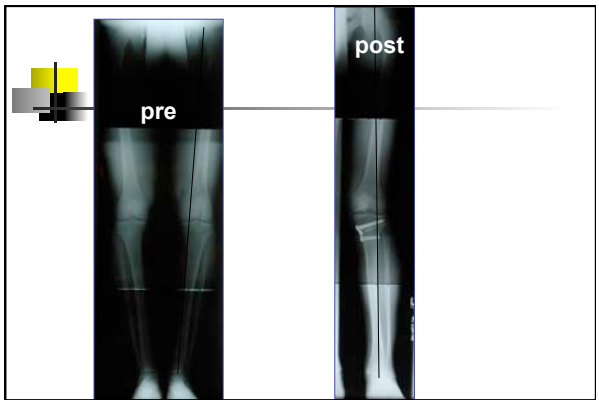
Early Arthritic Knee ≠ transplant

- Usually grade 4 changes
- Both on tibia and femur



Osteotomy : technical issues

- Techniques for osteotomy:
- Proximal Tibial
  - Lateral closing
  - Medial opening
  - ***Acute vs gradual distraction***
- Distal Femoral
  - ***Medial closing***
  - ***Lateral opening***



Evidence for Osteotomy

THE COCHRANE COLLABORATION®

Osteotomy for treating knee osteoarthritis (Review)

Brouwer RW, Raaij van TM, Bierma-Zeinstra SMA, Verhagen AP, Jakma TSC, Verhaar JAN

WILEY Publishers Since 1807

- 13 studies , 693 pts
- 6 studies comparing 2 techniques
- 1 study HTO alone vs HTO +mcfx
- 4 HTO different post op rehab
- 2 HTO vs UKA

Evidence for Osteotomy

Osteotomy for treating knee osteoarthritis (Review)

Brouwer RW, Raaij van TM, Bierma-Zeinstra SMA, Verhagen AP, Jakma TSC, Verhaar JAN

Authors' conclusions

•Based on 13 studies, we conclude that there is 'silver' level evidence (www.cochranemsk.org) that valgus HTO improves knee function and reduces pain

•There is no evidence whether an osteotomy is more effective than conservative treatment and the results so far do not justify a conclusion about effectiveness of specific surgical techniques

•No difference between techniques or vs UNI

Factors affecting results of HTO

- Heterogeneous population
- Variable indications
- Severity of disease/ knee condition
- Surgeon dependent
- Technical differences, ie fixation , techniques
- Patient expectations

- So review of the literature is imperfect !

Overall results of HTO

- good or excellent short and midterm results in isolated medial OA
- outcomes gradually deteriorate to a success rate between 60% and 70% at 10 years from surgery[4].

Authors	Year	Follow-up	Results
Aglietti et al[8]	1983	> 10 years	Satisfactory outcomes in 87% (at 2 to 5 years), in 70% (at 6 to 10 years) and in 64% (>10 years)
Matthews et al.[9]	1988	Mean of 7 years (1.4-14.4 years)	Satisfactorily results in 86% at 1 year, in 64% at 3 years, in 50% at 5 years and in 28% at 9 years.
Rudan et al.[10]	1990	Mean of 5.8 years (3-9 years)	80% of good or excellent results at last follow-up
Ivarsson et al.[11]	1990	5 to 13 years	75% of good and acceptable outcomes at 5.7 years and 60% at 11.5 years
Naudie et al.[12]	1999	10 to 22 years	75% of patients at 5 years, 51% at 10 years, 39% at 15 years and 39% at 20 years did not require a TKA
Spougar et al.[13]	2003	10 years	Survival rates at ten years follow-up were 65%-74%
Koshino et al.[14]	2004	5-20 years	Survivorship of 97.3% at 7 years, 95.1% at 10 years and 86.9% at 15 years from surgery
Jung et al.[15]	2005	20 years	Survival rates of 89.5% at 5 years, 74.7% at 10 years and 66.9 % for 15 and 20 years
Sprenger et al.[16]	2006	Mean 34 months (18-60)	Significant improvement of pain and knee function
Chiang et al.[17]	2006	Mean 15 years (13-16)	Excellent or good HSS scores in 18 knees at 5 years and in 13 knees at average 15 years
Papachristou et al.[18]	2006	Mean 10 years (5-17)	Survival rate of 80% at 10 years, 66% at 15 years and over 52.8% at 17 years of follow-up
Fischer et al.[19]	2006	Mean 18 years (12-28)	Survival was 85% at 20 years
Smithner et al.[20]	2008	Mean 12.4 years (3-25)	Survival rates were 94% after 5 years, 79.9% after10 years, 65.5% after 15 years, and 54.1% after 18 years
Akizuki et al.[21]	2008	Mean 16.4 years (16-20)	Survival was 97.6% at ten years and 90.4% at 15 years

From Bonasia, Amendola, Int Orthopaedics, Sept 2009

Evidence for Osteotomy

Arch Orthop Trauma Surg (2004) 124 : 258–261
DOI 10.1007/s00402-003-0545-5

ORIGINAL ARTICLE

Petri Virolainen · Hannu T. Aro

High tibial osteotomy for the treatment of osteoarthritis of the knee: a review of the literature and a meta-analysis of follow-up studies

- overall failure rate at 10 years was 24.6%
- Average probability of a good or excellent result after 60 months was 75.3% and after 100 months, 60.3%.

Factors affecting outcome from HTO

- Negative effect
  - *severe articular destruction*
  - *Undercorrected /overcorrected knees*
  - *advanced age*
  - *patello-femoral arthrosis*
  - *decreased range of motion*
  - *previous arthroscopic debridements*
  - *joint instability*
  - *loss of correction*
  - *lateral tibial thrust*
- Positive effect
  - *Valgus alignment post correction*

Complications of HTO

- Accurate correction improves results.
- Valgus overcorrection yields poor results:

Insall et al., JBJS (A) 1974
Coventry et al., Or Clin NA, 1979
Tjornstrand et al., CORR, 1981
Aglietti et al., CORR, 1983
Hernigou et al , JBJS ,1987

Overcorrection

40 yo F pain, valgus and hyperextension deformity, 20 yrs post hto

Post revision Lateral CW Wedge HTO

1 yr post op

Other factors

- Body mass index
  - ***No evidence to conclude BMI has any effect on outcome***

Evidence for Osteotomy

- Complications (10-41%)
  - *Peroneal N injury*
  - *Anterior compartment syndrome*
  - *Overcorrection/undercorrection*
  - *Proximal tib fib joint*
  - *Patellar height*
  - *Non union / malunion*
  - *Revision to TKA*

Peroneal N injury

- Related to proximal tib fib joint management

Complications

- Intrarticular fractures
  - *OW 11%, LCW 10-20%*
- Non union
  - *OW 1-4 %/ CWO 1-4%*
- Infection
  - *Internal fixation up to 4%*
  - *Ex-fix up to 54% (pin tract)*

Open vs Closing Wedge HTO ?

vs

Lateral Closing Wedge HTO

- Results deteriorate with time.
  - *~ 80% good/excellent @ 5 yrs*
  - *~ 50% good/excellent @ 10 yrs*

Ivarsson et al., JBJS (B) 1990
Coventry et al., JBJS (A) 1973
Coventry et al., JBJS (A) 1993
Insall et al., JBJS (A) 1984
Tjornstrand et al., CORR, 1981
Aglietti et al., CORR, 1983
Holden et al, JBJS(A) , 1988
Matthews et al, CORR, 1988
Naudie et al, 1999
Billings et al , JBJS , 2000

Why opening wedge?

- Advantages
  - *Leave the fibula alone*
  - *One osteotomy*
  - *Maintains/corrects bony anatomy*
  - *Less likely to overcorrect*
  - *Revision to TKA ? simpler*

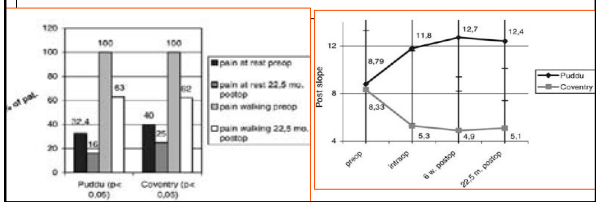
Why opening wedge?

- Disadvantages
  - *Bone graft*
  - *Slope alteration*
  - *Patella height*
  - *Rehabilitation/WB*

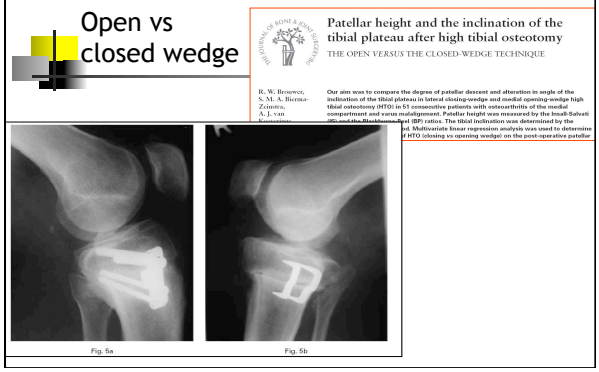
Concern with Opening wedge Osteotomy

S. Hoell · J. Suttmoeller · V. Stoll · S. Fuchs
G. Gosheger

The high tibial osteotomy, open versus closed wedge, a comparison of methods in 108 patients



Open vs closed wedge



Patellar height and the inclination of the tibial plateau after high tibial osteotomy

THE OPEN VERSUS THE CLOSED-WEDGE TECHNIQUE

R. W. Brouwer, S. M. A. Bierma-Zeinstra, A. J. van

Our aim was to compare the degree of patellar descent and alteration in angle of the inclination of the tibial plateau in lateral closing-wedge and medial opening-wedge high tibial osteotomy (HTO) in 51 consecutive patients with osteoarthritis of the medial compartment and varus malalignment. Patellar height was measured by the Insall-Salvati

pe. Multivariate linear regression analysis was used to determine f HTO (closing vs opening wedge) on the post-operative patellar

Fig. 5a Fig. 5b

Osteotomy fixation

- Stoffel et al.[52] (2004)
  - *compared modified Puddu plate (Arthrex, Naples, Fla) vs the TomoFix plate (Synthes, Solothurn, Switzerland)*
  - *Both provide immediate stability*
  - *Tomofix has more torsional and axail stability with lateral cortex fracture*
- Agneskirchner et al.[53] (2005)
  - *compared four different plates ;Long rigid plate the most stable (Tomofix)*
- Dorsey et al.[55] (2006)
  - *in their biomechanical study tested three plate fixation devices ; No difference in stability*
- Spahn et al.[56] (2006)
  - *Compared fixation techniques (conventional plate, angle stable plate with or without spacer) and concluded that spacer implants have superior biomechanical properties and that angle stable plates may prevent fractures of the lateral cortex.*

HTO Complications: Is there a concern revising an HTO to TKA?

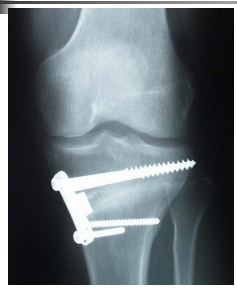


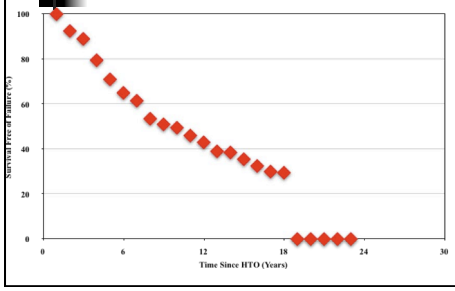
Table 1. Results of TKA Following HTO

Author	Year	Follow-up (Years)	TKA (No.)	Results
Katz	1987	2.9	21	Results worse than primary TKA
Staheli	1987	3.7	35	Results similar to primary TKA
Windsor	1988	4.6	45	80% had patella baja, results similar to revision TKA
Scuderi	1989	N/A	66	89% had patella baja
Amendola	1989	3.1	42	Knee scores similar, but less ROM in the HTO group
Jackson	1994		20	Worse results after HTO compared to UKR, because of complications
Mont	1994	6.1	73	Worse knee scores in HTO group
Gill	1995	3.8	30	Better results after HTO than after UKR
Bergenudd	1997	4-9	14	No difference in knee scores, more complications in HTO group
Toksvig	1998	10	40	knee scores same , RSA tibial movement same
Walther	2000		35	Worse knee scores in HTO group
Meding	2000	7.5	39	No difference in knee scores when compared with TKA in opposite knee

Koval, KJ (ed): *Orthopaedic Knowledge Update 7*. Rosemont, IL, American Academy of Orthopaedic Surgeons, 2002 Ch. 44.

Evidence for Osteotomy

SURVIVORSHIP : Naudie et al, 1999



Naudie et al, 1999

- Subset of patients
  - *Age < 50 yrs and Flexion > 120 degrees*
- Increased probability of survival

5 years	*95%*
10 years	*80%*
15 years	*65%*

HTO : Indications

- HTO may be a more predictable procedure in carefully selected patients with OA
  - ***Active, heavy demand***
  - ***Pre op activity level***
  - ***ROM > 120***
  - ***Mild to moderate deformity***
  - *Age ?*

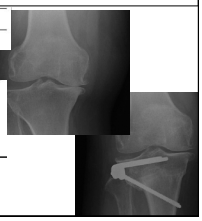
Evidence for Osteotomy

Repair of articular cartilage and clinical outcome after osteotomy with microfracture or abrasion arthroplasty for medial gonarthrosis

Knee , 2007

Daigo Matsunaga, Shaw Akizuki *, Tsutomu Takizawa, Ikuya Yamazaki, Joji Kuraishi

	HTO group	MF group	AA group
Total number	37 knees	26 knees	51 knees
Age (years)	64.0±5.9	65.0±3.8	64.6±5.9
Preoperative JOA score	49.8±6.8	52.5±8.7	52.4±6.0
Postoperative JOA score			
One year after surgery	86.5±6.8	84.0±5.9	86.0±7.2
Three years after surgery	86.8±7.0	86.6±6.6	88.9±7.0
Five years after surgery	88.9±4.8	85.6±7.4	87.0±7.8



- No difference at 5 years

Case: 55 yo avid runner

case

50 yo avid runner

OW HTO

2 years after HTO

- Gave up running
- 320 km bike race

Summary

- Osteotomy is a good option in the right patient
- Assess the patient expectations and knee condition
- Accurate correction and performance of the surgery is essential
- my choice : Opening wedge HTO

Thank you