Modern High Tibial Osteotomy

Medial Compartment OsteoArthritis of Knee
Dr. Milind Chaudhary

Director
Int. Deformity & Lengthening Inst.
Akola
Consultant,
Jaslok Hospital, Mumbai
Imm. Past President
ASAMI INDIA
History & Development
Planning
Techniques
Long term results
True indications
Robert Jones

Late 1850’s
performed mid tibial osteotomy
for Osteoarthritis of knee
in Liverpool
The most famous work in English is by these surgeons from England.
Mark Coventry
Iconic surgeon from Mayo Clinic made the HTO famous.................
But used staples for fixation, hence had poor long term results.
Prof. T. Koshino

Tibial Osteotomy in Gonarthrosis (Osteo-Arthritis of the Knee)*

BY GÖRAN C. H. BAUER, M.D.†, JOHN INSALL, M.D.‡, AND TOMIHISA KOSHINO, M.D.†, NEW YORK, N.Y.

Prof. T. Koshino has worked on HTO in Yokohama Japan since 1970.

Prof. Tomihisa Koshino has worked on HTO in Yokohama Japan since 1970.
Prof. Koshino has refined the technique with several new implants and accurate methods.
Dr Chaudhary with Prof. Koshino in Yokohoma, 2004. He devised methods to allow patients more movement in the knee after operation.
Prof Koshino showed that cartilage can regenerate after a year when proper alignment is maintained! There is no need for Joint Replacement in many patients!
Philippe Hernigou has extensive experience in Paris since Debeyre described this osteotomy more than 6 decades ago.
With more than 3700 operations, and a Follow Up of 20-30 yrs, they find this operation gives long lasting relief.
HemiCallotasis is gradual opening wedge creation for correction of Varus deformity.
Gradual opening wedge creation with unilateral fixation is popular and can achieve good results.

We report the outcome of 32 patients (37 knees) who underwent hemicallostasis with a dynamic external fixator for osteoarthritis of the medial compartment of the knee. There were 16 men (19 knees) and 16 women (18 knees) with a mean age at operation of 54.6 years (27 to 72). The aim was to achieve a valgus overcorrection of 2° to 8° or mechanical
The AO group has devised excellent locking plate systems for fixation which allows early walking without risk of loss of alignment.
The Operative technique is standardized and described in great detail.
Supra Tuberosity
Dome Osteotomy
Dome Osteotomy

DOME OSTEOTOMY OF THE TIBIA FOR OSTEOARTHRITIS OF THE KNEE

N. A. SUNDARAM, J. P. HALLETT, M. F. SULLIVAN

From the Royal National Orthopaedic Hospital, London

VOL. 68-B, NO. 5, NOVEMBER 1986

Yet another popular method of HTO which works well even in a cast.
Revival of HTO in the west

* Accurate deformity correction
  with Ilizarov fixator

*Sports Medicine group ---Noyes
Ligament laxity with Varus
Frank Noyes

- Primary Varus
- Secondary varus
- Teritiary Varus deformities
Focal Dome Osteotomy with Ilizarov Fixator

Dror Paley  Maurizio Catagni

Pioneers of the Ilizarov techniques in Italy & USA, elaborated techniques of varus correction with an à la carte approach.
Dr Milind Chaudhary with Prof Ilizarov in 1988, is the earliest practitioner of the Ilizarov techniques in India and has extensive experience in High Tibial osteotomies since 1990.
Effects of Mal-alignment

Varus = Medial Compartment OA
Loads on Medial Comp.

- Normal alignment = ~70% of total
- 6° varus = 97 %
- 4° valgus = 50 %
With increasing Varus deformity, the mechanical axis (red line) passes more and more medial to the knee—causing more and more loading of the medial compartment.
Major Factors influencing results

- Frontal Alignment Valgus
- Sagittal alignment & FFD
- High Adduction Moment Arm Gait
Other Factors influencing results

- Obesity
- Internal Rotation of the Tibia
Valgus Alignment

allows the Mechanical Axis to pass sufficiently through the lateral compartment…
to unload the Medial compartment & regenerate the cartilage.
SHORT term Pain Relief

- Decompression of the Subchondral Hypertension hence any osteotomy with undercorrection will offer pain relief
MEDIUM term Pain Relief

• Accurate re-alignment of Mech Axis

• unloads forces to allow regeneration of cartilage.
LONG Term Pain relief

maintenance of alignment!
Xray evaluation

- Standing AP weight bearing xray
- Rosenberg View 45° PA view
- Flexion views
Rosenberg view
How much cartilage wear?

56 yr old lady was advised Knee Replacement because “cartilage space cannot be seen on xray”
Yes, HTO can be done!

By taking x-rays in different planes, the joint space in medial compartment can be seen and hence HTO can be done.
A Infra-tuberosity dome osteotomy was done with Locked plating which achieved good correction into valgus and pain relief.
3 Steps of Planning

• Type of Osteotomy
• Magnitude of Correction
• Hardware for fixation
Choice of Osteotomy

- Closing wedge
- Angulation-Translation or DOME
- Opening Wedge
Closing Wedge Osteotomy
CWO

- “traditional” HTO
- Good for smaller deformities
- Many limitations and problems
1mm = 1°

- When parallel cut is 57 mm
- When distal cut is 54.15 mm

\[ c^2 = a^2 + b^2 - 2ab \cos C \]
1mm = 1°

- Larger Tibiae
  - 1mm = 1° will give undercorrection

- Smaller Tibiae
  - 1mm = 1° will give overcorrection
Click here for animation
Dome Osteotomy
Dome osteotomy

- “Smiling” dome below tuberosity—Focal Dome 😊

- “Crying” dome above tuberosity 😞
Click here for animation
56 yr old Orthopaedic Surgeon had severe pain and inability to walk more than a furlong. Work was affected. He was advised Replacement, which he refused. The Mech Axis is deviated significantly with dynamic Varus.
A Infra-tuberosity dome osteotomy was done with Lateral Translation of the distal fragment with excellent bony contact. Ilizarov fixator allows fine tuning of correction and maintenance of compression, which ensures healing.
Early walking

FWB in 4-6 wks

He was walking from the 2nd day and could attend to his clinic from the 3rd week. He could perform minor surgeries by the 6th week and walk almost full weight bearing.
The fixator came off in 3½ months and his alignment is in accurate 10° valgus. His Mechanical Axis is passing exactly through the “Fujisawa point”—unloading the medial compartment.
Magnitude of Correction
How much Valgus?

- Coventry ..................................................... 8º FTA
  Or
- Prof. Koshino .............................................. 10º FTA
  Or
- Yasuda (CORR 2002) ...................................... 12 -16º valgus?
How much Valgus?

• Fixed Formula….. through the Fujisawa Point @ 62% of the Joint width

• Based on extent of Cartilage Loss

• Based on Dynamic Varus
How far to correct the Mech Axis
Based on Cartilage Loss

Based on the work of Roland Jakob from Switzerland
Causes of Undercorrection

• Improper measurement
• Smaller wedge
• Improper Int Fixn
• High Adduction Moment Arm
• Underestimation due to FFD
High Adduction Moment Arm (HAMA)

Dynamic Varus

“Lazy Gait”
HAMA

- Knee Extension on Heel Strike & Foot Flat
- Intoeing
- Longer stride length
- *Delay* of Trunk Sway in stance phase of gait
HAMA

• Prodromos, Andriacchi, Galante

JBJS 1985A, (67) 1188-1194

A relationship between gait and Clinical Changes foll HTO
Wang, Kuo, Andriacchi, Galante

*JBJS 1990 72A, 905-909*

The influence of walking mechanics and time on results of proximal tibial osteotomy
Click here for movie

Movie shows Lateral Thrust of Dynamic Varus deformity
Correcting Lateral Thrust

- By Surgery
- By Gait training
Click here for movie

Sharma po
By Surgery

• by Overcorrection

  Sufficient to overcome Dynamic Varus

&

• External Rotation of Distal fragment
By Gait Training

- Out-toeing of foot while walking
- Shorter stride
- A little bit of Knee Flexion on Heel-strike
- Strengthening Hip Abductors
Role of FFD

FFD each $5^\circ = 1^\circ$ Varus


Underestimation of varus angulation in knees with flexion deformity.

Koshino T, Takeyama M, Jiang LS, Yoshida T, Saito T.
Large Deformity
Severe varus with thrust in a 56 yr old.
Gradual correction of more than 30° in fixator to give full correction of Mechanical Axis & pain relief.
Bilateral
33 yr old from London needed Bilateral correction to save on treatment time.
Bilateral Ilizarov Fixator to correct Varus with Medial Compartment arthritis in a 56 yr old.
Advantages of Hybrid Ilizarov & Focal Dome

• Large Deformities can be corrected

• Compression{sustained}…..reliable union

• Control over Coronal & Sagittal Plane

• Compensates Lateral Thrust
Advantages of Hybrid Ilizarov & Focal Dome

- Patello-Femoral pain by Retinacular Release
- Joints are free
- Resumption of activity & work
- Diabetics!
- Additional Lengthening & Shortening can be done
Patello-Femoral problems
Retinacular Release

- *Koshino 2002, Knee*. Tubercular advancement with retinacular releases

- *Christodolou 2005, CORR*
  Only Retinacular releases
Fixator Assisted Plating

Infra Tuberosity
Focal Dome
High Tibial Osteotomy
External Fixation

Used as

Intra-Op Alignment tool
Advanced age can be a deterrent in using external fixation.
FAP technique used in which fixator used as an alignment tool to achieve accuracy.
Extra Long Digital Cassette in OR and a special Portable Xray machine with high tube position to get a Full Length Alignment view.
Osteotomy fixed with a locking plate and good alignment.
Excellent Alignment and function.
Long Term Results
Koshino 15 to 28 yrs.

- 93.2% @ 15 yrs & 87% @ 28 yrs
- Closing wedge osteotomy with plates
- AKSS from 37±20 to 87±13 @ 15 yrs
  80± 19 @ 28 yrs
- PreOp Alignment 6º Varus PO 9º Valgus
Majima, CORR 2000

- 48 knees FU at 10 to 15 yrs
- Best alignment is 10° FTA valgus
Coventry 1993

- Valgus of 8º
- BMI < 27.5%

are better predictors of survival
Flecher, Parrate et al.

- Staple & Plate Fixation
- 85% Survival after 20 yrs
Akizuki et al

- 118 Knees Prospective Study at 16.4 years
- Giebel Plate fixation
- 97.6% Survival at 10 years & 90.4% @15 yrs
- TKR for 9% at mean of 13.5 yrs
- BMI < 27.5% and ROM > 100º for good res.
M. Chaudhary

- >160 knees
- FU from 2 to 19 years
- > 98% relief @ 5 years (no pain + no TKR)
- >95% relief @ 10 years
- >90% relief @ 15 years
Severe pain in a 55 yr old teacher. Fixator well tolerated.
8 yrs after first surgery other knee needed surgery.
Minimum pain after 17 yrs
47 yr old with Polio and shortening on Opp side with severe pain of Medial Compartment Arthritis on good leg. A standard HTO would have caused greater Limb Length Difference. Hence a shortening was added to the HTO.
Min. Valgus maintained after 18 yrs. No significant pain in operated limb. All function possible.
Modern Indications

- Medial Compartment arthritis & Varus
- Patello-femoral arthritis
- Mild FFD
- Physiological age and Activity levels
- Desire for repair
Thank you

milind.chaudhary@gmail.com