

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



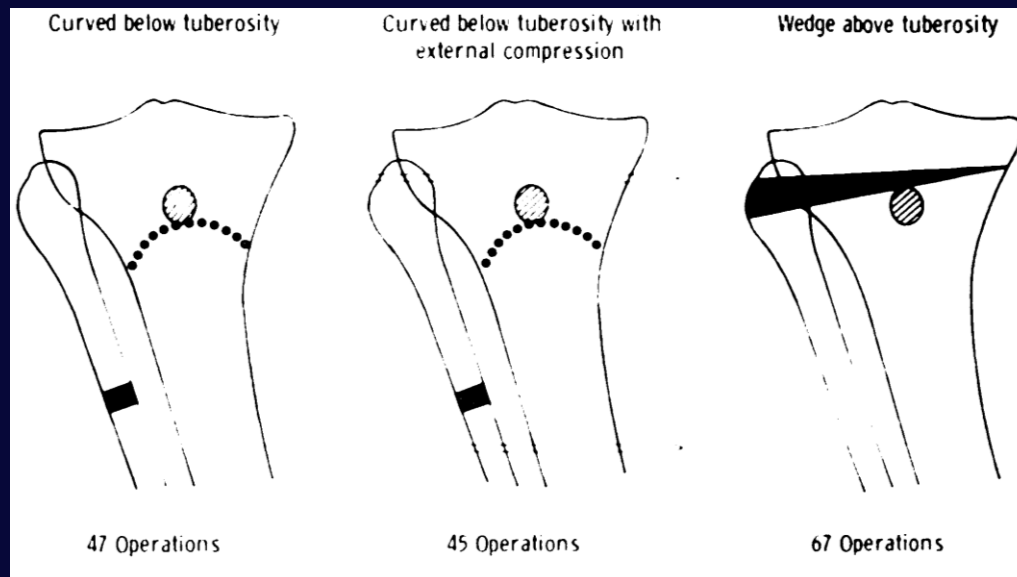
Late 1850's
performed mid tibial osteotomy
for Osteoarthritis of knee
in Liverpool

THE TECHNIQUE AND COMPLICATIONS OF UPPER TIBIAL OSTEOTOMY

A Review of 226 Operations

J. P. JACKSON and W. WAUGH, NOTTINGHAM, ENGLAND

From the Harlow Wood Orthopaedic Hospital, near Mansfield, Nottinghamshire



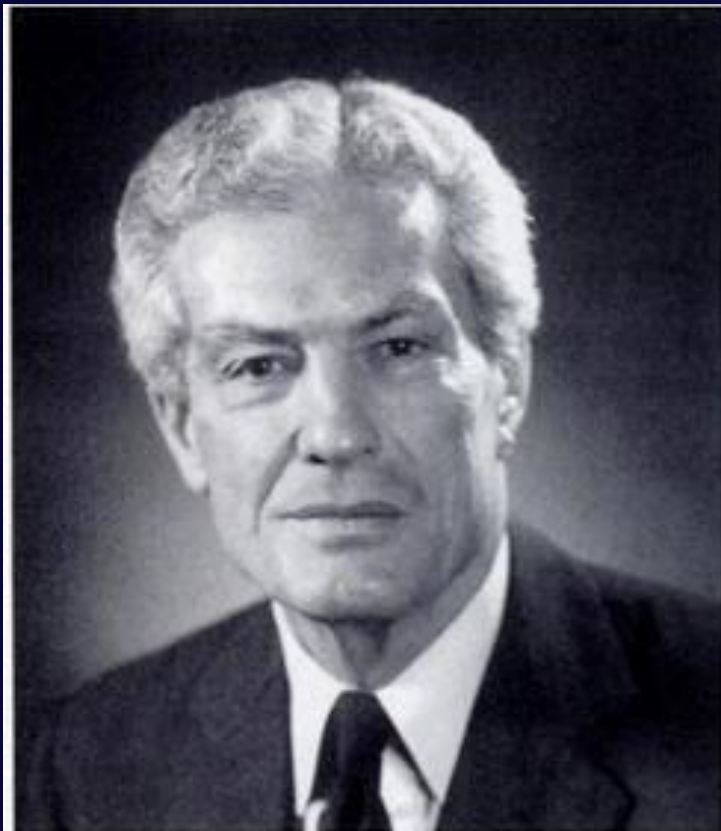
The most famous work in English is by these surgeons
from England.

Osteotomy of the Upper Portion of the Tibia for Degenerative Arthritis of the Knee

A PRELIMINARY REPORT

BY MARK B. COVENTRY, M.D.*, ROCHESTER, MINNESOTA

From the Section of Orthopedic Surgery, Mayo Clinic and Mayo Foundation, Rochester



Mark Coventry

Iconic surgeon from
Mayo Clinic made the
HTO famous.....

But used staples
for fixation, hence had
poor long term results.

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
JBJS 51A, Dec. 1969

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

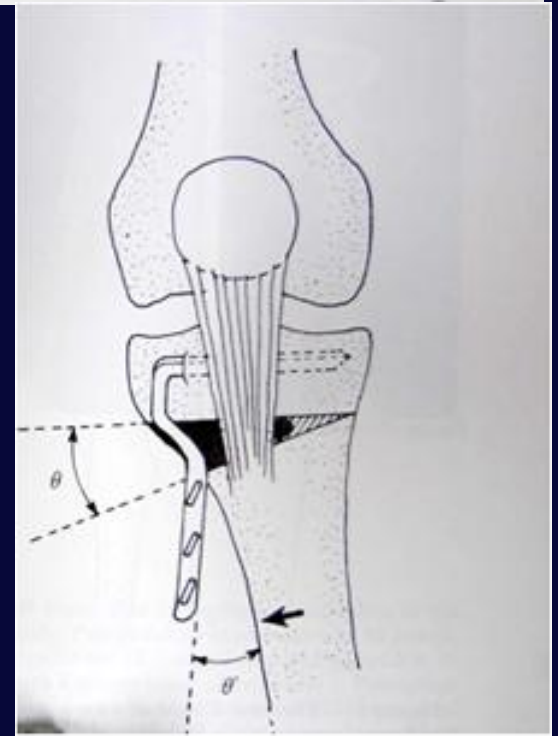


High Tibial Osteotomy with Fixation by a Blade Plate for Medial Compartment Osteoarthritis of the Knee

Tomihisa Koshino, MD, PhD,[°] Takamichi Morii, MD,[†]

Orth. Clin. North. Am.

Prof. Koshino has refined the technique with several new implants and accurate methods.



Increase in range of knee motion to obtain floor sitting after high tibial osteotomy for osteoarthritis

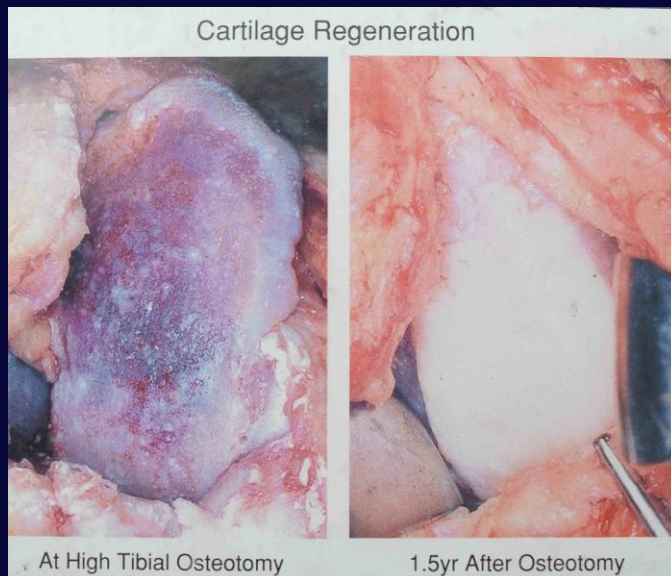
Tomihisa Koshino^{a,*}, Tomoyuki Saito^a, Keisuke Orito^a, Shigeyuki Mitsuhashi^a, Ryohei Takeuchi^a,



Dr Chaudhary with Prof.Koshino in Yokohoma, 2004. He devised methods to allow patients more movement in the knee after operation.

Regeneration of degenerated articular cartilage after high tibial valgus osteotomy for medial compartmental osteoarthritis of the knee

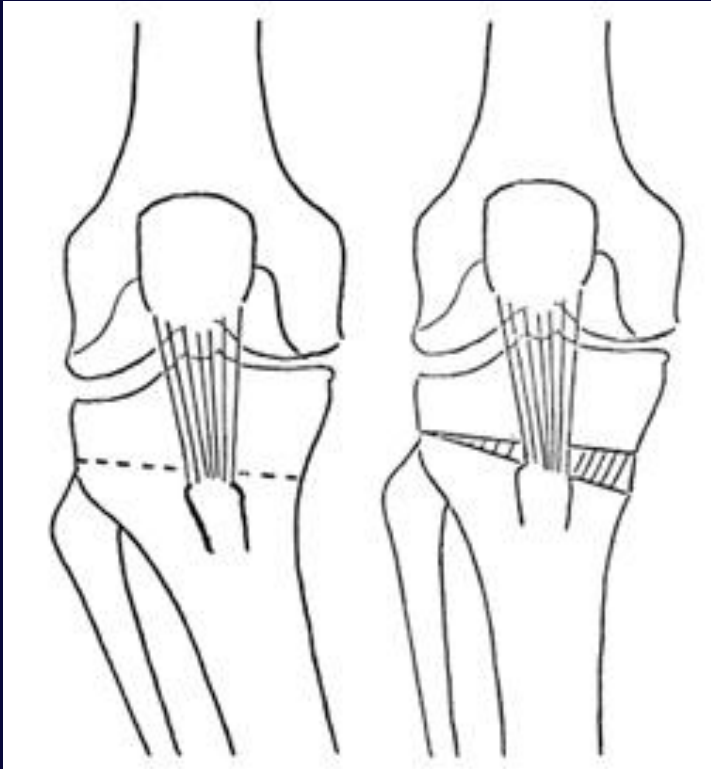
Tomihisa Koshino*, Shinichi Wada, Yuki Ara, Tomoyuki Saito



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!

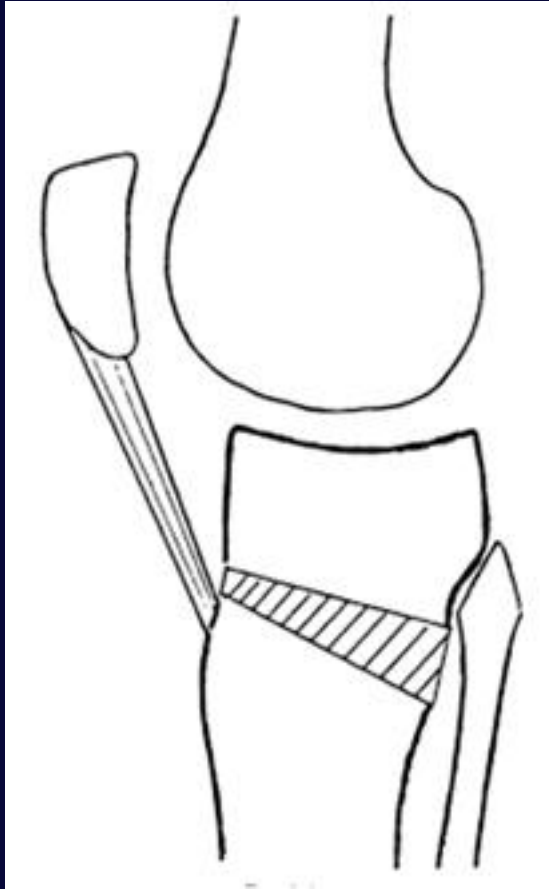
J. Debeyre, Ph. Hernigou, 1951

Open wedge osteotomy + BG



Philippe Hernigou has extensive experience in Paris since Debeyre described this osteotomy more than 6 decades ago.

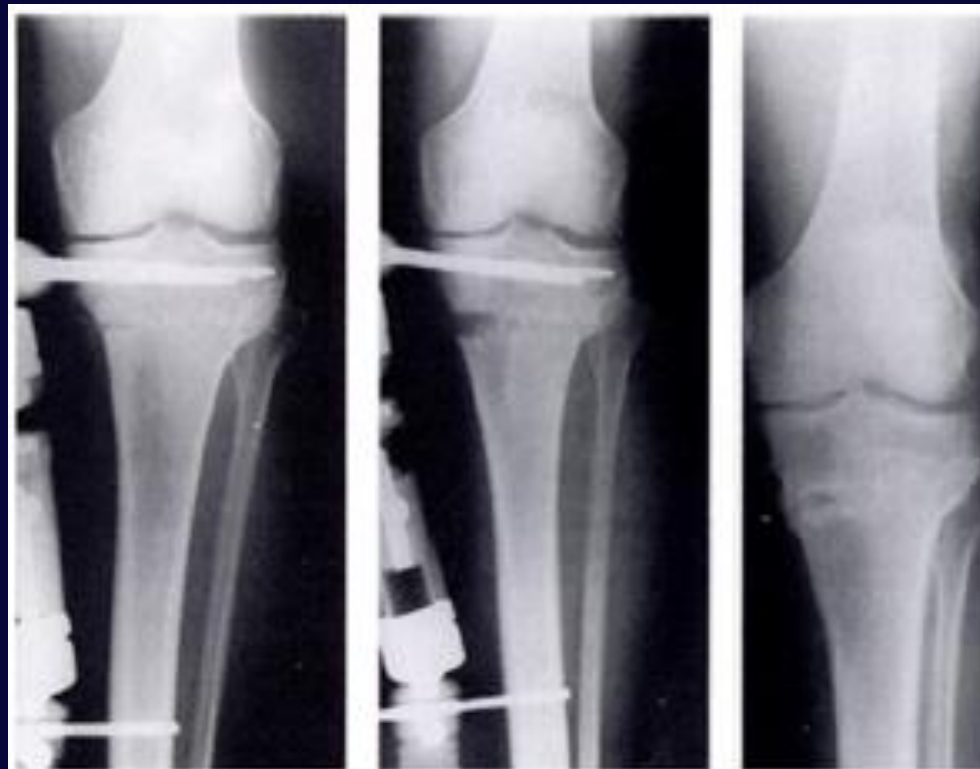
Ph. Hernigou, J. Debeyre



With more than 3700 operations, and a Follow Up of 20-30 yrs, they find this operation gives long lasting relief.

UPPER TIBIAL VALGUS OSTEOTOMY USING A DYNAMIC EXTERNAL FIXATOR

Turi G, Cassini M, Tomasi PS, Armotti P, Lavini F. L'osteotomia direzionale di ginocchio mediante la "emicallotasi". *Chir Organi Mov* 1987; 72(3):205-9.



HemiCallotasis is gradual opening wedge creation for correction of Varus deformity.



■ KNEE

High tibial osteotomy with a dynamic axial fixator

PRECISION IN ACHIEVING ALIGNMENT

V. Bachhal,
S. S. Sankhala,
N. Jindal,
M. S. Dhillon

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

JBJS 2011 India

Gradual opening wedge creation with unilateral fixation is popular and can achieve good results.

Open-Wedge High-Tibial Osteotomy With Rigid Plate Fixation

PHILIPP LOBENHOFFER, M.D., PH.D.*

*Department of Trauma and Reconstructive Surgery,
Henriettenstiftung Hannover Marienstrasse,
Hannover, Germany*

CARLO DE SIMONI, M.D.†

ALEX E. STAUBLI, M.D.†

*Department of Orthopaedics,
Kantonsspital Luzern,
Luzern, Switzerland*

Techniques in Knee Surgery 1(2): 93-105, 2002



The AO group has devised excellent locking plate systems for fixation which allows early walking without risk of loss of alignment.



2011



The Operative technique is standardized and described in great detail.

Supra Tuberosity Dome Osteotomy

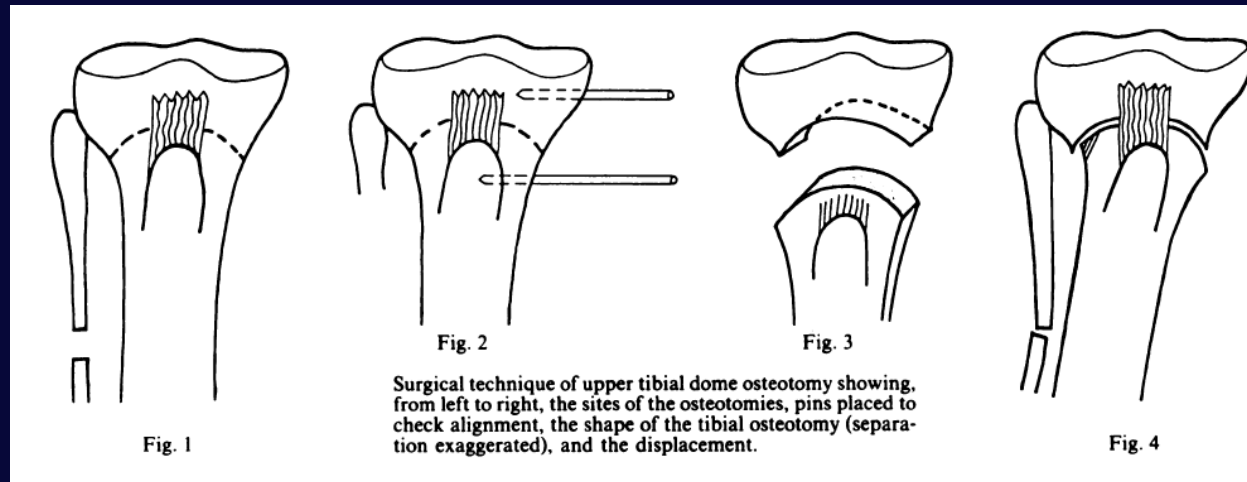
Dome Osteotomy

DOMES 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

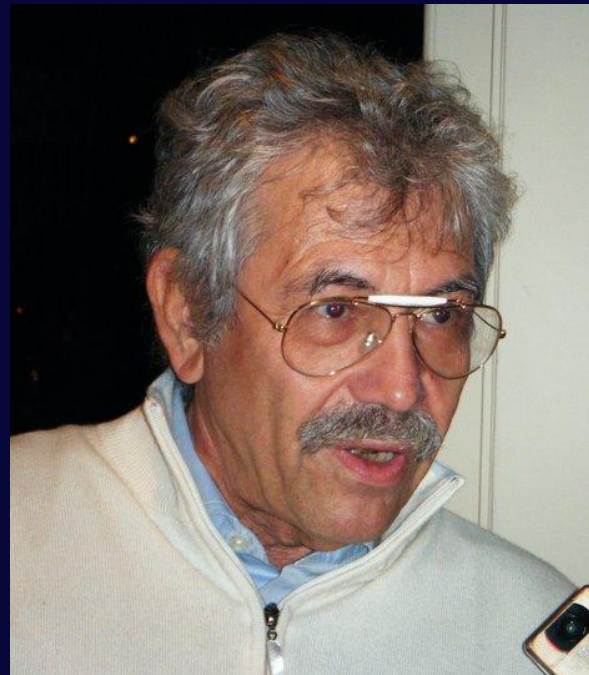
- Primary Varus
- Secondary varus
- Teritiary Varus deformities



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
a la carte approach.



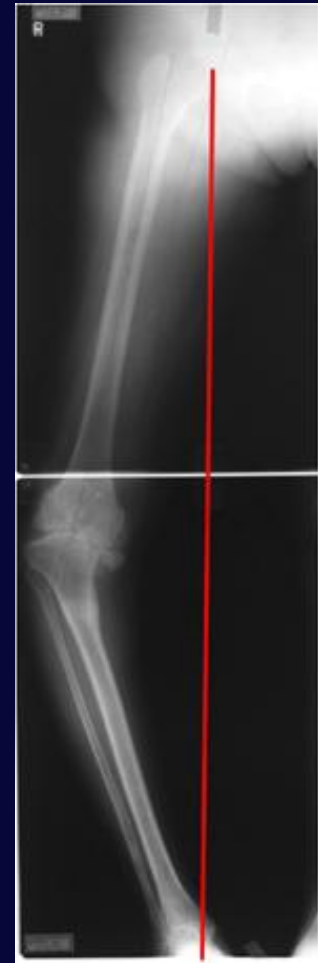
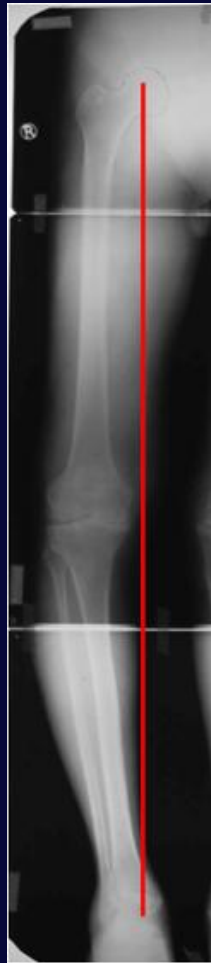
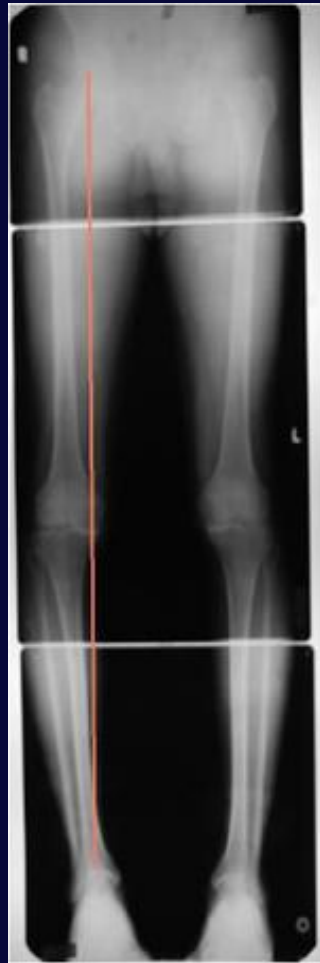
Dr Milind Chaudhary with Prof Ilizarov in 1988, is the earliest practitioner of the Ilizarov techniques in India and has extensive experience in High Tibial osteotomies since 1990.

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.

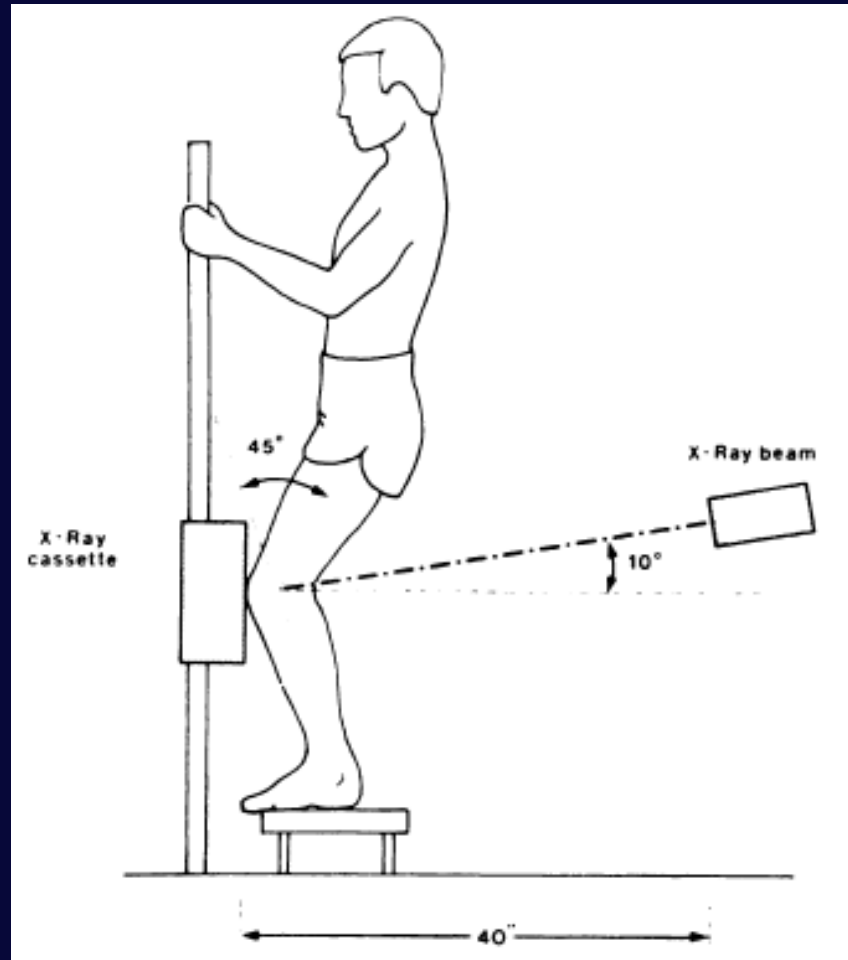
LONG Term Pain relief

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 xrays 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

$$1\text{mm} = 1^\circ$$

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

$$c^2 = a^2 + b^2 - 2ab \cos C$$



$$1\text{mm} = 1^\circ$$

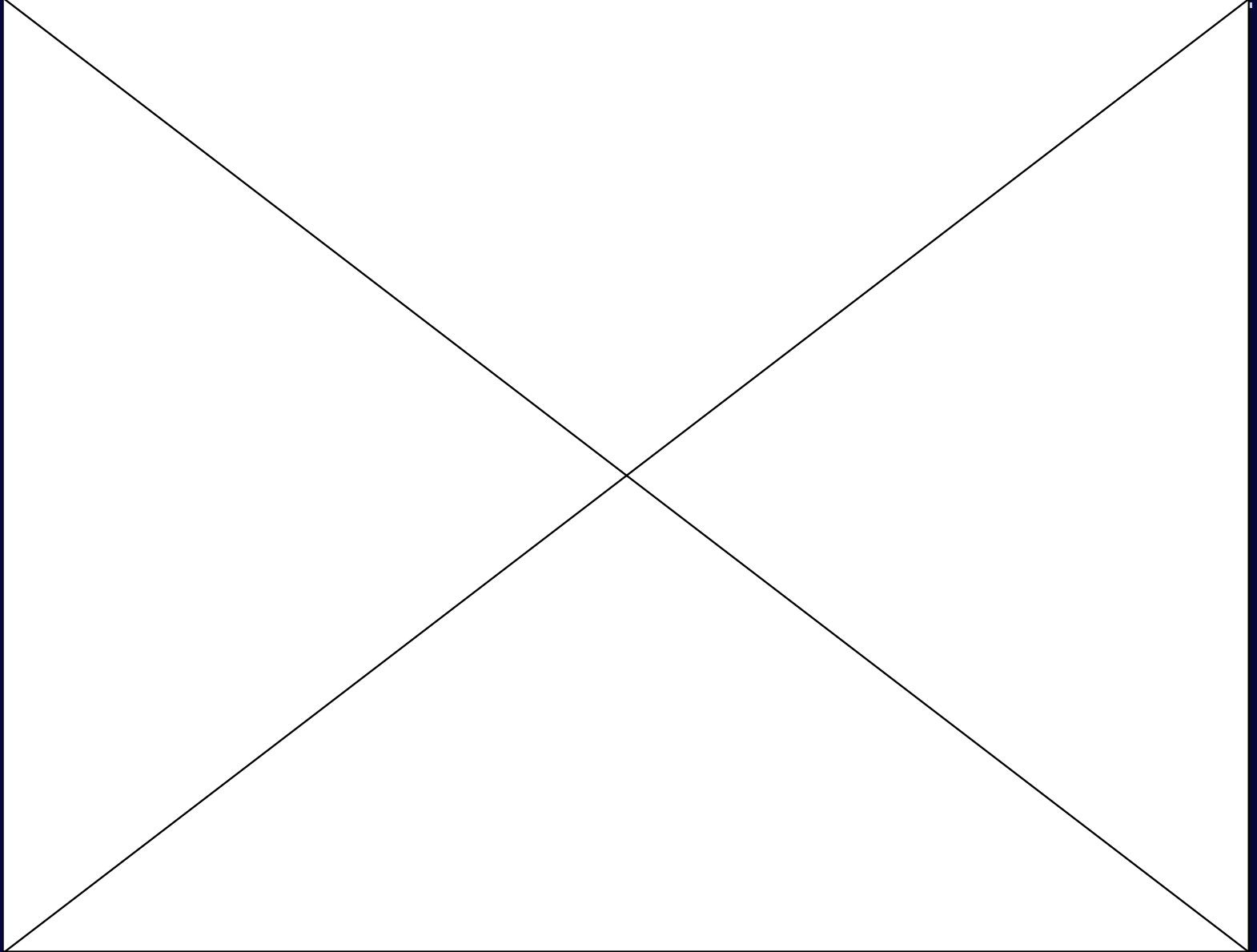
- Larger Tibiae---

1mm = 1° will give undercorrection

- Smaller Tibiae---



1mm = 1° will give overcorrection

[Click here for animation](#)

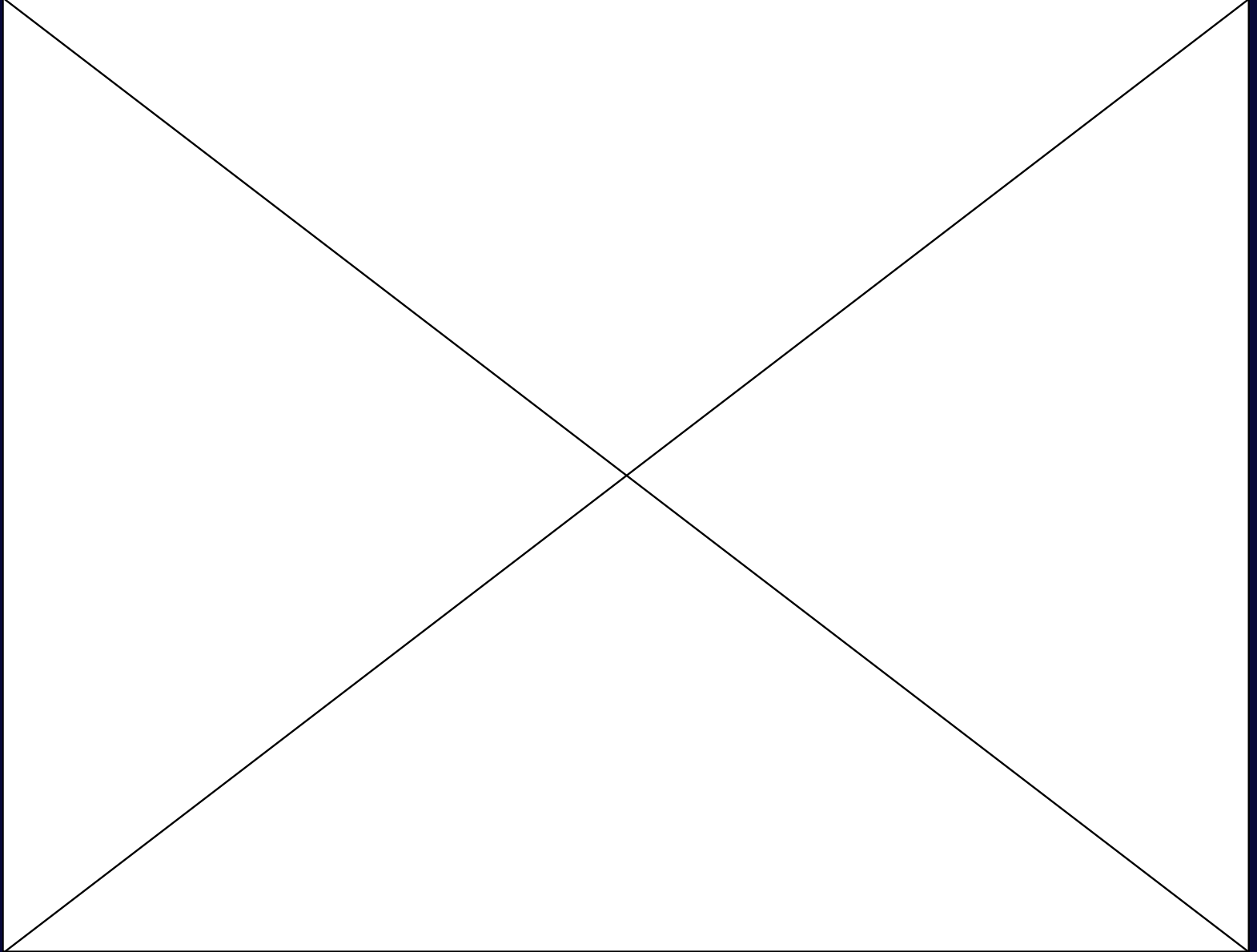


Dome Osteotomy

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 n 3½ moths 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

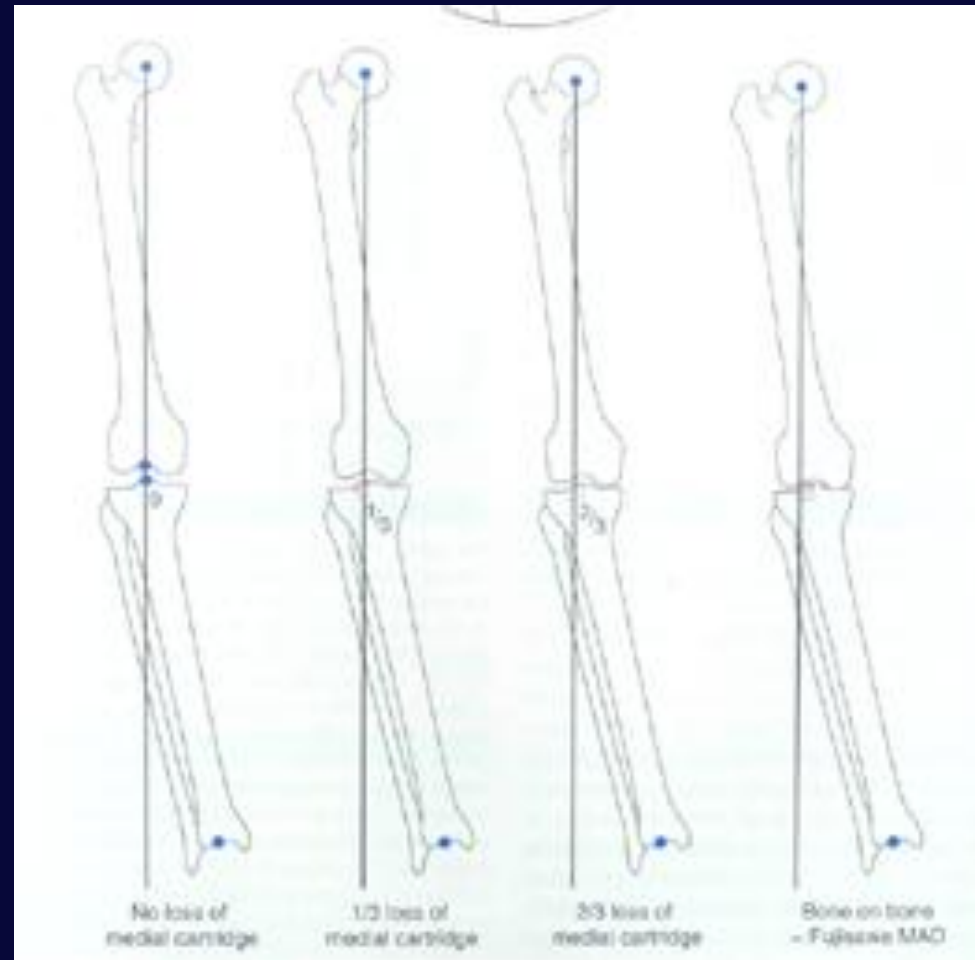
How much Valgus?

- Coventry.....8° FTA
Or
- Prof. Koshino.....10° FTA
Or
- Yasuda (CORR 2002)... ..12 -16° valgus?

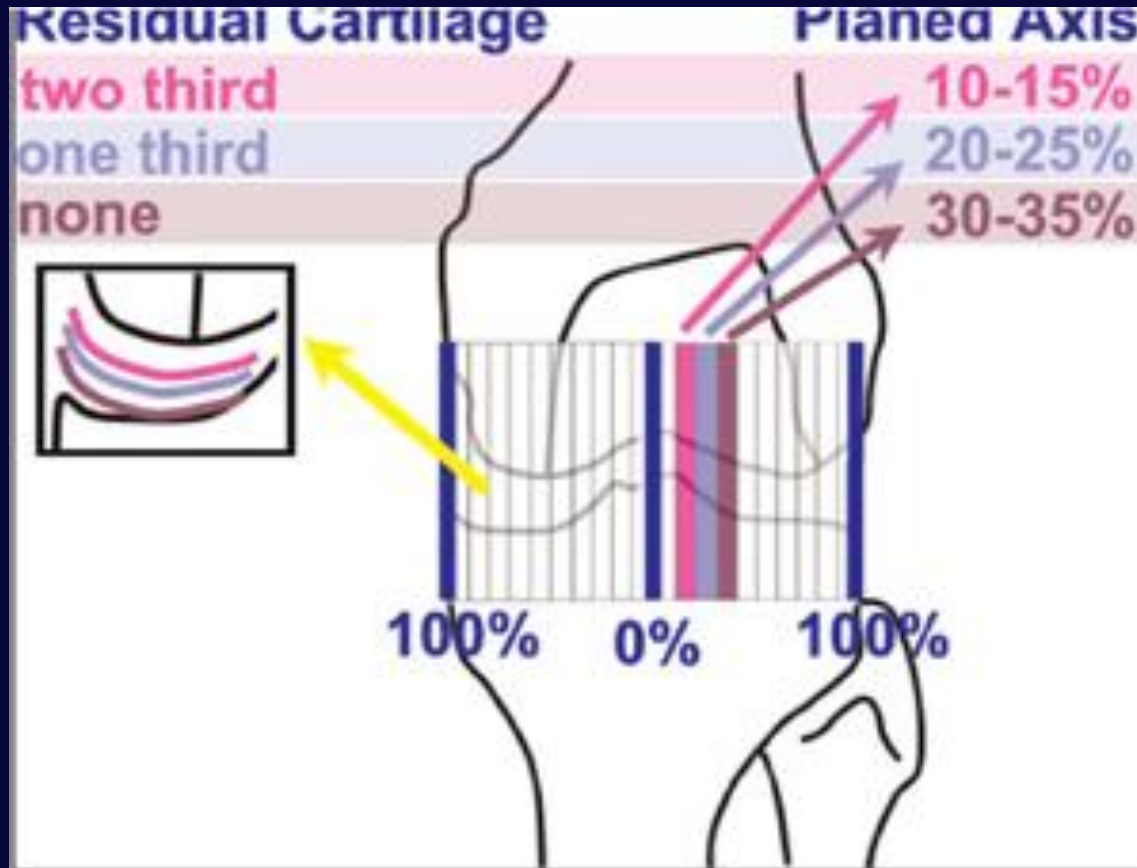
How much Valgus?

- 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

HAMA

- 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](#)

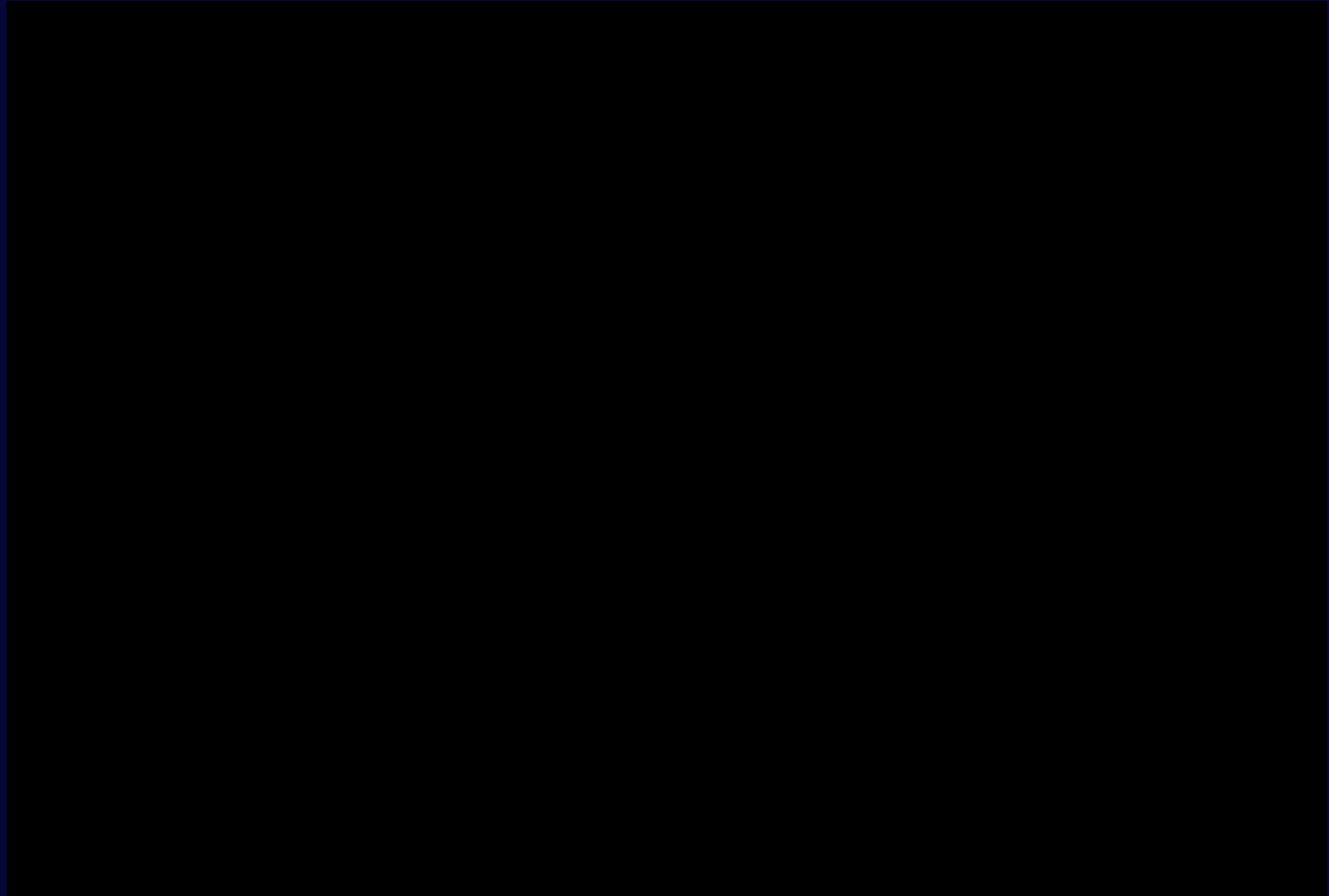


Movie shows Lateral Thrust of Dynamic Varus deformity

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

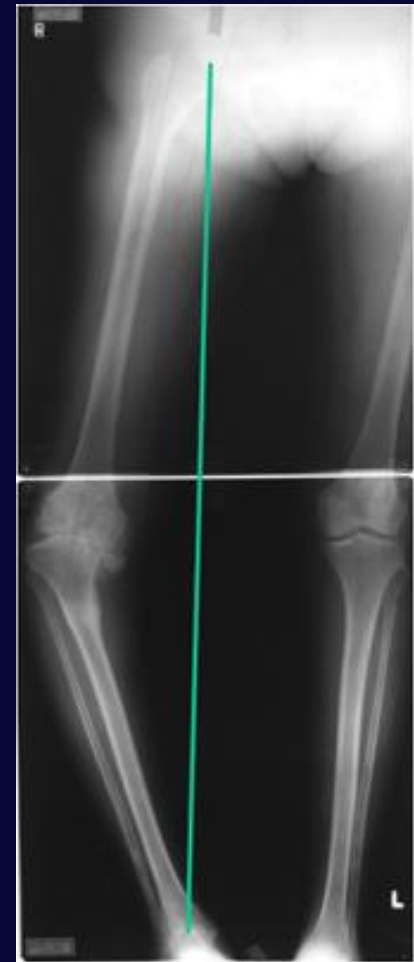
FFD each $5^\circ = 1^\circ$ Varus

- *Knee. 2002 Dec;9(4):275-9.*

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 6° Varus PO 9° Valgus

Majima, CORR 2000

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

Coventry 1993

- Valgus of 8°
&
- 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 > 100° 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.

17 Yr SURVIVAL



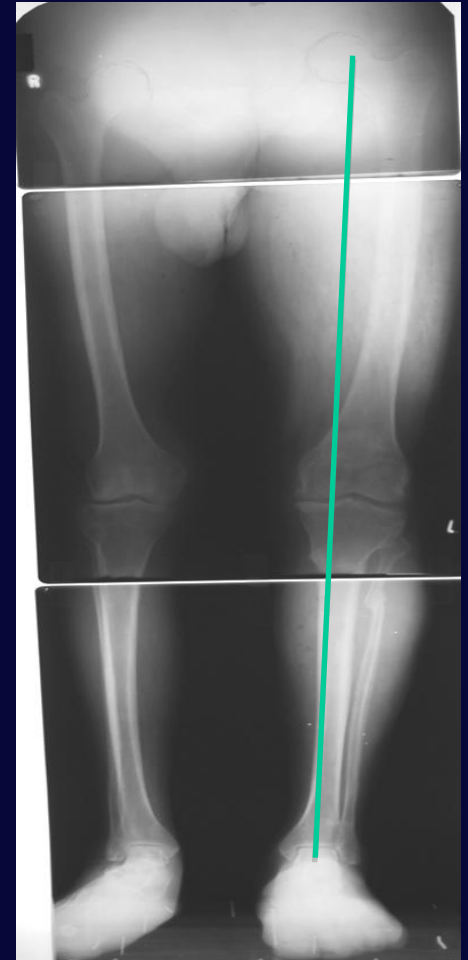
Minimum pain after 17 yrs

HTO with Shortening



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 .

18 YEAR SURVIVAL



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