

XXVI CONGRESSO
NAZIONALE SITOP

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IRCCS Ospedale Galeazzi - Sant'Ambrogio
MILANO



REVISIONE STORICA DELLA CHIRURGIA DEL PIEDE PIATTO

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PIEDE PIATTO LASSO SINTOMATICO CHE NON RISPONDE AL TRATTAMENTO CONSERVATIVO: CHIRURGIA

SCOPO

riduzione o risoluzione del dolore e riallineamento del piede



- ✓ ARTRORISI
- ✓ OSTEOTOMIE (extra-articolari)
- ✓ ARTRODESI
- ✓ ALLUNGAMENTO DEL TENDINE DI ACHILLE
- ✓ CHIRURGIA DEI TESSUTI MOLLI (rara)

TRATTAMENTO CHIRURGICO: ARTRORISI

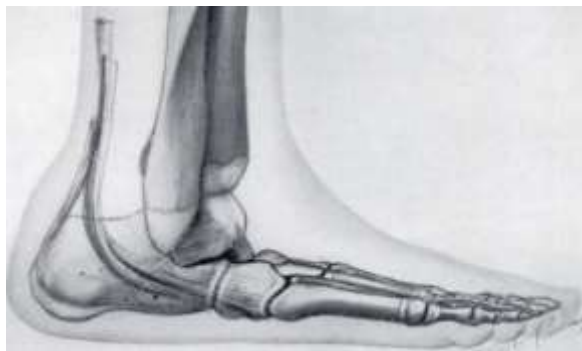
In 1946 by Chambers described the “abduction block,” as a wedge-shaped bone block aimed to impact the anterior border of the posterior facet of the calcaneus and to limit excessive anterior displacement of the talus on the calcaneus and correct the deformity



**Chambers EF: An operation for the correction of flexible flatfoot in adolescents.
West J Surg Obstet Gynecol, 54: 77-86, 1946**

TRATTAMENTO CHIRURGICO: ARTRODESI

This technique of using bone graft taken from tibia and placed in the sinus tarsi to obtain an extra-articular arthrodesis of the subtalar joint was used at the Children's Hospital in 1945 by Dr. Green. A preliminary report gained in 9 cases was presented at the AAOS Meeting in 1950. This operation is now been performed in 22 paralytic feet. Although this operation has been used primarily in the correction of the paralytic flatfeet, it would seem to be of merit in the treatment of severely pronated feet in young children.



Grice, JBJS (Am), 1952

TRATTAMENTO CHIRURGICO: ARTRORISI

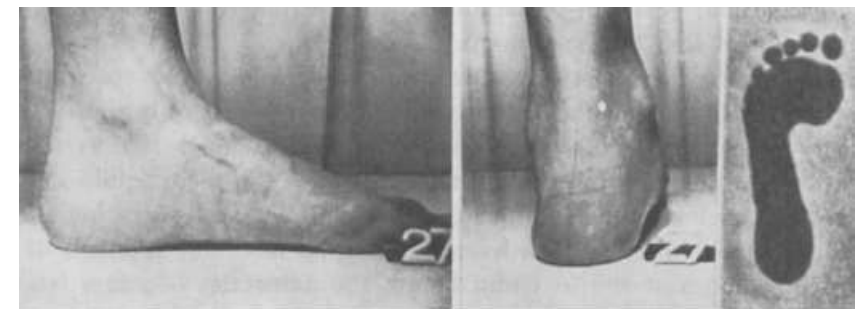
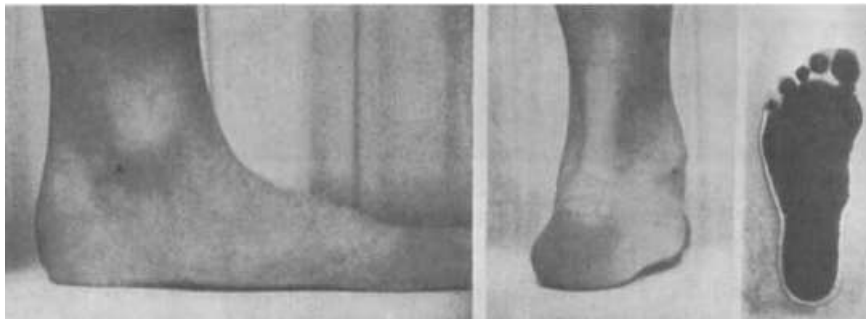
We maintain this correction by placing a homogenous bank-bone transplant into the tarsal sinus. The method is based largely on that described by Grice (1952, 1955) for talo-calcaneal arthrodesis, which he used in the treatment of pes planovalgus paralyticus. We produce an arthroereisis talo-calcaneal preventing pronation-abduction of that of the foot under the talus.



Haraldsson, Acta Orthop Scand, 1962

TRATTAMENTO CHIRURGICO: ARTRORISI

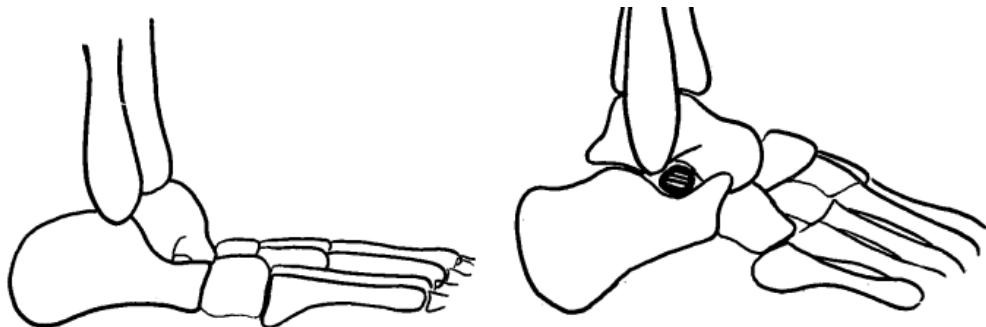
During 1954-1961 we operated upon 54 growing feet for static planovalgus at the Orthopaedic Clinic, Lund. We performed a talocalcaneal arthrorisis with insertion of homogenous transplant from the bone bank into the tarsal sinus. The bone block prevents pronation-abduction of the foot plate below the talus. The results were poor only in 4 feet (7.4 per cent). Talocalcaneal arthrorisis performed with homogenous graft from the bone bank is a satisfactory operation for pes plano-valgus staticus juvenilis not responding to conservative treatment.



Haraldsson, Acta Orthop Scand, 1965

TRATTAMENTO CHIRURGICO: ARTRORISI

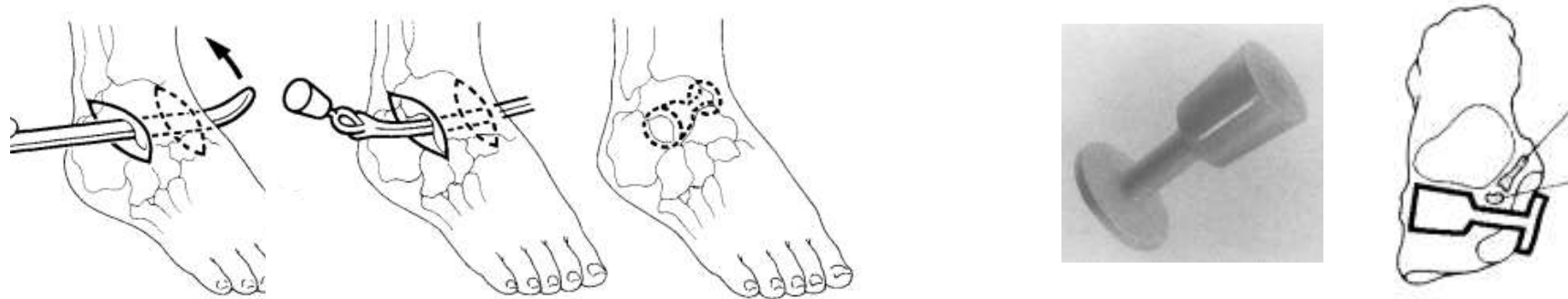
The author report a study on 80 patients operated on, followed up 2-11 years after surgery. The author proposed a “lateral arthroereisis”. In patients over 6 years old, a fresh homograft with a pyramidal or cone shape was used. If the stability of the structure seems inadequate, a Blount staple is added that was removed 4 months later. Having had occasion to re-enter the operative area a number of times at the end of 2 or 3 years in the same feet, it can be stated that the grafts are alive, mobile and painless. They are covered macroscopically and histologically by new cartilage.



LeLièvre, CORR, 1970

TRATTAMENTO CHIRURGICO: ARTRORISI (ENDORTESI)

Between 1970 and 1984, 234 painful flatfeet that did not respond to conservative treatment, were surgically treated by means of a double incision and by the placing of a “cuplike” endo-orthosis in the sinus tarsi. In 1985 the patients were revised. The author conclude that the prosthesis has a joint-limiting effect, reducing the excessive astragalus-calcaneus mobility. It is a passive stabilization with elastic blocking, without any disadvantages of an arthrodesis. Its advantage is that it respects absolutely the delicate morphology and physiology of the child’s foot.



Viladot, CORR, 1992

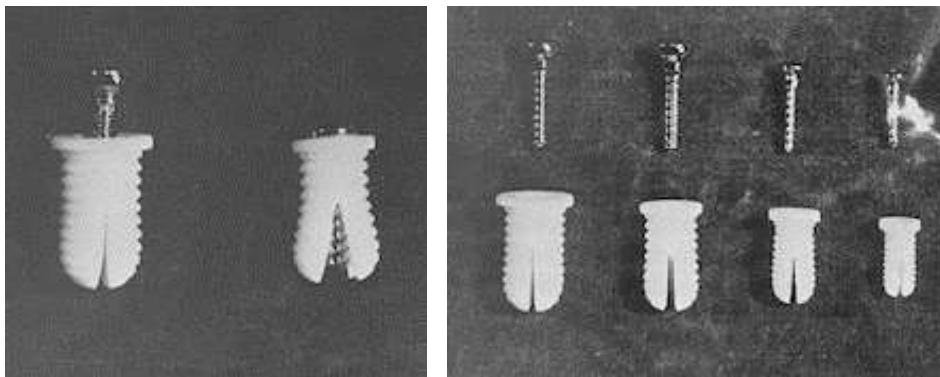
TRATTAMENTO CHIRURGICO: ARTRORISI (ENDORTESI)

Dopo la prima endortesi ideata e descritta da Viladot in materiale differente dall'osso e quindi non a rischio di integrazione nell'articolazione sottoastragica, qualche anno più tardi, nel 1976 Valenti riportava uno studio in cui descriveva la tecnica per l'utilizzo di una endortesi cilindrica in teflon per realizzare l'artrorisi.

Valenti V: Artrorisi sottoastragica con ortesi acrilica nel trattamento del piede piatto dell'infanzia, Minerva Ortopedica, 1976

TRATTAMENTO CHIRURGICO: ARTRORISI (ENDORTESI)

Fra il 1981 ed il 1983, 32 piedi piatti essenziali sintomatici o molto gravi anche se non sintomatici, sono stati trattati chirurgicamente mediante endo-ortesi ad espansione. Gli Autori concludono che il piede piatto essenziale in accrescimento ha indicazioni chirurgiche nel 2% dei casi e che la endo-ortesi ad espansione ideata dagli autori è risultata un valido mezzo per ottenere la correzione stabile e completa della patologia.



Giannini et al, GIOT, 1985

TRATTAMENTO CHIRURGICO: ARTRORISI (ENDORTESI)

Differenti tipi di spaziatori o viti in materiali diversi

- ✓ Silastic
- ✓ Polietilene
- ✓ Acciaio
- ✓ Titanio (Maxwell-Brancheau)
- ✓ Acido polilattico (PLLA)

21 children (8-15 y)



Giannini et al, JBJS (Am), 2001



**Maxwell et al, Clin Podiatr
Med Surg, 1999**

- ✓ Simple
- ✓ Effective in correcting functional flexible flatfoot

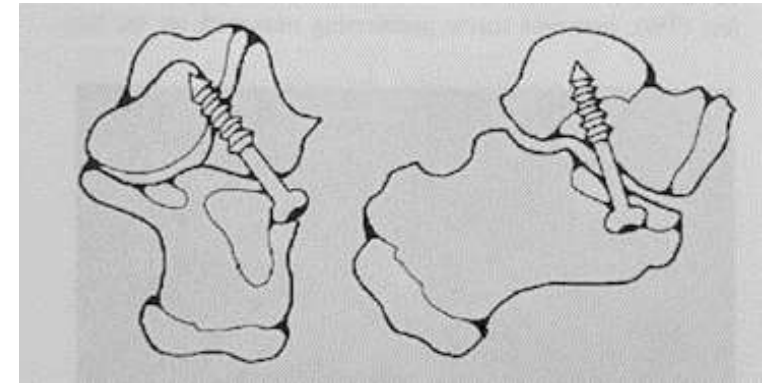
TRATTAMENTO CHIRURGICO: ARTRORISI (CALCANEOSTOP)

In 1970, R. Alvarez described the technique of subtalar screw arthroereisis (calcaneo-stop); the screw was allocated into the calcaneus. However, this method became widely known and was used in the early 1980s. Placement of the screw maintains correction of heel valgus by stimulating the proprioceptive receptors around the sinus tarsi and forces the hindfoot into a reduced position. Numerous authors emphasized the importance of this proprioceptive mechanism in maintaining the calcaneus in neutral position.



TRATTAMENTO CHIRURGICO: ARTRORISI (CALCANEOSTOP)

In 1985, Castaman was the first author who described a new technique for the calcaneo-stop procedure based on the insertion of a screw into the processus lateralis of the talus. This surgical alternative to obtain a calcaneo stop seem to have no significant difference according to the surgical complexity, post-operative care and final outcome. Placement of the screw maintains correction of heel valgus by stimulating the proprioceptive receptors around the sinus tarsi and forces the hindfoot into a reduced position.

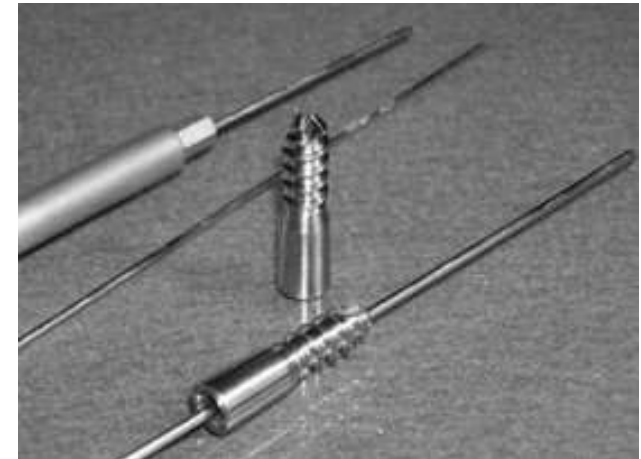


Castaman E: L'intervento di calcaneo-stop: storia ed aggiornamenti. Chir Piede, 1993

TRATTAMENTO CHIRURGICO: ARTRORISI-CALCANEEO STOP

Differenti tipi di viti in materiali diversi

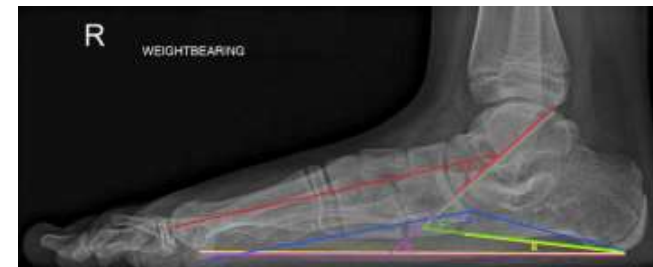
- ✓ Acciaio
- ✓ Acido polilattico
- ✓ Titanio
- ✓ Viti cannulate





Subtalar arthroereisis for the treatment of the symptomatic paediatric flexible pes planus: a systematic review

A database search for outcomes of arthroereisis for the treatment of symptomatic paediatric flexible pes planus provided **24 articles** which were included in this review, with a total of **2550 feet operated on**. The average age at the time of surgery was 11.62 years (range 5-17 years), within the ideal range within 9-12 years



Subtalar arthroereisis for the treatment of the
symptomatic paediatric flexible pes planus:
a systematic review

Author	Year	Journal	Study design	Level of evidence
Giannini et al ¹²	2001	<i>Journal of Bone and Joint Surgery</i>	Retrospective case series	IV
Jerosch et al ²⁶	2009	<i>Foot and Ankle Surgery</i>	Retrospective case series	IV
Scharer et al ¹³	2010	<i>Foot and Ankle Specialist</i>	Retrospective case series	IV
Kellerman et al ²⁵	2011	<i>Archives of Orthopaedic and Trauma Surgery</i>	Prospective case series	IV
Pavone et al ²⁷	2013	<i>Journal of Foot and Ankle Surgery</i>	Retrospective case series	IV
Richter et al ²⁸	2013	<i>Foot and Ankle Surgery</i>	Prospective case series	IV
De Pellegrin et al ²⁹	2014	<i>Journal of Children's Orthopaedics</i>	Retrospective case series	IV
Chong et al ¹⁴	2015	<i>Journal of Paediatric Orthopaedics</i>	Prospective, non-randomized comparative	IIB
Martinelli et al ¹⁵	2018	<i>Journal of Paediatric Orthopaedics</i>	Retrospective case series	IV
Cao et al ¹⁶	2017	<i>Orthopaedic Surgery</i>	Retrospective case series	IV
Das et al ³⁰	2017	<i>Journal of Taibah University Medical Sciences</i>	Prospective case series	IV
Giannini et al ³¹	2017	<i>Journal of Foot and Ankle Surgery</i>	Retrospective case series	IV
Arbab et al ³²	2018	<i>Zeitschrift für Orthopädie und Unfallchirurgie</i>	Retrospective case series	IV
Caravaggi et al ¹⁷	2018	<i>Gait and Posture</i>	Prospective, non-randomized comparative	IIB
Memeo et al ¹⁹	2019	<i>Journal of Foot and Ankle Surgery</i>	Retrospective, non-randomized comparative	III
De Bot et al ²⁰	2019	<i>Foot and Ankle Specialist</i>	Retrospective case series	IV
Ruiz-Picazo et al ²¹	2019	<i>Advances in Orthopaedics</i>	Retrospective case series	IV
Megremis & Megremis ²²	2019	<i>Journal of Foot and Ankle Surgery</i>	Retrospective case series	IV
Papamerkouriou et al ²³	2019	<i>Cureus</i>	Prospective case series	IV
Hagen et al ³³	2019	<i>Clinical Biomechanics</i>	Prospective case series	IV
Bernasconi et al ²⁴	2020	<i>Orthopaedics and Traumatology</i>	Retrospective comparative	IV
Indino et al ¹⁸	2020	<i>Foot and Ankle Surgery</i>	Retrospective case series	IV
Kubo et al ³⁴	2020	<i>Journal of Orthopaedic Science</i>	Retrospective comparative	IV
Franz et al ³⁵	2020	<i>Foot and Ankle Surgery</i>	Prospective case-control	III



Subtalar arthroereisis for the treatment of the symptomatic paediatric flexible pes planus: a systematic review

COMPLICATIONS (7.1%)

NOT REQUIRING SURGERY

Soft-tissue irritation/pain (42)
Malcorrection (27)
Peroneal contractures (19)
Wound infections (10)
4th metatarsal stress fractures (3)
Screw loosening (2)

REQUIRING SURGERY (3.1%)

Broken implant
Migrated implant
Inappropriated size
Incorrect position
Pain (29)

} 48



CONCLUSIONS

- ✓ The review found that arthroereisis as a treatment for symptomatic pediatric flexible pes planus produces favorable outcomes and high patient satisfaction rates with a reasonable risk profile.
- ✓ There is still a great deal of negativity and literature highlighting the complications and failures of arthroereisis, especially for older implants.
- ✓ Lack of high-quality prospective studies, a paucity of long-term data and heterogeneity of utilized outcome measures between studies. These factors need to be addressed to truly evaluate whether arthroereisis is an effective treatment for symptomatic pediatric flexible flatfoot.



World Journal of
Orthopedics

Submit a Manuscript: <https://www.i-hypublishing.com> | World J Orthop 2021 June 18; 12(6): 433-444
DOI: 10.5312/wjo.v12.i6.433 | ISSN 2218-5836 (online)

SYSTEMATIC REVIEWS

Arthroereisis in juvenile flexible flatfoot: Which device should we implant? A systematic review of literature published in the last 5 years

Andrea Vescio, Gianluca Testa, Mirko Amico, Claudio Lizzio, Marco Sapienza, Piero Pavone, Vito Pavone

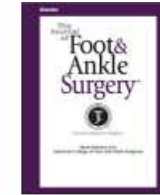
- ✓ A total of 1864 FFFs were identified. Eight studies concerned the subtalar AR (47.1%) and nine concerning CS (52.9%). The average age of patients at start of treatment was 11.8 years. Complications occurred in 153 of the 1864 FFF treated, with a rate of 8.2%.
- ✓ Both AR procedures are valid surgical techniques for treating FFF.
- ✓ In obese patients, the subtalar AR is not recommended.
- ✓ In adolescents who need to improve sports performance, the CS screw had better results compared with other implants.



Contents lists available at [ScienceDirect](#)

The Journal of Foot & Ankle Surgery

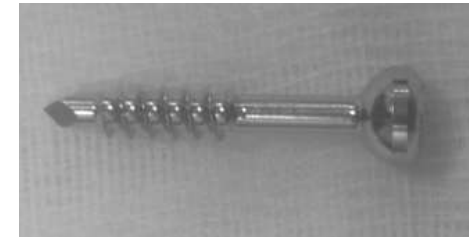
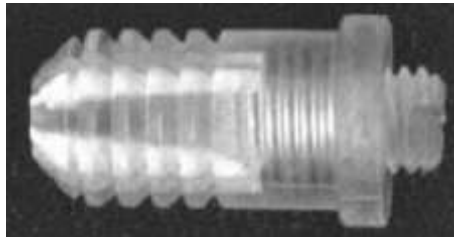
journal homepage: www.jfas.org



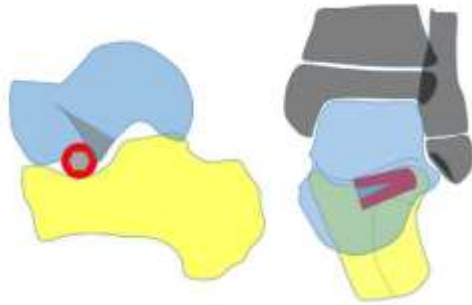
Original Research

Flexible Juvenile Flat Foot Surgical Correction: A Comparison Between Two Techniques After Ten Years' Experience

Antonio Memeo, MD, Fabio Verdoni, MD, Laura Rossi, MD, Elena Panuccio, MD,
Leopoldo Pedretti, MD



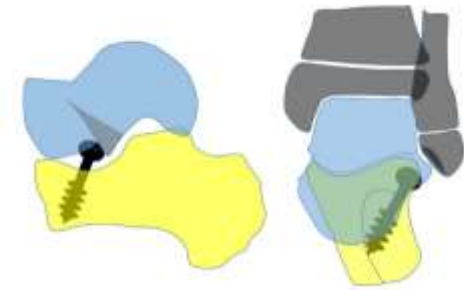
- ✓ A total of 402 FFF underwent surgical correction of symptomatic flatfoot. They were divided in 2 groups depending on the type of procedure used: exosinotarsal arthroereisis with metallic AO screw (202 feet) and endosinotarsal correction with biabsorbable device (200 feet).
- ✓ Evaluation was determined by 3 parameters: clinical evaluation, pain and radiologic angles.
- ✓ No statistical difference were found between the two techniques; the choice can be determined mostly by the surgeon's preference.



Subtalar Arthroereisis for Surgical Treatment of Flexible Flatfoot

Maurizio De Pellegrin, MD^a, Désirée Moharamzadeh, MD^{b,*}

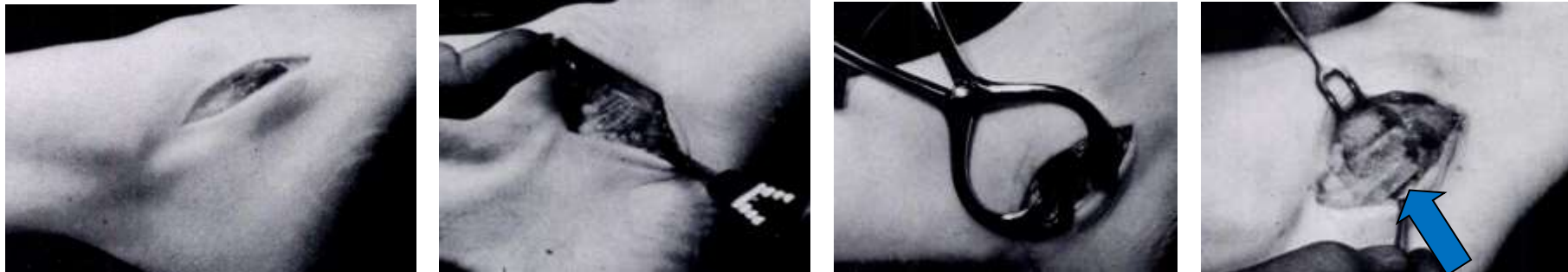
Foot Ankle Clinics of North America | 2021



- ✓ From 2010 to 2020 691 feet undergoing arthroereisis into the tarsal canal (SAE) and 1856, calcaneo-stop procedure (SAC). The average age at surgery was 11.4 and 11.6, while complications rate was 9% and 6.4%, respectively.
- ✓ These data confirm that SAC-stop may have an advantage over SAE as the screw is not places the subtalar joint but instead into the calcaneus.

TRATTAMENTO CHIRURGICO: CLO

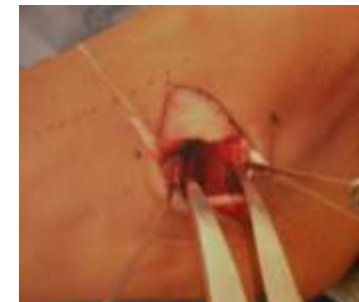
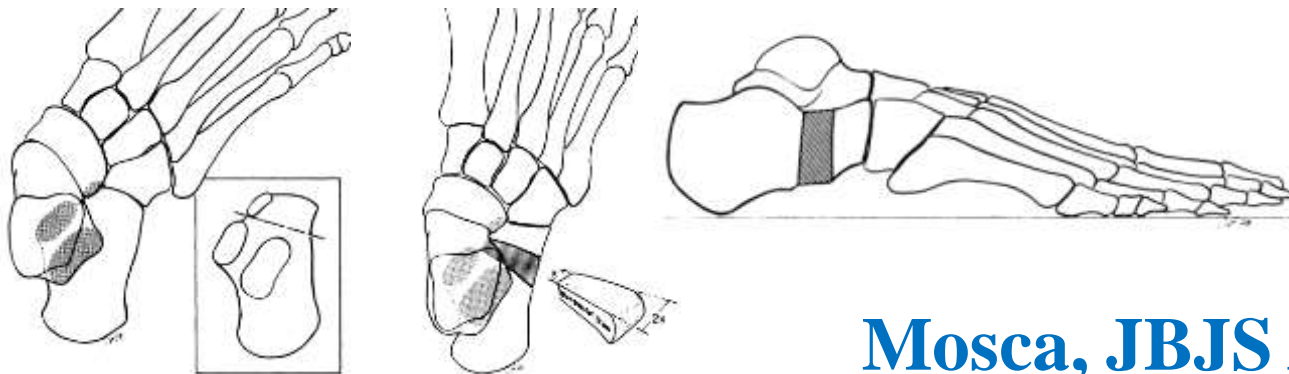
Calcaneal lengthening osteotomy (CLO) was originally described by Evans. He reported in the original paper that “a short lateral column was associated with valgus deformity of the tarsus” and that “should be possible to improve calcaneo-valgus deformity by lengthening the lateral border of the foot”. He proposed a lengthening osteotomy of the calcaneus about 1.5 cm behind the calcaneo-cuboid joint, in a plane parallel with that joint, stabilized with a bone graft taken from the tibia.



Evans, JBJS Br, 1975

TRATTAMENTO CHIRURGICO: CLO

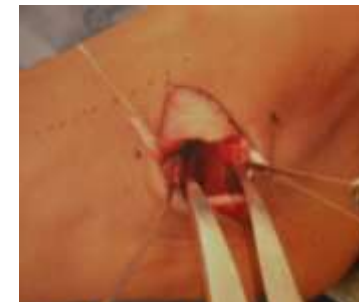
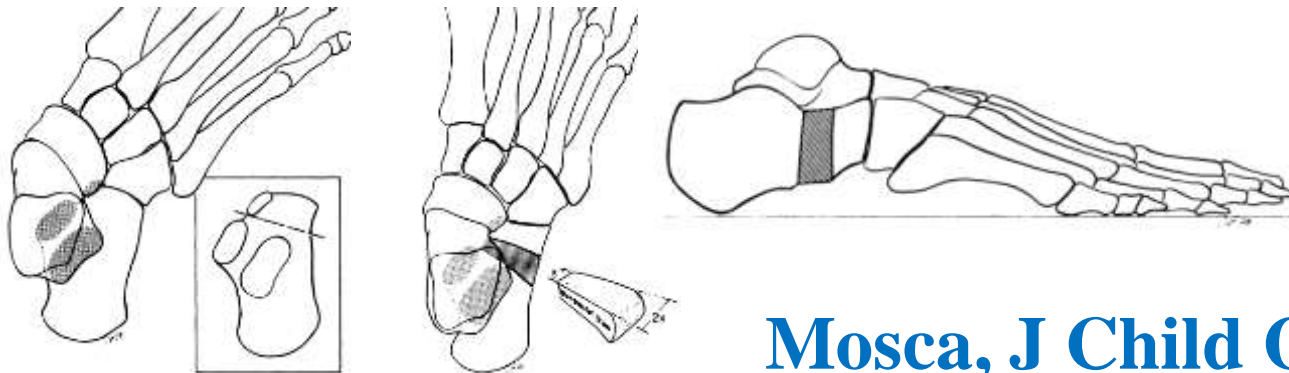
Mosca modified the Evans technique with regard to the skin incision, the position and direction of the osteotomy, the shape of the graft and the use of internal fixation. The osteotomy should be performed in the interval between the anterior and the middle facets of the subtalar joint. The osteotomy should be slightly oblique from proximal-lateral to distal-medial and fixed with Steinmann pins after the insertion of a trapezoid-shaped tricortical bone graft from the iliac crest.



Mosca, JBJS Am, 1995

TRATTAMENTO CHIRURGICO: OSTEOTOMIE

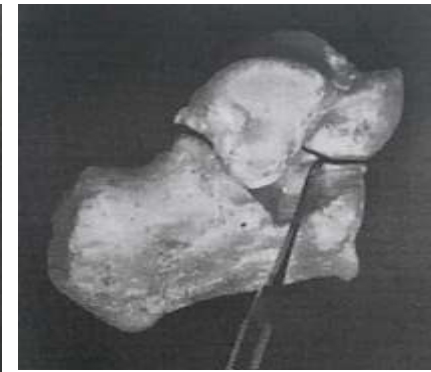
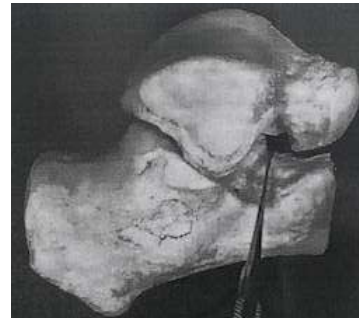
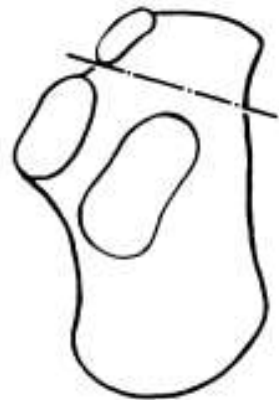
Mosca, 15 year later, stated that “flexible flatfoot with a short Achilles tendon, in contrast to simple flexible flatfoot, is known to cause pain and disability in some adolescents”. Surgery is indicated in these cases when conservative measurements fail. The calcaneal lengthening osteotomy is a procedure of choice and in almost all cases Achilles tendon is required.



Mosca, J Child Orthop, 2010

TRATTAMENTO CHIRURGICO: CLO

The authors, in an anatomic study of subtalar joint in 1056 calcanei (528 human cadavers), conclude that most subtalar joints have confluent anterior and middle facets. Performing a calcaneal lengthening osteotomy in these patients, as described by Evans or Mosca, is likely to violate the subtalar joint and to have potential deleterious long-term effect. Calcaneal lengthenings is probably not a prudent surgical procedure to correct symptomatic flexible flatfoot.



Ragab et al, JPO, 2003



ELSEVIER

Foot and Ankle Surgery 24 (2018) 453–459

Foot and Ankle Surgery

journal homepage: www.elsevier.com/locate/fas



Postoperative CT-scan 3D reconstruction of the calcaneus following lateral calcaneal lengthening osteotomy for flatfoot deformity in children. Is the surgical procedure potentially associated with subtalar joint damage?



Federico Canavese, MD, PhD^{a,*}, Alain Dimeglio, MD^b, François Bonnel, MD^b



- ✓ According to the findings reported here, a preoperative CT scan should be requested in patients scheduled for LCL osteotomy. Surgical planning on a dorsal view of a 3D-reconstructed calcaneus will allow the surgeon to know the topography of the subtalar articular facets of each patient and thus perform the osteotomy accordingly.



The optimal procedure for lateral column lengthening calcaneal osteotomy according to anatomical patterns of the subtalar joint: an anatomical study in the Chinese population

Jiajun Wu, Hua Liu and Can Xu*

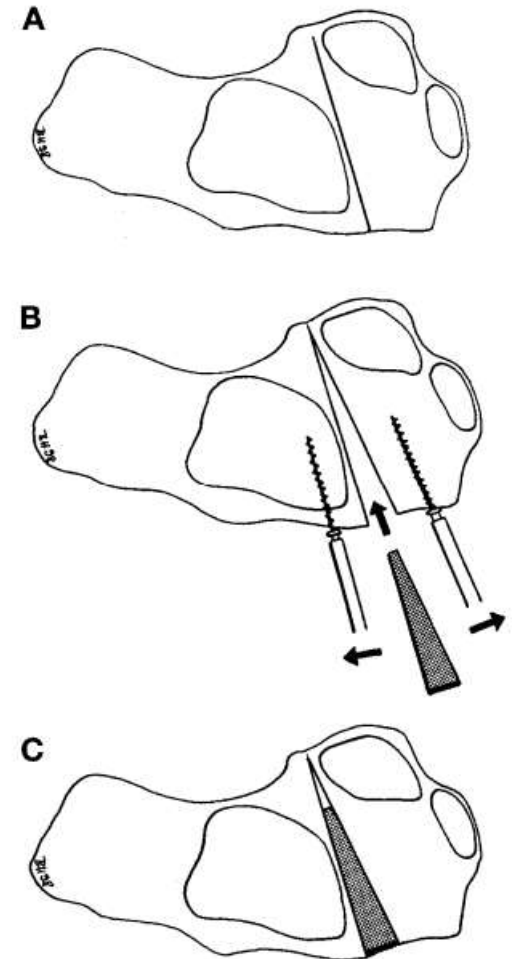
- ✓ The anatomy of the subtalar joint presents significant individual variations in the Chinese population. Calcanei with partly or completely fused anterior and middle facets were observed in nearly two thirds of individuals (63.8%). Since the modified Evans procedure might potentially incur damage to the subtalar joint facets, the Hintermann procedure may be more applicable to the Chinese population.



Lengthening of the Lateral Column and Reconstruction of the Medial Soft Tissue for Treatment of Acquired Flatfoot Deformity Associated with Insufficiency of the Posterior Tibial Tendon

Beat Hintermann, M.D.,* Victor Valderrabano, M.D.,† and Hans-Peter Kundert, M.D.‡
Basel, Switzerland, and Zürich, Switzerland

- ✓ 19 patients (19 feet) with acquired flatfoot were treated surgically using anterior calcaneal osteotomy for lengthening the lateral column and reconstructing the medial soft tissue.
- ✓ The mean age was 52.9 years (range, 24-72 years).
- ✓ In the pes planovalgus and abductus deformities, calcaneal osteotomy and reconstruction of the medial tendon and ligament seem to play a significant role in operative management.



Surgical Treatment of Severe Idiopathic Flexible Flatfoot by Evans–Mosca Technique in Adolescent Patients: A Long-Term Follow-Up Study

Vincenzo De Luna , Fernando De Maio , Alessandro Caterini , Martina Marsiolo , Lidio Petrungaro , Ernesto Ippolito , and Pasquale Farsetti 

Department of Clinical Sciences and Translational Medicine, Division of Orthopaedic Surgery, University of "Tor Vergata", Rome, Italy

Advances in Orthopedics
Volume 2021, Article ID 8843091



- ✓ 14 patient (mean age: 12.8 years), 26 FFF were surgically treated by Evans-Mosca procedure.
- ✓ In all cases we observed satisfactory final results. The AOFAS score improved from 60.03 to 95.26. Meary's angle improve from 25° to 1.4°. No case showed significant radiographic signs of midtarsal joint osteoarthritis. Nonunion of the osteotomy was never observed.
- ✓ According to our results, we believe that Evans-Mosca technique is a valid option of surgical treatment for severe idiopathic FFF and allows a satisfactory correction of the deformity with a low rate of complications (calcaneo-cuboib subluxation in 11.5° of cases).

Prospective comparison of subtalar arthroereisis with lateral column lengthening for painful flatfeet

David Y. Chong^a, Bruce A. Macwilliams^b, Theresa A. Hennessey^b,
Noelle Teske^b and Peter M. Stevens^{b,c}

Journal of Pediatric Orthopaedics B 2015, 24:345–353

- ✓ Prospective nonrandomized comparative study (15 patients, 24 feet evaluated clinically and radiographically divided in two groups).
- ✓ The authors found statistically significant improvements in both groups with no difference in their outcomes. They conclude that subtalar arthroereisis is a valid and potentially less invasive alternative to lateral column lengthening that merits further investigation.





Lateral column lengthening versus subtalar arthroereisis for paediatric flatfeet: a systematic review

Dong Hun Suh¹ · Jung Ho Park¹ · Soon Hyuck Lee² · Hak Jun Kim³ · Young Hwan Park³ · Woo Young Jang² · Jung Heum Baek¹ · Hyun Jae Sung¹ · Gi Won Choi¹ 

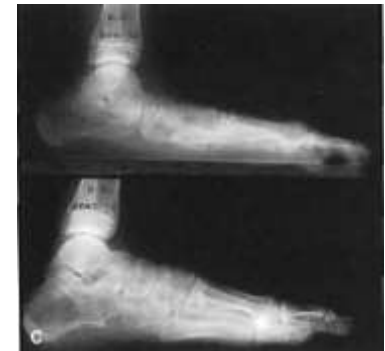
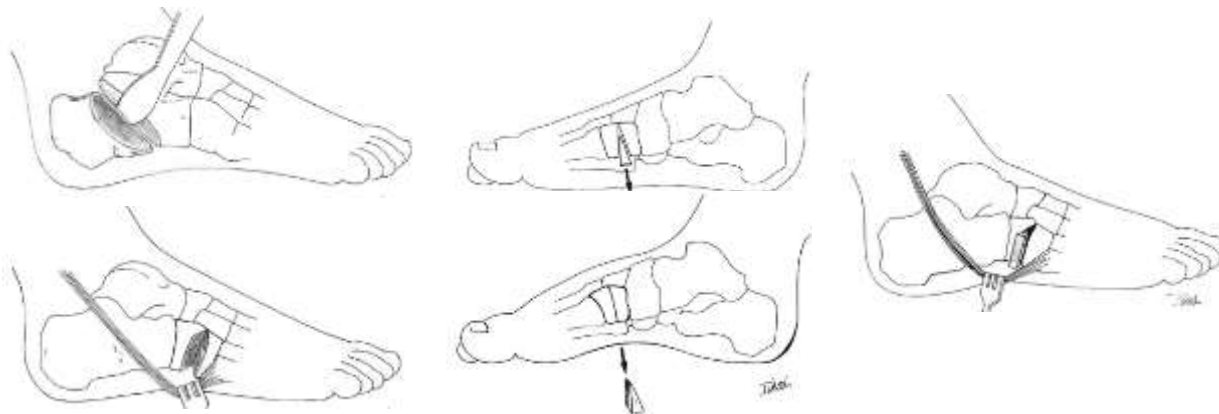
	LCL group	AR group
Number of studies	21	13
Mean MINORS score (range)	12.8 (10–20)	11.7 (6–18)
Level of evidence (number of studies)		
I	1	0
II	1	1
III	7	1
IV	12	11

LCL, lateral column lengthening; AR, arthroereisis

- ✓ The authors conclude that LCL group achieved more radiographic corrections and more improvements in the AOFAS score than the AR group.
- ✓ Complications were more common in the LCL group and the re-operation rates were similar between the two groups.

TRATTAMENTO CHIRURGICO: TRIPLE C

The calcaneo-cuboid-cuneiform (triple C) osteotomy was first reported by Rathjen and Mubarak. It consists in sliding and medial closing wedge osteotomy of the posterior calcaneus, an opening wedge osteotomy of the cuboid and a plantar based closing wedge osteotomy of the medial cuneiform. All the osteotomies were fixed by K-wire (23 patients, 24 feet: 23 excellent or good results, 1 fair)



Rathjen and Mubarak, JPO, 1998

Treatment Outcomes at Skeletal Maturity after Calcaneo-Cuboid-Cuneiform Osteotomy for Symptomatic Flatfoot Deformity in Children

Jung Ryul Kim, MD, Ki Bum Kim, MD, Seong Woo Chong, MD,
Dong Hun Ham, MD*, Sung Il Wang, MD

- ✓ 19 patients (30 feet) operated on by triple C osteotomy were evaluated at skeletal maturity
- ✓ Surgical correction of symptomatic flatfoot deformity in childhood resulted in favorable outcomes after the triple C osteotomy. Deformity correction was also maintained at follow-up.



Comparison of the Calcaneo-Cuboid-Cuneiform Osteotomies and the Calcaneal Lengthening Osteotomy in the Surgical Treatment of Symptomatic Flexible Flatfoot

Luis Moraleda, MD, Maria Salcedo, MD,* Tracey P. Bastrom, MA,† Dennis R. Wenger, MD,†
Javier Albiñana, MD, PhD,* and Scott J. Mubarak, MD†*

(J Pediatr Orthop 2012;32:821–829)

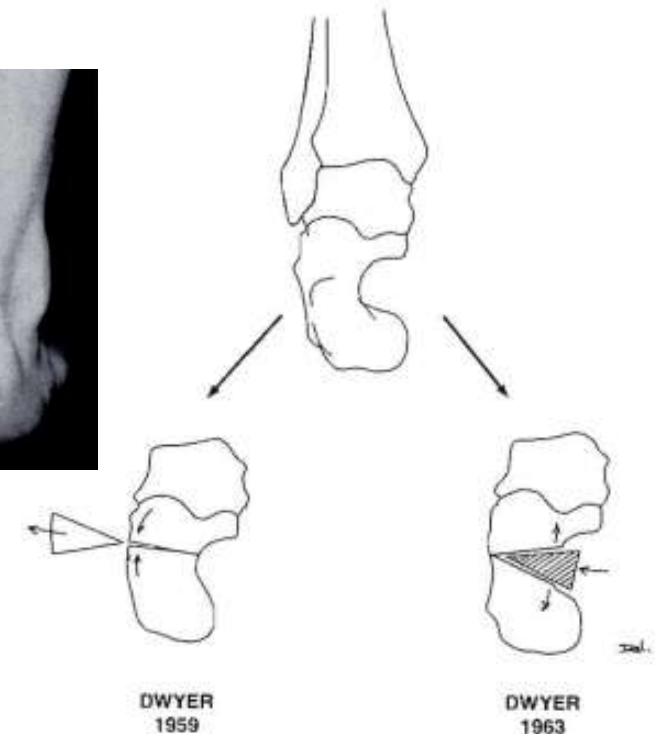
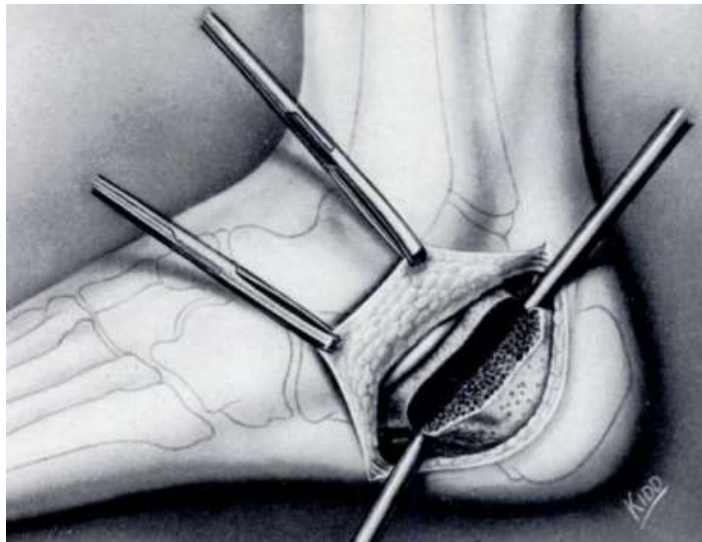
- ✓ 30 feet triple osteotomy – 33 feet calcaneal lengthening osteotomy (CLO)
- ✓ Both techniques obtain good clinical and radiographic results. The CLO achieves better improvement of the relationship of the navicular to the head of the talus but it is associated with more frequent and more severe complications, apart from calcaneo-cuboid subluxation.



Moraleda et al, JPO, 2012

TRATTAMENTO CHIRURGICO: CALCANEAL OSTEOTOMY

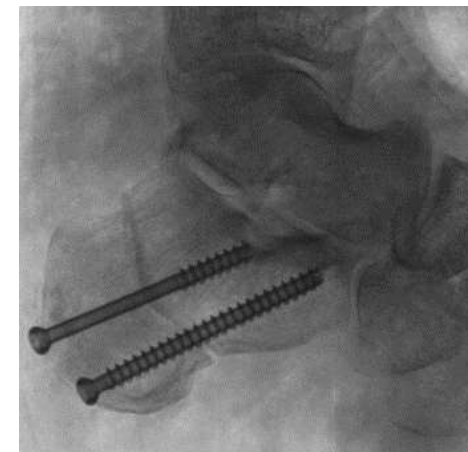
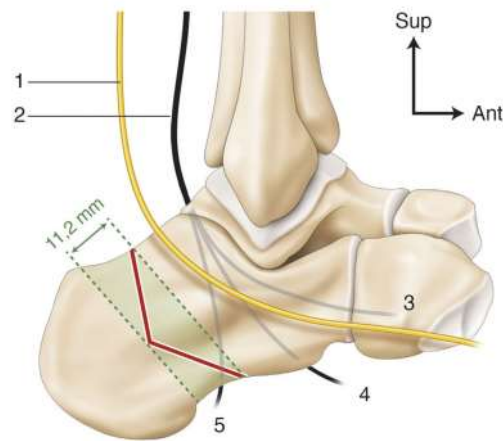
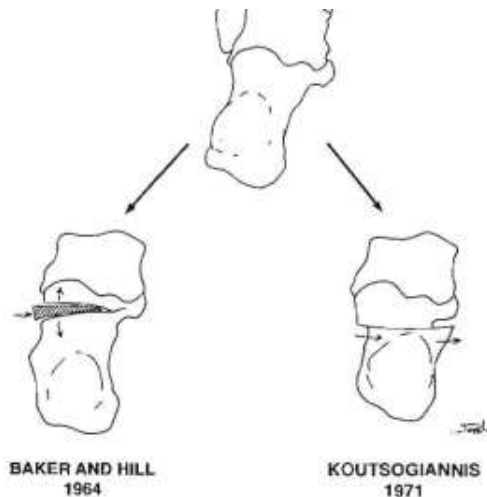
Dwyer first described the calcaneal osteotomy of the posterior calcaneus to correct pes cavus (1959) or relapsed clubfoot (1963).



Dwyer, JBJS Am, 1959
Dwyer, JBJS Br, 1963

TRATTAMENTO CHIRURGICO: OSTEOTOMIE

Actually, medializing osteotomy is consensual for surgical management of the talar valgus component of valgus flatfoot. It aims to reposition the calcaneal tuberosity and its insertions along the mechanical axis of the limb to correct the hindfoot valgus in flatfoot deformity.



Baker and Hill, JBJS Am, 1964; Koutsogiannis, JBJS Br, 1971

INDICAZIONI E SCELTA DEL TRATTAMENTO CHIRURGICO

- ✓ 48/110 responders (43.6%) considered that <10% of patients are candidates for surgery and 33.4% that this was the case in <25% of cases; the answers ‘<50%’ and ‘<75%’ were selected by 13.6% and 6.4% of the respondents, respectively.
- ✓ 92/110 responders (83.6%) identified the ‘improved ability to walk longer without symptoms or discomfort’ as the principal treatment expectation. Pain evaluated through the visual analog scale (VAS) was considered crucial in 31.8% of cases.
- ✓ Regarding the type of surgical treatment, 97.3% of SITOP affiliates declare to perform arthroereisis followed by lateral column lengthening (29.1%) and medializing calcaneal osteotomy (9.1%).

Pavone et al, SITOP survey on surgical treatment for flatfoot, JPO B 2022

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