4:00 – 5:00 pm
SESSION 8:
FLATFOOT

Moderators:

Gregory P. Guyton, MD
(Baltimore, Maryland)

Bruce J. Sangeorzan MD
(Seattle, Washington)
4:00 – 4:15 pm
SESSION 8:
Flatfoot for Dummies:
*Keeping it simple for predictable results*
-or-
*The Road to Flatfoot Nirvana (is Surrounded by a Dismal Swamp)*

Gregory P. Guyton, MD
(Baltimore, Maryland)

**Goals:**
1. Review the treatment of posterior tibialis tendon dysfunction by FDL transfer and calcaneal osteotomy
2. Recognize how you can **get the diagnosis wrong** and do the wrong operation
3. Recognize how you can **fail to appreciate additional diagnoses** and not correct them
4. Recognize how you can **underappreciate the magnitude of the deformity** and not do enough

**She has a flatfoot that means a posterior tibialis tendon problem, right**

- Maybe not, consider midfoot arthritis in particular as an alternate diagnosis
- Single-leg toe rise may not be entirely reliable
- Consider all the clues – location of pain, abduction, failure of posterior tibialis strength

Not so fast, beware the bunion! Look at the lateral x-ray to make sure the medial column is stable, particularly the TMT

- Check the Achilles! It’s likely if you aren’t doing a fair number of Strayer procedures you are subjecting your reconstructions to a great deal of added stress.

**Well, at least the MRI says the posterior tib is torn, and she can’t do a single leg-toe rise. Sign her up!**
Not if you want a good-looking arch at the end. There are no clear criteria for adding a lateral column procedure, but uncovering of the talar head beyond about 30% should make you think about it.

- Beware hindfoot arthritis
- Coalitions happen. Even in 50 year olds.

- One more check, look at a weight-bearing ankle film to make sure there is no deltoid insufficiency (a stage IV posterior tibialis dysfunction).

- Got my foot films, clear diagnosis, deformity checks out. Ready to go?

For God’s sake just let me do my operation!

- OK, sure
• Yes, you probably will. Pain relief can be surprisingly uncorrelated with the degree of correction and usually happens long before the FDL actually gains enough strength to function. In other words, the early outcome is mostly achieved by getting rid of the bad tendon and whatever corrective measures are done to passively raise the arch.

• The patient, on the other hand, may focus on the lack of apparent correction in the arch (roughly 50% of cases even with a calcaneal osteotomy), the lack of strength, and the persistence of swelling.

• Manage expectations. Patient’s self-rated time to maximal improvement was roughly 12 months in one study with a maximum of 18 months.


This talk reviews the algorithm for the complex peri-talar subluxation. In particular the speaker will address the role of complex osteotomy and fusion in surgical treatment of the adult acquired foot. The goal of surgery is to correct the elements that allow the hindfoot or forefoot to move lateral to the weight bearing plumb line. Lateral column lengthening corrects both valgus and abduction. If both are not present, it should not be used. LCL depends on intact talo calcaneal and calcaneo metatarsal ligaments. If these are stretched or damaged to the point of ineffectiveness, fusion is needed.
Figure 5

a) b) c) d) e) f)
Comparison of Radiographic Changes after Lateral Column Lengthening and Medial Displacement Calcaneal Osteotomy for Flexible Flatfoot

Presenting:

Jonghoon Jang, MD (Seoul, Korea)
Ji-yong Ahn; Chul-hyun Park; Woo-Chun Lee, MD

Introduction:
Lateral column lengthening (LCL) and medial displacement calcaneal osteotomies (MDCO) are common procedures for the treatment of symptomatic flexible flatfoot. The purpose of the present study was to investigate which surgery is more effective in flatfoot for correction of radiographic parameters by comparing radiographic changes after LCL and MDCO in patients with flatfoot deformity.

Materials and Methods:
This study includes 26 patients (32 feet) who had undergone LCL procedures and 24 patients (27 feet) who had undergone MDCO procedures (MDCO group) at our hospital between 2006 and 2009. Patients who underwent LCL was further subdivided into LCL only group (18 patients, 23 feet) and LCL with MDCO group (8 patients, 9 feet). The minimum follow-up was 24 months. Flatfoot associated with tarsal coalition, rheumatoid arthritis, post traumatic deformities were excluded. Weight-bearing foot anteriorposterior (AP), lateral radiographs and hindfoot alignment views were assessed. On AP view, talonavicular coverage angle and AP talo-first metatarsal angle were measured. On Lateral view, lateral talo-first metatarsal angle, calcaneal pitch angle, and the height of cuneiform were measured. On hindfoot alignment view, hindfoot valgus angle and hindfoot valgus ratio were measured.

Operative Technique:
Gastrocnemius recession was performed based on the patient’s preoperative Silfverskiold test. The MDCO was made through a standard lateral approach. The calcaneal tuberosity was medially translated 1 cm and stabilized with one or two 6.5-mm partially-threaded cancellous screws. The LCL was performed either by calcaneocuboid fusion or anterior calcaneal osteotomy. Anterior calcaneal osteotomy was made 15mm proximal to the calcaneocuboid joint. A tricortical autogenous iliac bone graft was inserted at the osteotomy site. Calcaneocuboid fusion was performed in 4 feet in LCL only group and 6 feet in LCL with MDCO group.

Results:
There were statistically significant improvement of all parameters in LCL only group and LCL with MDCO group. In contrast, there was no significant difference in all parameters except hindfoot alignment angle, hindfoot alignment ratio after MDCO. In LCL with MDCO group, there were better improvement of parameters of hindfoot alignment angle and hindfoot alignment ratio than LCL only group. (Table 1).
<table>
<thead>
<tr>
<th>Parameter</th>
<th>LCL</th>
<th>LCL+MDCO</th>
<th>MDCO</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Preoperative (SD)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AP T-N coverage angle</td>
<td>29.6˚±8.73</td>
<td>10.5˚±8.37*</td>
<td>7.9˚±4.36*</td>
</tr>
<tr>
<td>AP Talo-1st MT Angle</td>
<td>21.4˚±10.06</td>
<td>8.0˚±8.75*</td>
<td>10.4˚±7.13**</td>
</tr>
<tr>
<td>Lat. Talo-1st MT Angle</td>
<td>25.2˚±9.86</td>
<td>12.5˚±9.83*</td>
<td>10.6˚±6.54**</td>
</tr>
<tr>
<td>Calcaneal pitch Angle</td>
<td>11.6˚±5.20</td>
<td>18.0˚±5.41*</td>
<td>9.8˚±4.59**</td>
</tr>
<tr>
<td>Med. cuneiform Height</td>
<td>6.3mm±3.07</td>
<td>11.6mm±3.93*</td>
<td>6.5mm±2.48</td>
</tr>
<tr>
<td>Heel alignment Angle</td>
<td>12.5˚±7.39</td>
<td>1.4˚±5.74*</td>
<td>-0.6˚±5.36**</td>
</tr>
<tr>
<td>Heel alignment ratio</td>
<td>8.3%±22.47</td>
<td>22.1%±18.79*</td>
<td>-0.78%±14.66</td>
</tr>
</tbody>
</table>

**“*” means significant difference in postoperative parameters (p<0.05)**

**Discussion and Conclusion:**
Most of the radiographic parameters for assessment of flatfoot were improved in LCL only group and LCL with MDCO group. However, only hindfoot alignment was improved after MDCO.
In LCL with MDCO group, there were better improvement of parameters of hindfoot alignment angle and hindfoot alignment ratio than LCL only group. So we can say LCL has greater capacity than MDCO to correct radiographic parameters in transverse and sagittal plane.

**Key Words:**
Flat foot, lateral column lengthening, medial displacement calcaneal osteotomy, radiographic parameters
Lower Limb Alignment Compensation of Knee Deformity Occurs Through the Subtalar Joint

Presenting:
Phinit Phisitkul, MD (Iowa City, Iowa)
Adam Norton, BA; Ned Amendola, MD; Steve Liu, MD; Siwadol Wongsak, MD; Catherine Fruehling-Wall, BA; John J. Callaghan, MD

Summary
This study demonstrates that in patients with hindfoot malalignment, due to knee deformity, there exists a strong, significant correlation between the hindfoot angle and the STJ. The majority of compensation within the hindfoot occurs through the STJ while the aLDTA and ankle JLCA have a minimal role in the overall compensatory ability of the hindfoot. These findings have direct implications for treating patients with both knee and foot/ankle problems.

Introduction
Lower extremity malalignment, particularly at the knee joint, will affect hindfoot orientation, requiring compensation for proper gait. This study was performed to elucidate the degree of compensation occurring at three locations of the hindfoot (distal tibia, ankle, and subtalar joint) in response to altered lower extremity kinematics due to knee deformity.

Methods
378 TKAS in 304 patients were evaluated. Standing full-leg-length anteroposterior and Saltzman hindfoot alignment view radiographs were used to determine the mechanical axis angle, the degree of hindfoot malalignment, the anatomic lateral distal tibial angle (aLDTA), and the ankle joint line convergence angle (ankle JLCA). The relationship between knee deformity, as well as hindfoot deformity, and the aLDTA, ankle JLCA, and the subtalar joint (STJ) were assessed for linear correlation. Student t-tests were performed to determine the difference in the aLDTA, ankle JLCA, and the STJ between knees with varus and valgus deformity. Intraclass correlation coefficients were used to evaluate intra- and interobserver reliability.

Results
The mechanical axis angle correlated with the aLDTA, ankle JLCA, and the STJ in the entire cohort and in a sub-group of patients with \( \geq 10^\circ \) knee deformity. The hindfoot angle was correlated with the aLDTA, ankle JLCA, and the STJ in the entire cohort. The difference in the aLDTA, ankle JLCA, and the STJ between knees with varus and valgus deformity were significant in the \( \geq 10^\circ \) knee deformity cohort. The difference in the aLDTA, ankle JLCA, and the STJ between hindfeet with varus and valgus deformity were significant in the entire cohort. Intra- and interobserver reliability analysis showed excellent reliability in all measurements.

Conclusion
This study demonstrates that in patients with hindfoot malalignment, due to knee deformity, there exists a strong, significant correlation between the hindfoot angle and the STJ. The majority of compensation within the hindfoot occurs through the STJ while the aLDTA and ankle JLCA have a minimal role in the overall compensatory ability of the hindfoot. These findings have direct implications for treating patients with both knee and foot/ankle problems.
Radiographic Analysis of Surgical Correction of Adult Acquired Flatfoot Deformity

Presenting:
Sandra E. Klein, MD (St. Louis, Missouri)
Michael F. Iossi, MD; Jeffrey E. Johnson, MD; Jeremy J. McCormick, MD

Summary
The purpose of this study is to identify the expected radiographic correction with commonly used bony realignment procedures for adult acquired flatfoot deformity either individually or in combination.

Introduction
Adult acquired flatfoot deformity is a progressive bony deformity of the foot related to both tendon and ligamentous failure. Multiple procedures have been described to treat the wide range of stage II (flexible) disease deformities. In general, the treatment algorithms and recommendations have been based on clinical findings and the presence of “mild” versus “severe” deformity. The purpose of this study is to identify the expected radiographic correction with commonly used bony realignment procedures either individually or in combination. An algorithm for treatment of this condition using previously described clinical and radiographic parameters will be developed.

Methods
84 patients underwent 87 flexible deformity corrections between January 1999 and December 2010. Pre and postoperative weightbearing radiographs were available in 73 procedures in 70 patients. The average age of the patients was 55 years, and final radiographs were evaluated at an average of 20 months post operatively. Operative reports were reviewed, and patients were grouped according to the procedures performed. All patients had a FDL transfer to the navicular in addition to bony realignment. Radiographic parameters measured included: lateral talo-1st metatarsal angle, medial cuneiform – floor distance, calcaneal pitch, AP talo-1st metatarsal angle, AP talo-2nd metatarsal angle, and talonavicular coverage angle. Differences in pre and post operative radiographic parameters were analyzed.

Results
Patients were grouped into three primary categories according to whether a medial displacement calcaneal osteotomy, lateral column lengthening or both were performed. Group I consisted of patients undergoing a medial displacement calcaneal osteotomy alone. Group II included patients who received a lateral column lengthening alone. The surgical procedure in group III patients included both medial displacement calcaneal osteotomy and lateral column lengthening. The lateral talo-first metatarsal angle mean difference was 3.6 degrees in group I, 15.8 degrees in group II and 16.2 degrees in group III. The talo-navicular coverage angle mean difference was 4.7 degrees in group I, 17.8 degrees in group II and 17.9 in group III.

Conclusion
Medial displacement calcaneal osteotomy is frequently used alone with FDL transfer to the navicular to correct a stage II flat foot deformity. However, this procedure does not create a large change in commonly used radiographic parameters. The lateral column lengthening resulted in larger radiographic improvements. When the two procedures were combined, the radiographic results were similar to lateral column lengthening alone. Both clinical and radiographic parameters are a consideration when choosing the bony realignment procedure when treating a flexible flatfoot deformity. When treating a
more severe deformity, the lateral column lengthening results in more radiographically measureable improvement in alignment.
Correlation of Radiographic Parameters and Functional Outcome Scores in Patients after Flatfoot Reconstruction

Presenting:
Scott J. Ellis, MD (New York, New York)
Joshua H. Lamb, MD; Elizabeth Young, BS; Carolyn Sofka, MD; Jonathan T. Deland, MD

Postoperative hindfoot alignment statistically impacts functional outcomes following adult flatfoot reconstruction, though its clinical relevance remains unclear.

Introduction:
Surgical reconstruction for Adult Acquired Flatfoot Deformity may include a tendon transfer, a medializing calcaneal osteotomy, and a lateral column lengthening. Currently, there is limited understanding of the relationship between postoperative radiographic alignment and functional outcomes. The purpose of this study is to examine the relationship between postoperative radiographic parameters and functional outcome scores for patients undergoing flatfoot reconstruction.

Methods:
Between 2007 and 2010, forty-seven patients were identified who underwent a flatfoot reconstruction, including a tendon transfer, heel slide, and lateral column lengthening, by a single surgeon. All patients had a minimum of one year follow-up, including AP, lateral, and hindfoot alignment radiographs. All patients completed FAOS and SF-12 surveys. Postoperative radiographic measurements were analyzed with results from survey data. Radiographic alignment was compared between patients with the best functional outcomes and patients with the worst functional outcomes, for each scoring category of the FAOS and SF-12.

Results:
When we analyzed the cohort in its entirety (n=47), there was no clear correlation between radiographic alignment and functional outcomes. However, when a sub-analysis was performed comparing patients with the highest and lowest functional outcome scores, we found medial cuneiform to fifth metatarsal height and calcaneal pitch to be a significant radiographic parameter. Specifically, the FAOS pain and activities of daily living (ADL) scores correlated to base of fifth metatarsal to medial cuneiform height. Patients with better pain scores had a height of 14.94 ± 4.48 (p=0.019) and those with better ADL scores had a height of 12.89 ± 4.28 (p=0.005). Patients with better SF-12 mental component score had a calcaneal pitch of 15.22 ± 3.00 (p=0.021). With respect to both radiographic parameters, patients with increased medial cuneiform to base of fifth metatarsal height and calcaneal pitch had lower functional outcome scores. There was no statistical difference between other postoperative radiographic parameters.

Discussion and Conclusion:
The ideal postoperative alignment following flatfoot reconstruction is not known. Our study showed a significant difference between the radiographs of patients with the best functional outcome scores and the worst functional outcome scores in terms of medial cuneiform to fifth metatarsal height and calcaneal pitch. In other words, patients who did not do as well following surgery tended towards higher arch height, possibly a sign of over correction. In our small study population, we saw a range of postoperative alignments associated with good functional outcome scores. This suggests that, while...
important, postoperative alignment is not the sole determinant of functional outcomes following flatfoot reconstruction.