SECTION 5 – CRITICAL DECISION MAKING IN ORTHOTIC THERAPY

QUESTIONS

Answering the some critical (as in choosing between criteria) questions should help as a guide to selecting an appropriate orthosis, determining posting angles and applying effective additions.

HOW DOES THIS FOOT FUNCTION?

Too much motion - needs control (deeper, wider, stiffer/rigid)

Too little motion - restore motion or shock absorption.

"Normal motion" - does not need an orthosis.

Motion at wrong time – develop a posting strategy

HOW DO YOU WANT THIS FOOT TO FUNCTION?

Redirect GRF to Affect Mobility, Stability or Load?

Increase/Decrease Joint Moments to Reduce Stress Strain Relationships?

ARE THERE STRUCTURAL ABNORMALITIES CREATING THIS COMPENSATION?

Bony - Use Posting

Ligamentus laxity – Increase shell thickness, Deep Heel Seat, Flanges, Wedge to sulcus, I.C.A.

Soft tissue - strength, flexibility, proprioception, mobilization

Extrinsic Factors - forced pronation (genu valgus/varus or limb torsion) - control their butt, Increase orthotic control (Deeper, Wider, Stiffer).

Flexible Compensatory Pronation – Increase orthotic control (Deeper, Wider, Stiffer).

WHAT ARE THE PATIENT'S AND YOUR GOALS?

Activity

More rigid material combinations for increased GRF in sport activities.

Sport biomechanics, sprinter extend forefoot post/wedge, jumper soft arch fill.

2 pair of devices are often a reasonable option. One for sport & one for ADL

Patient's Weight

Generally speaking heavier persons need more rigid devices
EVA arch fill in to enhance control
Intrinsic Post = less control

Physiological Age

The more flexible (good ROM) the more aggressive the device.

Soft foam combinations can help to increase shock absorption or augment diminished fat pad.

What type of shoe wear will this orthosis be used in?

Casual - deep enough heel seat
Dress - modify device
Sport - send shoe; evaluate appropriateness for foot type

INITIAL CONSIDERATIONS

Age of the Patient

Older = Flexible Materials
Younger = Rigid Materials

Older = Decreased Posting Amounts
Younger = More Adaptive Foot

Body Weight

Heavy = Durable Materials (Stiffer)
Light = Compressible Materials

Heavy = Extrinsic Posting
Light = Intrinsic Posting

Activity Level

Sedentary = Flexible Materials
Active = Durable Materials (Stiffer)

Sedentary = Intrinsic Posting
Active = Extrinsic Posting

Function

Control = Rigid Materials
Accommodation = Flexible Materials

Control = Intrinsic/Extrinsic Posting
Accommodation = No Posting

Shoe Wear

Low Volume = Narrower & Shallower
High Volume = Deeper & Wider

Low Volume = Intrinsic Posting
High Volume = Extrinsic Posting

INHERENT CHARACTERISTICS

General "Rule of Thumb":

Thinner = Flexible
Thicker = Rigid

Compressible = Flexible
Denser = Rigid

Acute contours or abrupt curvatures in a shell will make it more rigid. Less contour or flatter curvatures will result in a more flexible shell.

Compressibility

Softer = Less Durable
Harder = More Durable

Softer = Less Effective Posting
Harder = More Effective Posting

Width & Length

Wider = More Control
Narrower = Less Control

Longer = More Control
Shorter = Less Control

SECTION 5 - BIOMECHANICAL EVALUATION: ORTHOTIC INDICATIONS

Specific biomechanical evaluation findings indicate different shell selections, additional or alternate components, positive casting techniques, posting angles or other modifications as applicable.

SUB-TALAR JOINT

<5 Deg. of Eversion:
RF motion on loading response will likely force STJ to function at end range. Inability to fully compensate for FF varus is likely.

Indicates: minimal or moderate RF post angles, FF posting as needed.

<15 Total R.O.M.:
RF motion is likely insufficient for adequate shock absorption during loading response/contact phase.

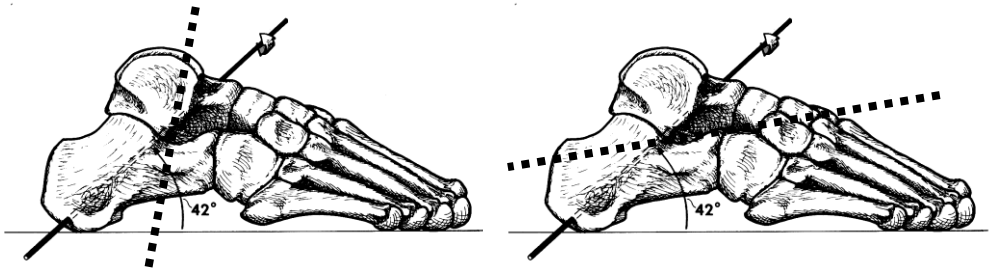
Indicates: softer materials for RF posting

Axis:
High STJ axis: calcaneus moves less in the frontal plane.

Indicates: lower RF posting angles

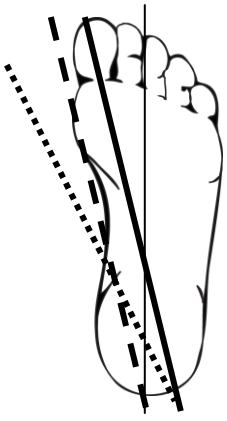
Low STJ axis, calcaneus moves more in the frontal plane.

Indicates: higher RF post angles and probably heel skive.



Axis:
Medially deviated STJ axis: calcaneus maximally everts.

Indicates: Heel Skive, ↑ RF posting angles



MID-TARSAL

Global ROM
Restricted ROM suggests lack of ability to compensate in mid-foot

Indicates: posting control and shells should be made of softer material.

Loose ROM suggests compensatory motion is likely excessive

Indicates: stiffer/harder shells, firmer/harder post materials, including consideration of flanges.

MID-TARSAL

Integrity
End range STJ joint motion into supination does not adequately affect mid-tarsal joint stability.

Indicates: Affect of RF posting for mid-tarsal control is minimized
Post RF to affect leg/hip function.
Use stiffer shells, flanges.

First Ray Position
Plantarflexed position exposes first met head to greater ground reactive force.

Indicates: 1st Ray Cut Out

Dorsiflexed position is commonly associated with FF varus

Indicates: FF post

First Ray Motion
Semi-rigid first ray indicated by limitation of motion in one direction is often secondary to compensatory adaptation (plastic deformation).

Indicates: First ray cut out when plantarflexed; Increase (more aggressive) FF posting when dorsiflexed,

Rigid first rays are usually associated with immobile feet that do not attenuate shock well.

Indicates: Selection of softer, more shock absorbing shells/molds; First ray cut out when plantarflexed, with foam padded fill-in.

Hallux Dorsiflexion

Limited dorsiflexion open change signals 1st MPJ degeneration. When compared to limited motion closed change, adequate motion open change suggests functional hallux limitus.

Indicates: FF post or wedge to sulcus

Contraindication: for 1st Ray Cut Out

Ankle Dorsiflexion

Limited ankle dorsiflexion causes STJ and/or midtarsal joint to compensate during early mid-stance.

Indicates: lower longitudinal arch on the positive cast to allow for navicular drop.

Toe Positions

HAV is evidence of 1st Ray instability and contracted digits are commonly associated with this instability

Indicates: stiffer/harder shells, greater positing control, 1st Ray Cut Out as indicated above.

Contracted Digits are often a response to midtarsal compensation (instability) during mid-stance.

If secondary to insufficient integrity (instability)

Indicates: stiffer/harder shells, consider flanges

If secondary to excessive RF (STJ) compensation

Indicates: greater RF positing control (angle), consider heel skive

If secondary to influence outside of foot

Indicates: stiffer/harder shells, increase post control (angle), consider heel skive.

Morton's Toe is a structural deformity that limits the 1st met head's ability to push against the ground in terminal stance.

Indicates: Morton's extension, consider FF to Sulcus as possible option.

Corns and Calluses

Pinch callusing along the medial side of the distal phalanx or first metatarsal head is evidence of functional hallux limitus.

Indicates: greater posting control, 1st Ray Cut Out as applicable.

Callusing under the 2,3 & 4 metatarsal heads is a result of midtarsal or first ray instability in gait.

Indicates: stiffer/harder shells, I.C.A., Cuboid Pad

Heavy and/or nucleated callus under the 2nd metatarsal head is a result of ineffective 1st Ray push off in gait.

Indicates: Morton's extension as applicable

Callusing under the 4th & 5th metatarsal heads is a result of partially compensated or uncompensated FF varus.

Indicates: FF posting would be effective

Foot Appearance

Visible change in arch shape between semi-weight bearing and full weight bearing is the result of LMJA compensation, where a navicular drop of 8mm or greater is apparent.

Indicates: select stiffer/harder shell, firmer post materials; and consideration of flanges

Obvious change in arch shape between semi-weight bearing and full weight bearing is the result of LMJA compensation and subtalar pronation, where a navicular drop of 8mm or greater is obvious.

Indicates: stiffest/hardest/thickest shells, firmest post materials; arch reinforcement (fill-in) and flanges.

Hallux Dorsiflexfion Closed Chain

Inability to dorsiflex proximal segment is the result of functional hallux limitus.

Indicates: RF posting needed, select shell firm/stiff enough to resist arch collapse, 1st Ray Cut Out as applicable.

Inability to dorsiflex proximal segment to full 10º is the result of an unstable 1st Ray, although not likely a fully dysfunctional hallux dorsiflexion event.

Indicates: RF posting needed

Tibial Varum

Varum angle greater than 4º increases need for STJ pronation.

Indicates: RF posting angles 4 degrees or greater, FF posting or wedging to sulcus as needed

Varum angle greater than 7º is a pathological alignment that positions RF such that if it does not compensate, excessive shock (vibration) will result at the knee.

Indicates: Zero degree RF post if goal is to aid in retraining STJ pronation on contact. Greater than 4 degree posting after STJ begins compensating again

A varum angle greater than 7º is a pathological alignment that positions RF such that if it compensates excessive motion (displacement and acceleration) will result.

Indicates: Greater than 4 degree RF posting, with heel skive recommended, FF to Sulcus

Knee Positions

Varus Knee positions cause same compensation as Tibial Varum condition (See Above). Care should be taken to determine if the STJ is compensating, or not.

Valgus Knee positions cause forced pronation of the STJ on loading response, which is usually compounded by prolonged unlocking (instability) of midtarsal joint in midstance, as the body weight remains medial to the foot. This condition is also present during terminal stance, resulting a pronatory influence until toe off.

Indicates: stiffer/harder shells, increased stiffness & increased angle on RF posting angles, FF to Sulcus, consider medial flanges and arch reinforcement (fill-in).

Calcaneal Stance Position

The three positions between stance postures are interrelated, where changes (or no change) between positions are suggestive of STJ compensation during loading response.

Neutral Position: Inverted
Resting Position: Inverted
Half Squat: Rectus

Indicates: 0º RF posts

Neutral Position: Inverted
Resting Position: Rectus
Half Squat: Everted

Indicates: Minimal (2º - 3º) RF posts

Neutral Position: Inverted
Resting Position: Everted
Half Squat: More Everted

Indicates: Moderate(4º) to Maximum (6º) RF posts

Neutral Position: Rectus
Resting Position: Everted
Half Squat: More Everted

Indicates: Maximum (6º) RF posts

Neutral Position: Rectus
Resting Position: Rectus
Half Squat: Everted

Indicates: Minimal (0º - 2º) RF posts

Calcaneal Stance Position (Cont.)

It is extremely rare to find an everted position of the calcaneus in neutral stance. If one is found, and it changes position between postures:

Indicates: utilize maximum varus RF posting and FF wedging if extrinsic factors are also present, consider heel skive of 10º – 15º.

It is also uncommon to find a calcaneal position that is inverted in all three standing postures.

Indicates: no RF posting (nothing applied to the heel area) is recommended, soft materials for posting, molds or shells with unitized RF/Mid-Foot components.

Off weight bearing STJ R.O.M. observations made at the beginning of this evaluation are reviewed for correlation or alternate indications.

<5º of Calcaneal Eversion corresponds to STJ functioning at end range of motion during loading response.

Indicates: reduce RF post angles.

<15º of Calcaneal Motion corresponds to STJ function at end range of motion and ineffective shock attenuation.

Indicates: reduced RF post angles, softer materials for shells, posts and molds.

Supination Resistance Test

Off weight bearing assessment for a medially deviated STJ axis is recommended for patients presenting with an everted calcaneus in resting stance and especially a more everted position in standing half squat posture.

Kevin Kirby, DPM also described in his article for the J. American Podiatric Medical Association a weight bearing "Supination Resistance Test", in an effort to predict reliably if more aggressive orthotic intervention was required to effect a medially deviated STJ axis position: "Methods for determination of the positional variations in the subtalar joint axis, **77:** 228 1987.

Craig Payne, DipPod, MPH, et al. in the same journal (2003) published his findings on an attempt to test inter and intra-rater reliability for the test. He stated, "The amount of force needed to supinate the foot is independent of its posture."

Indicates: Reduced shell stiffness and posting control for a STJ that is easily supinated.

Short Leg

"The more ways there are to do something, the less likely any of them are very good", was asserted by Dave Nolan, DPT during a lab session for APRN, When the Foot Hits the Ground Everything Changes, Boston, November 2006.

There are a myriad of measurement techniques for determining limb length difference. Even with a gold standard radiograph of the long bones in standing, there remains a question of how much the affect of angular relationships at the hip, knee and STJ in double limb stance will convolute how much farther an anatomical landmark is actually away from the ground, from left to right sides.

Irrespective of technique, measured short leg implies asymmetrical function in the lower half of the body. Unilateral examination findings will likely be apparent, with calcaneal stance position being the most affected followed by arch height change between semi and full weight bearing.

If the patient sits a majority of the day

Indicates: Heel Lift under RF post; Heel Lift tapered to mets on devices with arch filled-ins

If the patient stands/walks a majority of the day

Indicates: Heel Lift, Lift tapered to mets or sulcus, FF Lift or Sole Lift, consideration of asymmetric posting and possibly even a different shell (material or thickness) used on the contra-lateral foot

If the patient is predominately in a standing posture a majority of the day

Indicates: Sole Lift heel to toe, best if applied to the outsole of the shoe, consider asymmetrical post angles.

Functional asymmetry secondary to pelvic anomalies will commonly result in unilateral examination findings and asymmetrical foot shape.

Indicates: Heel Lift, Lift tapered to mets or sulcus, asymmetrical posting strategies, FF Lift or Sole Lift, consideration of asymmetric posting and possibly a different shell (material or thickness) used on the contra-lateral foot

Note: Lifts to orthoses are applied only on request of the ordering clinician.