SECTION 4 - POSITIVE CASTING

THE SHAPE OF THE SHELL IS DERIVED FROM THE SHAPE OF THE CAST

Thermo-forming plastic for orthopedic intervention was originally developed at the University of California Laboratory, Berkley (U.C.B.L.).

STANDARD PLASTER ADDITIONS

Widen Lateral Border & Heel Seat

Plaster is added to side of lateral aspect (border) of the cast, from the 5th metatarsal head bisection proximal to the heel, then continuing around heel area to its medial aspect. This is done to accommodate for an expanding fat pad not captured in the off-weight bearing impression mold.

Used to:

Lateral column and heel plaster expansion allows for fat pad displacement/expansion when the foot lands/loads onto the shell.

Lower Longitudinal Arch (L.A.)

Plaster is added to the arch area, from behind the base of the first extending proximal to the distal medial aspect of the calcaneus. The plaster is thickest under 1st metatarsal and taper laterally to the3rd metatarsal. An $^{1}/_{8}$" of plaster is a standard specification, although lab specifications and preferences vary greatly.

Used to:

Allows for mid-tarsal movement to occur during mid-stance to assist with patient tolerance.

Concept of Compression

Keeping contours on the cast close to the actual foot shape results in increased motion control, by virtue of increased fat pad compression around osseous structures.

"The effects of posting and molding of foot orthotics are extremely different and when combining posting and molding, the effects of molding appear to be dominant." Mündermann A., et al.

NEWTONIAN DYNAMICS (KINETICS)

As the foot impacts the ground, a resultant ground reactive force (GRF) is imparted on all its segments. There are net forces in all three planes, but the primary force is vertical, resulting in a dorsiflexory thrust. Using an orthotic shell to direct this dorsiflexory force (pushing up) under any segment of the foot will elicit a plantarflexory response at an adjacent segment(s), whenever motion is available.

Pushing up the metatarsals will plantarflex the toes.

Pushing up under the 2nd, 3rd & 4th metatarsals will plantarflex the 1st & 5th metatarsals.

Pushing up under the cuboid will plantarflex the 4th & 5th metatarsals, the lateral column and Increase the Calcaneal Angle.

Pushing up at the longitudinal arch apex will plantarflex the 1st, 2nd & 3rd metatarsals, the medial column.

Pushing up under the lateral column will plantarflex the medial column, and conversely, if the medial column is lifted the lateral column is plantarflexed.

Concept of Rotational Equilibrium

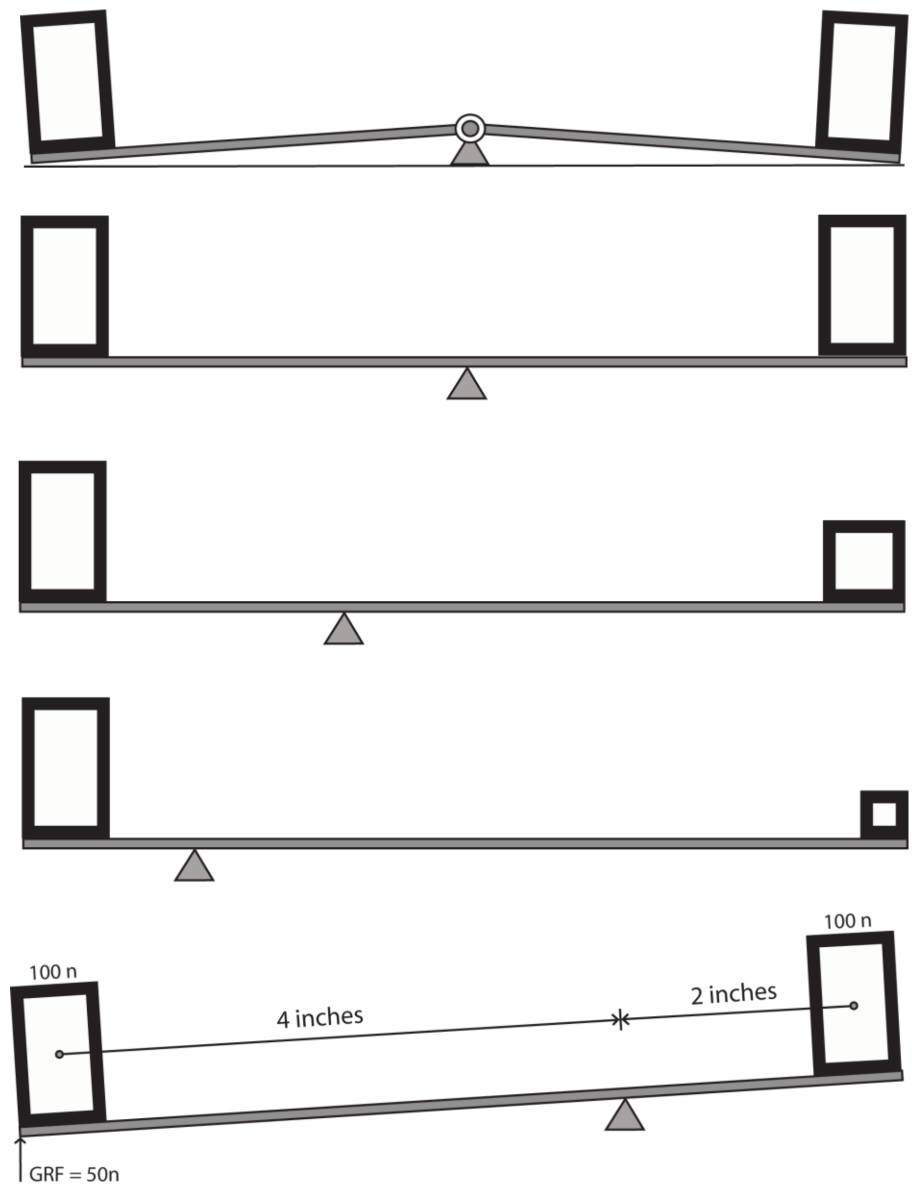
An object at equilibrium has no imbalance of forces causing it to move, linear or rotational. If an object is translating or rotating an imbalance of force has been applied. Any object with an axis of rotation that is at rest must have a net moment (lever force) acting across that axis of rotation that is equal to zero since the moments acting in opposite directions counterbalance each other, exactly.

Rotational equilibrium exists across an axis of rotation if the sum of the moments acting in one direction equals the sum of the moments acting in the opposite direction.

Pushing up directly under a joint axis will allow motion on both sides of the axis, a balancing moment.

Pushing up on one side of a joint axis will impart greater GRF, extend the lever arm moment and produce a rotational response around the axis.

Concept of Rotational Equilibrium (Cont.)



"Specifically, in regard to the foot, in order to meet the conditions of rotational equilibrium across the subtalar joint axis, the subtalar joint either must not be rotating or must have a constant rotational velocity, and the sum of the magnitudes of subtalar joint pronation moments must exactly equal the sum of the magnitudes of subtalar joint supination moments." Kriby, K.

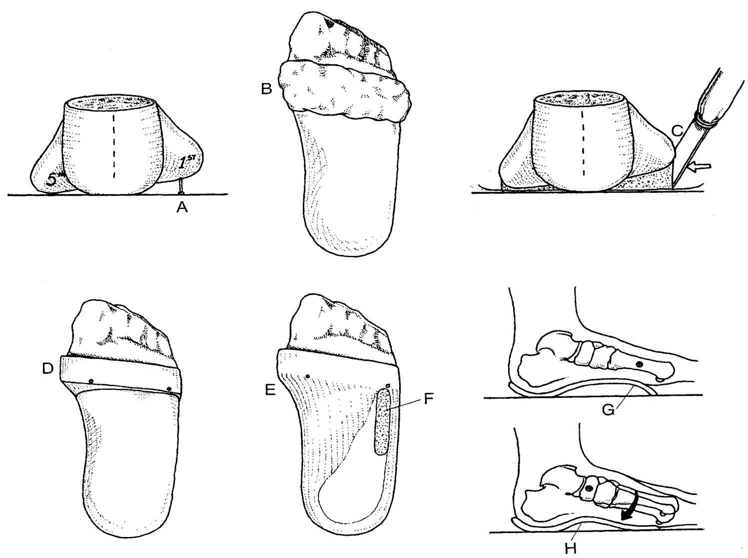
"Blake inverted and medial heel skive orthotic techniques effectively increase the subtalar joint supination moments and decrease the subtalar joint pronation moments by redirecting the reaction forces acting on the plantar foot from a more lateral to a more medial location." Kriby, K.

Intrinsic Forefoot Post

The best-known element of the Root Cast Technique, intrinsic forefoot posts, is constructed across the forefoot of a positive cast. Intrinsic forefoot posts produce more gradual contours on the shell, which are easier for patients to tolerate.

A nail (post) is driven into the met head area to a depth sufficient to maintain the calcaneal bisection at a vertical position. Plaster is spread onto the supporting surface and the forefoot of the cast is placed into the plaster. Excess plaster is trimmed away from the met area, leaving a platform angled from one side of the foot to the nail.

Forefoot posting supports (maintains) the frontal plane deformity, reducing rearfoot compensation into and through mid-stance.



Reprinted from “Foot Orthoses and Other Forms of Conservative Foot Care”, with permission of Thomas C. Michaud, DC

Used to:

Create a subtle drop off at the distal edge of the device, or to incorporate posting angles that employ less material across the instep, when shoe volume is a concern.

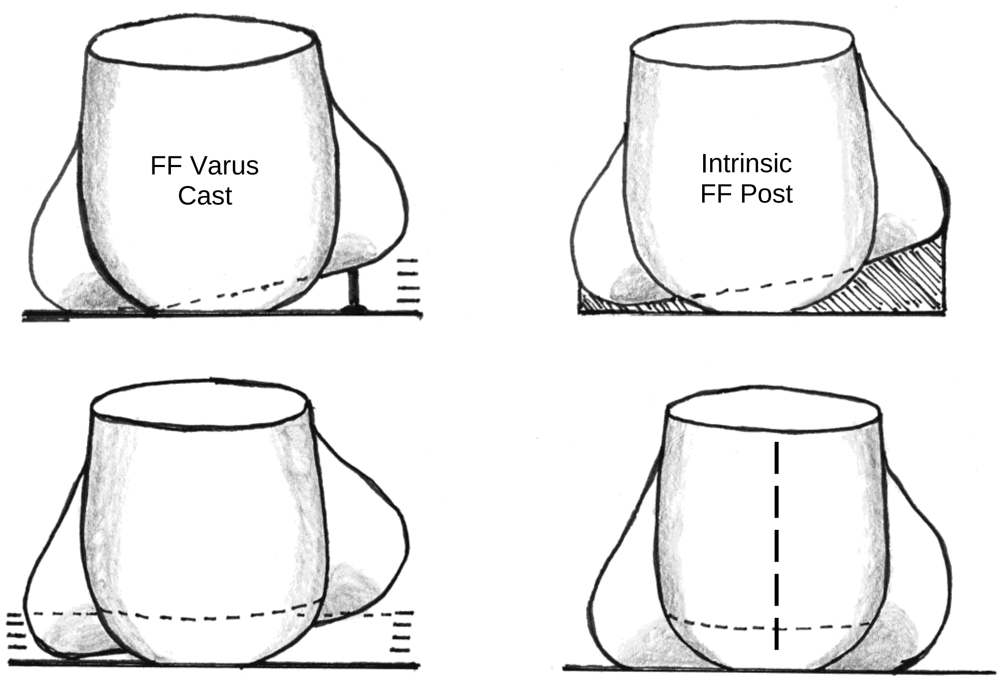
Modify Forefoot Perpendicular (⊥) to Rearfoot

The forefoot plane (1^{st} to 5^{th} Met head) is altered, by way of both removing and adding plaster, to bring it into perpendicular alignment with the calcaneal bisection.

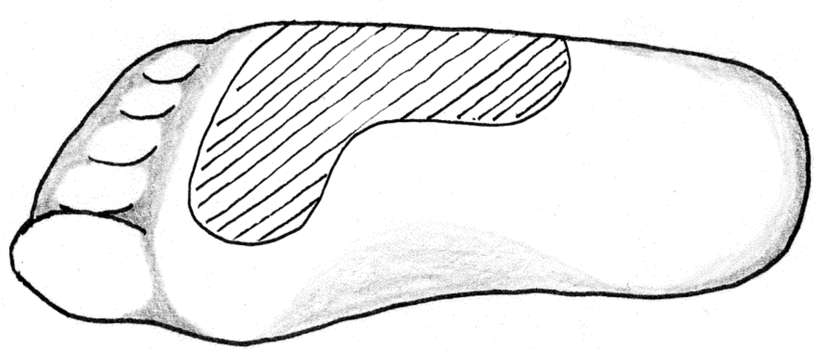
In the case of an inverted forefoot to rearfoot alignment, this causes the forefoot to evert and the 1^{st} Ray to plantarflex during mid-stance. This will impart an additional dorsiflexory force along the lateral column during loading response. The 5^{th} Ray compensate around it's own axis in tandem with OMJA compensation (abduction and dorsiflexion).

Used to:

Model (re-shape) the foot during weight acceptance/loading responce (mid-stance) through the principle of Newtonian Dynamics.

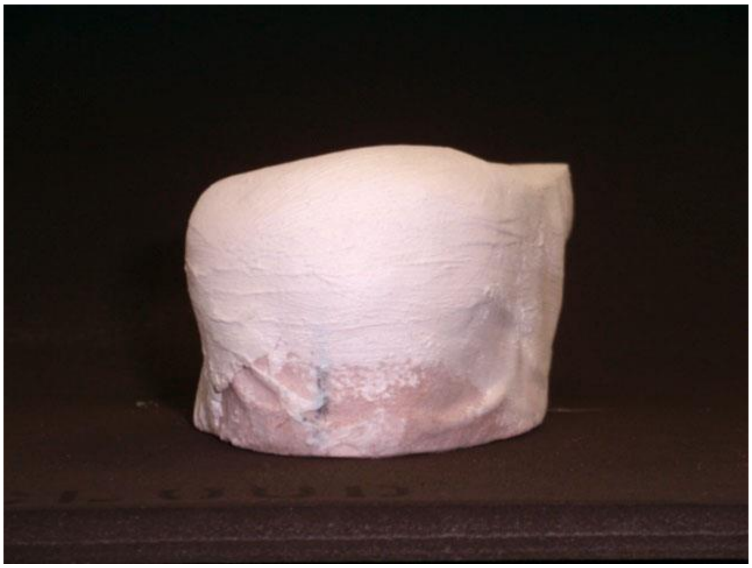


Filing Area for Modifying Positive Cast
FF Perpendicular to Calcaneal Bi-Section



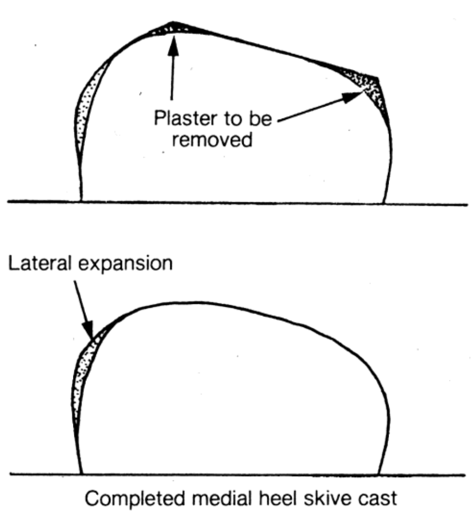
Heel Skive

A flat spot, at a 5°, 10° or 15° angle to the supporting surface, is filed into the heel area plantar to the condyle.



Used to:

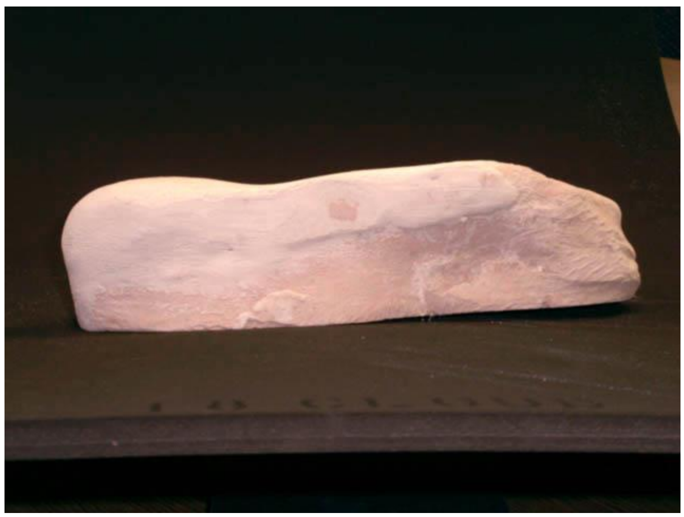
Increase the ground reactive force delivered into the medial condyle of the calcaneus. This increases rearfoot control without having to increase the extrinsic post amount.



I.C.A. (Increased Calcaneal Angle):

A short, narrow arch is filed into the cast along the lateral half of the foot, extending from the distal aspect of the lateral calcaneal condyle to the styloid process of the 5th metatarsal. The apex is under the anterior portion of the calcaneus, around the calcaneal/cuboid joint.

Pushing up under the calcaneal/cuboid joint maintains articular integrity (congruity) and increases oblique axis stability.



Used to:

Improve mid-tarsal joint stability, especially at the oblique axis.

M.A.P. (Medial Arch Platform)

Patients with forefoot abduction during gait, where the navicular becomes noticeably prominent, may not find a vertically shaped arch comfortable.

Plaster is added to create a flattened (horizontal) medial aspect in the arch. The medial side of the cast is modified along where the trim line of the shell will be.

Used to:

Reduce the edge affect that can irritate a foot with OMJA compensation that causes the navicular to protrude medially. Will also reduce the amount of volume taken up by the shell along the apex of the arch.

Root Cast Technique (Includes "Root Heel & M.A.P.)

Merton Root, DPM devised an original method for modifying a positive cast to alter contours of a foot model. He originated the concept of intrinsic posting for treating mal-alignments of the forefoot plane.

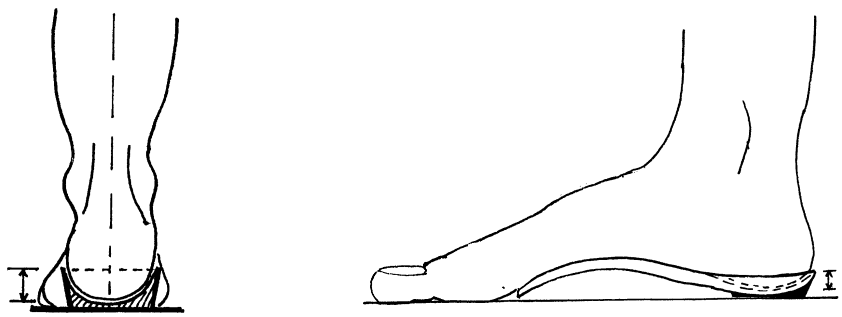
His original technique employed a shallow, flattened contour at the heel and in the arch. This permitted the foot to sit down in the heel counter by allowing the fat pad around the calcaneus to expand under body weight. Also, the medial side of the cast was modified, where the trim line of the shell would be, by adding plaster to create a flattened medial edge on the device, without lowering the lateral arch. This made for a lower profile shell, while still maintaining longitudinal and oblique axis control.

Used to:

Create a lower profile device, with posting angles to control for frontal plane deformities, when shoe volume is a concern.

Heel Cupping/Heel Seat Depth

Increasing compression of fat pad around calcaneus improves control over it’s movement. It also improves shock attenuation through the fat pad during heel strike. When the plantar fat pad is allowed to displace under body weight, it flattens at the peak weight bearing area, distorting (blooming) to where weight bearing is the least.



Used to:

Simultaneously improve motion control and shock attenuation by enveloping more of the plantar fat pad.

Root Cast Technique

Modifying the positive cast of a foot was initially popularized by Merton Root, DPM. He originated the technique of intrinsic forefoot posting on the cast, inspiring it’s use in controlling rearfoot compensation by altering the forefoot shape on a positive cast.