Why Orthotics & Ergonomic Footwear?

• To reduce, eliminate and prevent trauma and pain in load bearing joints of the body

• To reduce biomechanical trauma and drug intervention in autoimmune and collagen vascular disease such as Rheumatoid Arthritis, Degenerative Joint Disease (Osteoarthritis) and Diabetes.
  
  • To improve and or maximize athletic performance
    
    • To prevent and or reduce injuries
    
    • To reduce fatigue and improve body comfort

• To improve developmental growth and reduce disease in Children's feet.

• To reduce the effects of Organic disease (Congestive Heart Failure, Obesity, Peripheral Vascular Disease, Hypertension, Diabetes), by improving body mechanics and increasing aerobic activities while improving sedentary lifestyles.

• To improve the quality of life.
From Sports to Fashion to Work

87% of the population will have foot and body pain resulting from abnormal ergonomic or biomechanical disease costing billions of dollars annually.
Ergonomic Footwear is a dual functional solution which combines state of the art shoes designed to adapt to the foot’s altered functional demands to varied terrain surfaces and anatomical size variations while maximizing biomechanical function of the foot by controlling unique Subtalar (Rear Foot) and Midtarsal Joint (Midfoot) anatomical joint variances place upon it by varied lifestyle activities.
mass customization
ergonomics
performance
endurance
symmetry

using medical know how plus 3D imaging and software intelligence to open access to medical, industrial & retail markets.
Adaptive footwear which expands to changing foot girth, width and length throughout the day.
Spira

Kinetic Coil Reduces Impact Trauma

The Element

The Element of Advantage

WvS

The Element

SWC201 Black / Black

SWY281 Oyster / Oyster

SRG201 White / Charcoal / Red

SRG202 White / Grey / Cranberry

SRU401 White / Black / Bronze

SRU407 White / Sky Blue

SLT102 White / Blue

SLT705 White / Lilac

SLT707 White / Black / Gold
Why 3DO?

There are simply too many problems associated with the diagnosis and the manufacturing of Custom Medical Grade Orthotics (27 error points) leading to inadequate biomechanical control.

Our goal was to develop a user friendly process, (from 3D imaging to manufacturing), which was reproducible and stable, thereby removing the errors associated with neutral joint positioning which leads to significant errors. By increasing the accuracy of biomechanical control through precise bio-engineered tri-motion controlled Orthotics, we are able to control complex load bearing joints of the body.

We simply put the Doctor and the Technician inside 3DO utilizing Intelligent Software thereby simplifying a complex process and opening up the utilization of Custom Medical Grade Orthotics to Medical, Industrial and Consumer markets Worldwide.
How Bio-Engineered Medical Grade Orthotics can help the Orthopedic Surgeon

- Despite how good a surgical procedure is planned and executed, surgical wound healing and bone changes (osteoblastic & osteoclastic activity) are beyond the surgeons control.
- The further the surgical area is from the foot, the more difficult the accuracy of the surgical correction (lever arm vectors).
- Bio-Engineered Orthotics alter the foot to floor interaction and help to provide adequate surgical correction, ensuring better post operative results.
- Wolf’s law is a dynamic element in Orthopedic surgery. The cause and effect of load bearing pathomechanics is the underlying etiology of most diseases necessitating surgery.
- The science of functional and static biomechanics and ergonomics will have a positive and profound effect on the treatment of complex mechanical etiologies in load bearing kinematic disease of the body.
The Problem

- There is a 800 million dollar “junk market” of insoles and products called “Orthotics”.
- You can not make a Orthotic from a 2D source.
- You must be able to isolate and understand 3D load bearing static and dynamic foot function to be effective.
- Bio-Engineered Orthotics can achieve high levels of load bearing body function if they are made correctly. Most Orthotics do not work effectively because critical joint wedge interlocking of the subtalar and midtarsal joints & 1st Ray does not properly occur leading to improper control.
3DO Imaging & Foot Sizing Technology

Digital Foot Fitter (foot sizing)

3DO Ergo Pod (medical)
Imaging Systems

3D Static
• Optical Laser
• Pin (Amfit)

3D Static and Dynamic
• Calibrated conductive Carbon foam – 3DO

2D
• Ink pressure systems
• Light (photocopy)
Why 2D imaging systems don’t work

Static versus dynamic
- Both analysis are vital
- Dynamic data enables physician to see deforming forces that creates disease.

- The foot is a 3D appendage of the body and requires 3D imaging. 2D foot tracings do not provide critical “Z Axis” or depth data necessary for arch height and surfacing.

Anatomical Variations Demands Customization
Analyze the art of *motion*
using intelligent software

body mass analysis
velocity of movement (motion)
pressure analysis (force)
3D surfacing using

*shape technology™*
3D Weight Bearing Kinematic Analysis, an ergonomic imaging solution

- Easy to operate by non medical staff
- Weight Bearing 3D Kinematic Imager
- Static and dynamic gait analysis
- Multiple billing codes are applicable
- Diabetic foot assessment screenings
- Provide ergonomic solutions
- Ideal for injury & workers compensation claims
- Outcome measurement
- Proof of medical necessity

“This technology is light years ahead of the competition!”
Steve Eaton, MD
Anesthesiologist & Pain Specialist
The Fully Integrated Process

- Size
- Scan
- Order
- Manufacture
- Fit
Closed Chain Kinematics

- Closed Kinetic Chain Gait Events
  - Foot Biomechanics & Ergonomics
    - Foot Pronation and Supination
      - Created by the Tri-plane Motion of the foot
    - Reactive forces from the ground emanating through the foot are transmitted into load bearing joints of the body creating disease. These forces are a major component of a wide variety of orthopedic disease and trauma. They are often not evaluated and thereby lead to complications which can be avoided.

Effects of Pronation & Supination effects total load bearing joint mechanics

- Ankle
- Lower Extremity and Knee
- Thigh and Hip
- Pelvis and Spine
Medical Diseases Created or Exacerbated

- Degenerative Joint Disease (DJD)
- Collagen Vascular Diseases – Rheumatoid Arthritis
- Organic Diseases (CHF – Hypertension – Obesity – PVD – Diabetes)

“Bio-Engineered Custom Foot Orthotics are one of the best kept secrets for lowering health care costs by maximizing body ergonomics, while reducing trauma to osseous (bone and cartilage), intrinsic and extrinsic musculoskeletal load bearing structures.”

“The more we maximize bio-mechanical function of the body, the better we keep patients, workers and consumers aerobically fit, thereby reducing disease and morbidity.” “Medicine’s treatment of load bearing pain with medication, and failed surgeries simply is not working”

Dr Craig Lowe
Even insurance companies are aware that by keeping patients active and aerobically fit, reduces disease and health care costs.

Blue Cross - Blue Shield

Many people don’t realize that merely walking 10,000 steps a day can help them lose weight, lower their cholesterol and reduce the risk of heart attack. Spreading this knowledge can not only save lives, but could also save our healthcare system up to $77 billion a year.

That’s why Blue Cross and Blue Shield Companies launched WalkingWorks™ — to let people know that adding steps to their daily routine is good for them and good for all of us. After all, the more we know, the healthier we can be.

To find out more about our WalkingWorks™ program, visit us at walkingworks.com.
Injury Treatment & Prevention

Orthotics prevent and reduce injuries, medical and workers compensation claims by maximizing ergonomic performance of the body. Treating mechanical disease with mechanical solutions.

- Foot and Ankle
- Lower Leg and Knee
- Thigh and Hip
- Pelvis and Spine
- Reducing Fatigue
- Improving Productivity
- Improving Comfort and the quality of life at work
Functional Biomechanics

- Why is the foot vitally important in the treatment of Orthopedic Surgery and why it should never be without treatment?
  - Wolfs Law
  - Kinetic loading
  - Effects of abnormal mass loading
  - General comments on pathomechanics
Basic Foot Physiology & Biomechanics
Tarsal – Metatarsals
Foot Anatomy & Biomechanics

Foot anatomy (Three Planes)

Frontal  Lateral  Axial
Pathomechanics – The Foot is the key

The foot is effected by a variety of critical physical properties, which if left untreated affects medical and surgical care of all load bearing joints.

- Mass Displacement Loading
  - Closed Kinetic Chain
- Motion Analysis
  - Velocity of movement over time
    - Degrees per second
- Pressure Loading
  - Linear pressure
  - Sheer pressure
- Body Balance
  - All three planes
- Phasic Muscle Activity

Bio-Engineered Custom Foot Orthotics, (if manufactured correctly) will provide tri-plane kinetic load bearing control of the body interaction with the ground and minimize abnormal mass, motion, pressure and balance conditions critical to biomechanical and ergonomic stability.
Complexities of Foot Mechanics

- Tri Plane Axis of Motion
- The Foot’s Dual Functionality of shock absorption and stabilization
- The anatomical region of the body responsible for load bearing pathomechanics
Ankle function is effected by foot pronation and tibial torsion.
Pes Rectus

Normal Foot Anatomy

Extrinsic Anatomy at Ankle

Intrinsic Plantar Anatomy
Biomechanical Foot Types*

**Pes Cavus** (Hypermobile and Rigid Deformity Types)
- Hypermobile Foot (High Arch to Low Arch Weighted)
- Midtarsal Joint (Forefoot) Valgus
- Plantarflexed 1st Ray (Forefoot Valgus)
- Rigid Foot (High Arch with little to no Arch Collapse)

**Pes Rectus** (Normal Arch)
- Midtarsal (midfoot) pronation (mild)
- Midtarsal Joint (Forefoot) Varus (mild)

**Pes Planus** (Low Arch) - (Hypermobile & Rigid Deformity Types)
- Hypermobile Foot
  - Midtarsal (midfoot) pronation
  - Hypermobile 1st Ray
  - Midtarsal Joint (Forefoot) Varus
- Rigid Foot
  - Forefoot Varus

* It should be noted that there are a wide variety of foot pathology combinations and that proper diagnosis must be made. Listed above are some of the basic types.
Pes Rectus = Normal Arch

Normal Forefoot to Rearfoot Alignment

C = Calcaneous perpendicular to Forefoot (FF)
FF = Forefoot parallel to floor (metatarsal heads)
PL = Peroneus Longus Tendon
Pes Planus (Flatfoot)

Forefoot Varus
(Axial – Frontal View)

Non Weight Bearing
Forefoot Inverted to Calcaneous (C)
(neutral rear foot)

Weight Bearing
Calcaneous Eversion (C)

1 2 3 4 5

FF

FF
Pes Planus (Flatfoot)
Forefoot Valgus

Non Weight Bearing
Forefoot Everted to Calcaneous (C)

Weight Bearing
Calcaneous Inversion (C)
Normal Axis of Joints
Ankle
FIGURES 1-63 and 1-64  The axis of motion for the ankle joint.
Normal Axis of Joints
Subtalar
&
Midtarsal
FIGURES 6-24 and 6-25 When the subtalar joint moves from a pronated position (Fig. 6-24) to a supinated position (Fig. 6-25), the oblique axis of the midtarsal joint (O.M.J.A.) becomes more vertical. Vertical ground reaction forces (G.R.) develop a larger force vector to produce midtarsal joint stability (arrow s) and a smaller vector to produce midtarsal joint rotation (arrow R) when the foot becomes supinated at the subtalar joint. This is one of the factors that makes a foot a rigid lever when it supinates normally during propulsion. Less muscle effort is required to maintain stability of the midtarsal joint when the foot is supinated during propulsion.
FIGURES 6-7, 6-8, and 6-9  These illustrations show the relative motion and position between the talus and calcaneus as the subtalar joint moves from a supinated position (Fig. 6-7), to a neutral position (Fig. 6-8), and into a pronated position (Fig. 6-9).

Arrow TD represents the transverse distance between the calcaneocuboid and the talonavicular joints. With pronation, the transverse distance increases as the talus adducts upon the calcaneus. This talar adduction occurs with internal leg rotation.

Arrow VD represents the vertical distance between the calcaneocuboid and talonavicular joints. With pronation, the vertical distance decreases as the talus plantarflexes upon the calcaneus. The talar plantarflexion is accompanied, at least in part, by anterior movement of the proximal tibia.

The plantar aspect of the calcaneus is inverted from the ground when the subtalar joint is supinated. It becomes parallel to the ground when the subtalar joint is neutral, and the calcaneus is everted to the ground when the subtalar joint is pronated. The talus does not move in a frontal plane with subtalar joint motion. In the illustrations, observe that the superior surface of the talus neither inverts nor everts when the subtalar joint moves. The height of the superior surface of the talus, relative to the ground, decreases with pronation. When the foot pronates, the leg and pelvis drop. They are conversely elevated with supination. Therefore, unilateral pronation results in a functional limb shortage.
FIGURE 1-72 The midtarsal joint has two independent axes of motion, both providing for motion in the direction of supination and pronation. The oblique midtarsal joint axis (O.M.J.A.) primarily provides inversion and eversion of the forefoot, with clinically insignificant motion in the other two body planes.

FIGURE 1-73 A lateral view of the two axes of motion for the midtarsal joint (See Fig. 1-72).
FIGURE 1-72  The midtarsal joint has two independent axes of motion, both providing for motion in the direction of supination and pronation. The oblique midtarsal joint axis (O.M.J.A.) primarily provides inversion and eversion of the forefoot, with clinically insignificant motion in the other two body planes.
FIGURE 2-7 In a foot that supinates normally during propulsion, the interaction of forces at the joints of the medial arch produces small tension forces that can be easily resisted by normal ligament and muscle function. Weight bearing forces (arrow A-B) angle very slightly with ground reaction forces (arrow D-C) in the transverse plane of the foot.

FIGURE 2-8 When a foot abnormally pronates during propulsion, the talus is adducted excessively. Weight bearing forces (arrow A-B) angle greatly with ground reaction forces (arrow D-C). Muscles and ligaments must overwork to resist large tension forces that can disrupt the integrity of the bones in the medial arch.
Normal Axis of Joints

1st Ray
FIGURES 2-13 and 2-14  When the peroneus longus muscle contracts during the midstance period of the stance phase of gait, the cuboid is stable and provides the pulley about which the peroneus longus tendon functions. The peroneus longus tendon turns underneath the cuboid in its peroneal groove and attaches to the lateral plantar aspect of the 1st cuneiform and to the base of the 1st metatarsal. As the tendon passes from the peroneal groove, it goes forward, upward, and medialward to its attachment. The tendon uses the cuboid as a pulley, and, when the muscle contracts, its tendon exerts a plantar stabilizing force upon the base of the 1st ray labeled A-B. It also exerts a lateral stabilizing force holding the 1st ray against the 2nd ray as indicated in both illustrations by arrow A-C. Furthermore, it exerts a posterior pull upon the 1st metatarsal and the 1st cuneiform to stabilize the base of the 1st ray posteriorly against the navicular as illustrated by arrow A-D. The peroneus longus tendon passes almost perpendicular to the 1st ray axis and well below it and has a significant lever arm for its function. As a result, the peroneus longus is a strong stabilizer of the 1st ray against ground reaction directed upward against the head of the 1st metatarsal and is also a strong stabilizer of the base of the 1st ray against the rest of the lesser tarsus.
slightly from the transverse plane. The 1st ray exhibits triplane motion, but nearly all of that motion occurs in the frontal and sagittal planes. The amount of transverse plane motion is clinically insignificant and will not be considered in subsequent discussions. As the 1st ray is dorsiflexed, it inverts. As it is plantarflexed, it everts. The quantity of dorsiflexion-plantarflexion motion is approximately equal to the amount of inversion-eversion motion.

FIGURE 1-78  The axis of motion of the 1st ray.

Peroneus Longus Tendon

FIGURE 1-79  The axis of motion of the 1st ray as viewed from anterior to posterior at the tarsometatarsal joints.
FIGURES 1-15 and 1-16 Figure 1-15 is a drawing of the articular surface of the 1st metatarsal head. Fig. 1-16 illustrates the adaptive changes in the shape of the 1st metatarsal head that develop with advanced hallux abductovalgus deformity. The 1st metatarsal head becomes wider by the addition of bone on its lateral aspect. The articular surface of the 1st metatarsal head also becomes ab ducted relative to the longitudinal axis of the shaft of the 1st metatarsal head.

Functional adaptation of bone which occurs at the 1st metatarsal head eliminates the normal sagittal plane motion of the hallux as it dorsiflexes. With advanced hallux abductovalgus deformity, the hallux abducts and everts as it dorsiflexes. An abnormal triplane axis of motion replaces the normal transverse axis of the 1st metatarsophalangeal joint when advanced hallux abductovalgus deformity has developed.
Static Body Balance & Reactive Ground Forces
Static Stance Stability

Importance in body stability is critical in a number of ageing and disease states.

Center of body mass (CG)

- Transverse Plane (CG)
  - Angle and base of gait (Exhibit 1)
- Lateral (CG)
  - Lateral Limb (Exhibit 2)
- Frontal Plane (CG)
  - Exhibit 3

Exhibit 1  Exhibit 2  Exhibit 3
Dynamic Body Balance & Reactive Ground Forces
Vertical Ground Reactive Forces

- The key to remember is that there is equal reactive force moving through the foot from the floor as there is from the upper body impacting the floor surface.
The foot’s interaction with the ground creates **transverse plane rotation** as a result of the foot’s tri plane motion (pronation). This rotation creates real mechanical problems for the knee joint which is designed to work on the sagittal plane (flexion & extension).
Abnormal Patella tracking occurs when the leg excessively rotates during midstance. Chondramalascia

Excessive pronation creates excessive transverse plane motion which results in excessive limb, pelvis, spinal trauma

Ankle joint axis (18° external rotation) due to tibial torsion. Ankle should not pronate.

Under normal conditions the Knee joint acts as a "hinge" (flexion / extension) and is subject to trauma with foot pronation

There should be no rotation of the leg if foot pronation is controlled. Patella should sit within the femoral groove

Leg & Foot Closed Kinetic Chain Gait Goals
Motion Analysis
-
Gait Analysis
Dynamic Mass Displacement
Biomechanical Quadrants (4)

Heel Contact (1) – Inverted 4-6 degrees varus (lateral mass migration through lateral body of calcaneous - Subtalar Joint Unlocked). Mass migrates to Cuboid where forefoot loading begins (midstance phase of gait).

Midtarsal Joint Wedge Locking occurs and foot changes from shock absorber to stabilizer as Peroneus Longus fires plantarflexing the 1st Ray for active propulsion (4). The Posterior Tibial tendon assists in supination of foot (decelerating pronation).

Normal Mass Migration
Normal Gait
(Heel Contact) Phase 1 (Quadrants 1 & 2)
 Begins at heel contact where the Calcaneous (frontal axis) interacts with the floor with a lateral outward tilting (Varus) of between 4-6 degrees (walking) and higher (8-10 degrees in more accelerated linear sports such as running). Ankle dorsi flexion at heel contact approximates 10 - 12 degrees to the leg. At this point in time, the foot is acting as a “Shock Absorber” along with the knee to absorb the impaction of body mass against reactive floor trauma.

Forefoot Contact – (Midstance Gait) Phase 2 (Quadrants 1-2-3-4)
 As the forefoot loads, weight migrates from the lateral (varus position) rear foot through the lateral Cuboid at which time the Peroneus Longus (Lateral Leg) fires. Next the 1st Ray (Navicular – Cuboid – 1st Metatarsal – and Hallux), plantar flexes against the floor reducing midfoot and forefoot pronation and body mass quickly (1-2 milliseconds) transfers from the cuboid to the 1st metatarsal. While this is happening there are retrograde forces reacting in equal mass and force against the foot from the floor thereby pressure locking the midtarsal joints against the subtalar joint causing the “Locking Effect”. At this point the foot changes from a shock absorber to a “Stabilizer” in preparation for stable joint interlocking and the transfer of body weight over the foot as propulsion begins.

Propulsive Phase of Gait Phase 3 (Quadrants 3 - 4)
 Propulsion occurs as the plantar MPJ’s load. In addition, the retrograde firing of the Peroneus longus occurs, this causes active plantar flexion of the 1st Ray along with assistance of the lesser metatarsal flexors (Flexor Digitorium Longus and Brevis) to the lesser metatarsals 2,3,4,5. The hallux and 1st Ray bear the major responsibility for the power of active propulsion.
Mass Displacement Analysis

- Mass Displacement Analysis evaluates how the foot is absorbing and transmitting body weight loading during dynamic gait events.

1. It provides evidence of effective heel strike (inverted – midline – everted)

2. It provides evidence of midtarsal joint wedge locking against the Sub Talar Joint by virtue of medial mass shifting during midstance as foot changes function from shock absorption to stabilization.

3. 1\textsuperscript{st} Ray function can be easily seen by evaluating how effectively body mass is migrated from the 1\textsuperscript{st} metatarsal head and hallux during midstance through propulsion.

- Normal Values

Heel Contact = Varus 6-8
Midstance = Arch Support
Propulsion = 1\textsuperscript{st} Ray

- Contact = 27%
Midstance = 40%
Propulsive = 33%
Equinus – Effect on Body Mass

- Effects all 3 body planes
- Equinus Effect - (2 Types)
  1. Hamstring Equinus (majority in men)
  2. Gastrocnemius Equinus (majority in women)
  - Anterior Shifting of body mass (Sagittal Plane) (X)
    - Accelerates pronation motion & velocity of joint motion
      - Subtalar and Midtarsal Joints
        » Increase in Plantar fascia and flexor intrinsic trauma
          Plantar fascia and heel pain syndromes
        » Increase in transverse plane limb rotation
    - Increases metatarsal head pressures
      - Metatarsalgia and Intermetatarsal Neuromas

HS = Hamstrings
GS = Gastroc/Soleus
Motion Analysis
Motion Analysis

• 3DO analyzes gait cycle events
  – Heel Contact
    • Foot functions as shock absorber with knee as body weight reacts with the floor
  – Midstance
    • Foot functions as stabilizer as rear foot and mid foot joints lock due to anatomical alignment & reactive ground forces
  – Propulsion
    • Foot is plantarflexing 1st Ray and stabilizing the transmission of weight in preparation for the swing phase of gait.

• 3DO provides high resolution graphic motion analysis, dynamic mass displacement and pressure visualizations as the foot moves over the 3D media (floor).
Normal Pes Rectus Foot Type

Normal Gait Analysis & Weight Bearing Kinematic Mass Displacement

Heel Contact (walking) 4 – 6° Varus to floor (Foot Shock Absorption)
  1. Lateral Mass Migration Plantar Lateral Calcaneous migration to Plantar Cuboid.

Midstance - forefoot begins contact with floor (Foot Rigidity)
  1. Peroneus Longus Fire and 1st Ray plantarflexes resisting pronation as body migrates over floor. Reactive ground wedge locking MTJ occurs.

Propulsion (Foot Rigidity)
  1. Medial mass migration off 1st Ray as foot re-supinates and prepares for swing phase,

Contact = 27%  
Midstance = 40%  
Propulsive = 33%
Normal Values

- Normal heel contact is between 4-6 degrees inverted.
- Mass migrates along lateral Calcaneous until forefoot starts to load (midstance)
- Peroneus longus fires de-accelerating forward body movement while plantar flexing the 1st Ray.
- Body mass migrates medially (midstance as midtarsal joints lock)
- Active Propulsion occurs from 1st MPJ and Hallux
- Digits grasp as secondary propulsive effect
Effects of Pronation & Supination on body mechanics

✓ Ankle
✓ Lower Extremity & Knee
✓ Thigh and Hip
✓ Pelvis and Spine

Pressure
- Pronatory (abnormal motion) can create shearing dispersive type pressure lesion(s).
- Supinatory (restricted motion) conditions can create high impact enucleated (scared) type lesion(s).

Motion
- The simultaneous Tri Plane motion of the foot (joints) effects transverse plane rotation of the limb.

Body Mass Displacement
- Any abnormal shifting of the center of body mass created by abnormal foot mechanics & Equinus conditions can effect posture and accelerate the effects of load bearing disease (degenerative joint disease) and accelerate the effects of metabolic disease (Rheumatoid Arthritis) etc.

Balance
- Abnormal forefoot to rearfoot alignments such as forefoot valgus can cause ankle injuries.
- High pronatory conditions can create body balance instability.
- Equinus conditions create instability & increase injuries.
Pressure Analysis
Linear Pressure
Sheer Pressure
Linear Pressure

Figure 2-4: A section of a foot cut at the proximal end of metatarsus of a person standing on one foot on ground contact only at the forefoot.

Figure 2-5: A sectioned foot in static stance.
FIGURE 2-3  The foot of a 60 Kg. person standing on the foot, with ground contact only at the forefoot.
Sheer Pressure

- Critical in the analysis of diabetic pressure loading
  - Leads to tissue breakdown augmented by neuropathy
Pressure Analysis

High Resolution “Shape Technology” enables you to see detailed surfacing deformation effected by weight bearing pressure.

Example 1

Dispersive shearing pressure of the 2\textsuperscript{nd} and 3\textsuperscript{rd} MPJ (Static) which changes to 4\textsuperscript{th} and 5\textsuperscript{th} MPJ upon dynamic gait due to action of 1\textsuperscript{st} ray.

Mass displacement reveals pronated heel contact with 1\textsuperscript{st} ray hypermobility (A).

Oblique 3D Imaging
Bio Engineered Corrective Orthotics

How they work...
Orthotic Function

- Goal of Orthotic intervention is to induce normal body mass migration and motion of the rear foot, midfoot while improving the propulsive phase of gait by controlling all three body planes in 4 independent anatomical foot segments.
**Lateral Rearfoot** – Critical heel contact area of the foot. Rear foot Varus posting influences lateral mass migration at heel contact phase of gait.

**Midtarsal Joint Locking** – Retrograde forces from the floor against the foot assist in pressure locking of the midfoot. Failure causes pronation (abnormal) movement or collapse of the arch and heel. This excessive motion causes excessive transverse plane rotation of the leg, knee, hip, pelvis and spine. Orthotics assists in promoting normal pressure joint locking of midfoot.

**Medial Forefoot** - Where active propulsion occurs. At midstance, the Peroneus Longus acts to decelerate pronation by plantar flexing the 1st Ray. Orthotics improves 1st Ray function.
FIGURES 1-36, 1-37, and 1-38  From the neutral subtalar joint position (Fig. 1-37), this foot inverts 20°, with full subtalar joint supination, to an inverted position of 27° (Fig. 1-36). This foot also everts 10°, with full subtalar joint pronation, to an everted position of 3°. This left foot also measures 30° of frontal plane motion when the subtalar joint is moved through its full range of motion just like the opposite foot (Figs. 1-33 and 1-35). However, this left foot has a 7° rearfoot varus deformity. In other words, the position at which the left foot is neither supinated nor pronated at the subtalar joint is that position in which the calcaneus (and the rest of the foot) is inverted in relation to the longitudinal bissection of the leg by 7°.
FIGURES 1-33, 1-34, and 1-35 From the neutral subtalar joint position (Fig. 1-34), this foot inverts 20° when the subtalar joint is fully supinated (Fig. 1-33) and everts 10° when the subtalar joint is fully pronated (Fig. 1-35). This foot has a normal rearfoot, and its full range of subtalar joint motion, measured in a frontal plane, is 30°.
Balance, Body Mass and Body Sway are important Static and Dynamic properties of 3DO.

Understanding these effects will enhance your ability to pick up more critical information of weight bearing kinematic conditions which leads to disease, injury and performance issues.

The normal center of body mass is shown above. Any divergence represents a shift from the central axis which can effect injury, disease, and or deformity.
Reactive Upper Limb Loading

Pelvic and Femoral  Spine
Reactive Upper Limb Loading

Ankle and Leg
- Ankle Joint Axis
- Effects if abnormal tibial torsion
- Effects of Equinus
  - Cause and effects

Knee
Functional Biomechanics

Subtalar Joint (STJ)
- Role of STJ
- Subtalar Joint Tri-Plane Axis
- Its role in wedge locking of the midtarsal joints (arch)
- Its role in pronation and resultant transverse plane limb rotation

Midtarsal Joints (MTJ)
- Role of MTJ
- How pronation occurs
  - Failure of MTJ Locking
- How pronation contributes to closed chain limb rotation.
Functional Biomechanics

1st Ray Function
- Its vital role in foot function
- Pathomechanics
- Role of Orthotics in 1st Ray stabilization
- Navicular - Medial Cuniform – 1st Metatarsal – Hallux

Metatarsal Phalangeal & Digital function
- Balance and stability
- Propulsion
- How Orthotics effect MPJ stability
- Pathomechanics
Left Orthotic - Normal Mass Migration

Heel Contact 4-6 degrees Varus (STJ Locks MTJ @ Midstance) (Y) (X)

Foot changes from shock absorber to rigid lever for active propulsion

Induces STJ Locking of MTJ

Most Active Area at Heel Contact

1st Ray Function (navicular - medial cuneiform - 1st metatarsal - hallux) occurs in quadrant (4) depicted above.
Static Loading
Dynamic Loading
FIGURE 6-30 After heel strike, the normal foot pronates, and the knee flexes until the end of the contact period. The calf muscles decelerate subtalar joint pronation at this time and cannot decelerate the anterior momentum of the tibia until the subtalar joint stops pronating. After the subtalar joint stops pronating, the calf muscles begin to decelerate anterior momentum of the tibia throughout the midstance period and extend the knee.

Because the calf muscles do not decelerate forward momentum of the tibia during the contact period, the knee flexes and absorbs the shock of heel strike.
FIGURE 3-2A Contraction by the gastrocnemius muscle pulls backward upon the femur to maintain the center of gravity of the trunk (C.G.) just anterior to the ankle joint. In some individuals, the anterior tibial muscle contracts alternately with the gastrocnemius during static stance. Anterior tibial activity is probably necessary when the center of gravity falls at or behind the center of the ankle joint.

FIGURE 3-2B The center of gravity of the trunk (C.G.) is supported in an average position that is slightly anterior to the ankle joint. Contraction by the gastrocnemius muscle simultaneously exerts a posterior force upon the leg and a plantarflexion upon the forefoot around the ankle joint axis A. The lever arm from the gastrocnemius tendon fibers to the ankle axis is AT to A. The forefoot is stabilized against the ground by the tension force from the gastrocnemius and also by gravity which falls forward of the ankle joint axis CG to A. Ground reaction against the forefoot exerts a dorsiflexion force at the ankle around the lever arm A to MPJ. The gastrocnemius muscle must exert a posterior pull on the leg to prevent ankle joint dorsiflexion.
FIGURE 1-94 This figure illustrates the maximum amount of hallux dorsiflexion that can usually occur without simultaneous plantarflexion of the 1st ray. The hallux can dorsiflex 20° to 25° from the ground, and that amount of dorsiflexion is about 43° to 48° from the longitudinal axis of the 1st metatarsal.

Fig. 1-94

FIGURE 1-95 This figure shows the same amount of dorsiflexion as in Fig. 1-94, but heel lift causes the dorsiflexion to occur as the hallux is stabilized on the ground.

Fig. 1-95

FIGURE 1-96 This figure shows the foot in final propulsion. The hallux is dorsiflexed 75° from the 1st metatarsal as heel lift elevated the base of the 1st ray 48° and the 1st ray plantarflexed in relation to the rest of the foot by 10°. The transverse axis of motion of the 1st metatarsophalangeal joint (T.A.) has shifted to allow the proximal phalanx of the hallux to glide to the dorsum of the 1st metatarsal head.

Fig. 1-96
FIGURE 1-97 This figure shows the relationship of the trunk and entire lower extremity which is approximated during final propulsion.

Fig. 1-97

FIGURES 1-94, 1-95, 1-96, and 1-97 The hallux is only able to dorsiflex approximately 20° to 25° from the ground when the foot is bearing full weight on the forefoot and heel. Because of the declination angle of the 1st metatarsal, this represents a somewhat greater range of motion of dorsiflexion relative to the metatarsal itself. Further dorsiflexion of the hallux beyond 20° to 25° is required during propulsion. Before final toe off, the hallux must be able to dorsiflex approximately 75° relative to the 1st metatarsal. To achieve the full range of dorsiflexion at the 1st metatarsophalangeal joint, the base of the proximal phalanx of the hallux must move to the dorsal anterior surface on the head of the 1st metatarsal. This type of gliding motion requires a shifting of the transverse axis of the 1st metatarsophalangeal joint. As the heel lifts and the 1st ray plantarflexes with propulsion, the transverse axis of the 1st metatarsophalangeal joint shifts in a dorsal posterior direction, allowing the base of the proximal phalanx to rotate further onto the dorsum of the 1st metatarsal head. The full range of dorsiflexion of the hallux cannot be achieved without plantarflexion of the 1st metatarsal. As the 1st metatarsal plantarflexes, the 1st metatarsal head glides posteriorly upon the sesamoids in order to move the head of the 1st metatarsal to its new position with the base of the hallux, which is being stabilized against the ground.
Gait Analysis

Heel contact
Midstance
Propulsion
Swing Phase
FIGURE 6-2 The stance phase of gait is divided into three periods. The contact period starts at heel strike (H.S.) and terminates with forefoot loading (F.F.L.). At the end of the contact period, all metatarsals are bearing weight. The midstance period is that period of stance in which the entire foot is making ground contact and is bearing the full weight of the body. The midstance period starts with forefoot loading and terminates with heel lift (H.L.). The propulsive period is initiated with heel lift and terminates with toe off (T.O.).
FIGURE 6-31 During the clinical observation of gait, the relative position of the two feet during the gait cycle is valuable in determining what stage of the gait cycle either foot is in. At the time of heel strike with one foot, the opposite foot should be approaching the midpropulsive period. At the time of toe off of one foot, the opposite foot should be in the late contact period. While one foot is in the swing phase of gait, the opposite foot is in the stance phase of gait. The stance phases of the right and left foot overlap in such a way that one foot is bearing weight in late propulsion while the opposite foot is bearing weight in the early contact period. During this overlap of the stance phases of gait, the transmission of weight from one foot to the other is accomplished smoothly.
FIGURE 6-3 Weight reception by the foot during locomotion was studied by Schwartz and Heath. Sensors placed in positions under the heel, selected metatarsal heads, and the hallux demonstrated the above sequential loading and relative proportion of weight reception by each area studied. All metatarsal heads reach a fully loaded plateau at the time subtalar joint pronation ends and supination begins. These important events mark the end of the contact period and the beginning of the midstance period. Weight reception by the forefoot does not significantly increase again until late in the midstance period.

After heel lift, the metatarsus unloads from lateral to medial. The 5th metatarsal becomes non-weight bearing immediately after heel lift. The 3rd and undoubtedly the 2nd metatarsals bear the most weight during propulsion but begin to unload as weight transfers to the hallux. It is logical to conclude that the 2nd metatarsal develops a greater and slightly later peak load than the 3rd metatarsal. Loss of stability by the hallux, for any reason, transfers a greater propulsive load to the 2nd and 3rd metatarsals, and they must bear the excessive load throughout propulsion. Normal weight reception by the 1st metatarsal head throughout locomotion is minimal.

FIGURE 6-4 Vertical ground reaction force acting upon the foot peaks twice during the stance phase of gait. This force peaks first at the end of the contact period and again during propulsion. At these peak periods, the force of vertical ground reaction exceeds a force equivalent to body weight. During the midstance period, vertical ground reaction decreases to less than the force of body weight.
Figure 6-5  Sagittal plane motion of the segments of the lower extremity.

After heel strike, the hip begins to extend. Simultaneously the knee flexes, the ankle plantarflexes, and the subtalar joint pronates. Later in the contact period, after the forefoot makes ground contact, the ankle begins to dorsiflex, and then the knee begins to extend at the end of the contact period. Throughout the midstance period, the hip and knee extend, the ankle dorsiflexes, and the subtalar supinates. To initiate propulsion, the knee flexes, and the foot then rapidly plantarflexes at the ankle joint as the heel lifts. In the late propulsive period, the hip begins to flex. The subtalar joint continues to supinate throughout propulsion. Just as toe off occurs, the subtalar joint begins to pronate again.

During the early stage of the swing phase, the hip and knee continue to flex, the ankle momentarily continues to plantarflex, and the foot continues to pronate. During the later part of swing phase, the hip is relatively inactive, and the knee extends rapidly to nearly full extension in anticipation of heel strike. The ankle dorsiflexes in late swing phase, and the foot supinates just prior to heel strike.

At heel strike, shock absorption is accomplished by subtalar joint pronation, ankle plantarflexion, and knee flexion. Abnormal loss of any of these motions at heel strike will result in the shock of heel strike being transmitted up the extremity to the lumbar spine.
FIGURE 6-6 Transverse plane motion of the segments of the lower extremity.

The entire lower extremity rotates internally, pronating the foot during the contact period of stance phase. During the midstance and propulsive periods of stance phase, the lower extremity externally rotates, and the foot supinates. Early in the swing phase, the extremity reverses direction and rotates internally throughout the remainder of the swing phase. During the swing phase of gait, motion at the subtalar joint is independent of transverse leg rotation because the foot is non-weight bearing. During the stance phase, however, a closed chain state is developed at the subtalar joint as the foot bears weight. Therefore, any transverse leg rotation produces subtalar joint motion. Internal leg rotation produces pronation, and external leg rotation produces supination.

The amount of transverse rotation for each segment of the lower extremity becomes greater distally. The total amount of transverse motion of the tibia is more than twice that of the pelvis.
Phasic muscle activity
Manufacturing

Reducing production errors from 27% (plaster) to < 1% by eliminating error points in the diagnosis to production through 3D Weight Bearing Kinematic Imaging
Manufacturing

- Products all hand made
  1. Fully Guaranteed Quality
- Thermo-pressed or Milled
- Made from Static & Dynamic Data
  1. Greater accuracy – Less Error
- Technicians see what you see
  1. Motion Analysis
  2. Pressure Analysis
  3. Mass Displacement Analysis
  4. Body Balance
  5. True 3D Plantar Surfacing
- Biomechanical Consultants monitor quality and are available for case discussions.
Errors in Plaster, Foam Box, Laser and Pin Impressions methods

1. Improper diagnosis or alignment of subtalar and midtarsal Joints.
2. No understanding of functional pathomechanics
   1. Example 1st Ray function
3. Slipper cast too thin and vulnerable to distortions
4. Negative cast not dry enough upon removal = distortion
5. Patient movement = distortion
6. Improper protection when shipping – cast distortion due to crushing.
7. Improper calcaneal vertical balancing by technician
8. Positive fill too wet leading to collapse of negative cast
9. Improper arch fill
10. Improper heating of thermoplastic in convection oven.
11. Poor negative suctioning leading to plastic gapping.
12. Improper subtalar and midtarsal posting corrections
13. Errors or lack of information in prescription ordering.
14. Grinding errors
Determining Neutral Joint Positions a Better Way

We believe neutral joint castings are prone to just too many errors.

There are approximately 27 error points that have been identified when making Orthotics from plaster negative slipper casts.

Since 1995, 3DO technology evolved after attempting to find better ways to manufacture Orthotics with fewer errors. The conclusion was to make a stable 3D Weight Bearing Kinematic Analysis Solution which would be portable, durable, and affordable and would provide a stable and reliable and reproducible data capture foundation. This is by capturing the foot in a reproducible static stance position (relaxed calcaneal stance – fully pronated). We then re-align forefoot to rearfoot positioning into a neutral position by evaluating static stance positioning and dynamic gait analysis using body mass displacement, 1st Ray function, body balancing, motion analysis and gait analysis to provide information which indicates how to structurally supports the foot in neutral closed kinetic chain functional alignment.

We simply do it using digital data. . . The more information we have, the better job technicians can do. We “see what you see”. . . Casts do not.
- **Evaluate Gait Cycle Events**
  - Heel Contact
    - Equinus events
  - Midstance
    - Prolonged = Increased pronation
  - Propulsion
    - 1st Ray function
    - Hallux stability and function
    - Digital function
- **Evaluate Mass Displacement Curves**
  - Evaluated against published norms
  - Quality of lateral mass displacement at heel contact.
  - Medial migration to 1st Ray
    - Transfer from midstance into propulsive phase of gait
- **Motion Analysis**
  - Millisecond values in Gait Events
  - Visual frame by frame analysis of all gait cycle events
- **Pressure Analysis**
  - Peak pressures of Calcaneous
  - Peak pressures of plantar metatarsal heads
- **Body Balance Analysis**
  - Anterior, posterior, lateral or medial balance issues.
- **3D Plantar Surfacing**
  - High resolution 3D graphics sees plantar defects (fibromas, tylomas etc..)
Thermoplastic Quality

- Plastic memory (integrity) is paramount in maintaining anatomical correction.
- Plastic molecular flow strength maximized in suction thermoforming process.

- Best
  - Heat thermo-pressed
    - Hand molded
- CNC Milling
  - Moderate memory
- Injection molding
  - Poor memory*
Hand made quality

Manufacturing

Its a dirty job...
Digital 3D Custom Manufacturing

- Error points eliminated as seen in older methods of manufacturing.
  - No plaster casts
  - No positive casts
  - No vertical balancing
  - No shipping or damage to casts
  - No thermo-pressing from plaster mold.
- Eliminates manual “art” associated with plaster balancing.

- 3D digital files have computed subtalar to midtarsal joint alignment (intelligent software)
- Additional data no available in plaster, laser or pin driven 3D imaging.
  - Mass Displacement Analysis
  - Motion Analysis
  - Pressure Analysis
    - Linear and Sheer Pressure
  - Body balancing (all 3 planes)
  - Symmetry
  - 3D Plantar Geometry
    - Shape technology
  - Gait Analysis
- Technicians can see everything the doctor sees.
  - Lab imaging software
Other benefits

- Ability to port to CNC Milling or Thermo pressed corrective shells
- Computed digital correction must match a defined Orthotic shell exactly.
- Evaluation of “Equinus” influences.
- Ability to see complex sheer forces important in diabetic foot care.
- User friendly operation and ordering reduces production errors.
Three independent methods of confirming adequate data acquisition

1. Software Calculations based on the analysis of:
   - Mass Displacement
   - Motion Analysis
   - Pressure Analysis
   - Body Balance
   - 3D Geometry
   - Symmetry
   - Gait Analysis
2. Calculations of weight bearing pixel data (Z Axis)
3. Visual Examination of weight bearing and dynamic imaging.
- 3D Data Z Axis
- Gait Analysis Graphs
- Milling Pathways (CAD Files)
- Frame Grabber (Production Software)
- Biomechanical Interpretation
- Diagnostic Software
- Physician Consultants monitor data and production

![Graph of Left Foot Pressure](image)

*Graph showing pressure distribution over the gait cycle.*
Anatomy Quadrants (4) – Vital to understanding of foot function and Orthotic Control

Medial Column
Forefoot
- Vital 1st Ray function occurs in this quadrant from midstance throughout propulsion.
- Critical to midstance and propulsive phases of gait.
- Orthotic control is vital.

Rearfoot
- When there is activity here it usually denotes pathology, (Rearfoot valgus or pronation)
- Instability
- Usually uncompensated Rearfoot pathomechanics

Lateral Column
Forefoot
- When there is activity here it usually denotes pathology
- Forefoot inversion
- Hallux Limitus
- Antalgic gait
- Cavus rigidity (uncompensated)

Rearfoot
- Vital area of heel contact
- Mass should displace laterally which represents inverted position of Rearfoot
- Critical in subtalar locking (lateral mass migration)
- Mass should migrate along the body of the lateral plantar calcaneous to the cuboid
  - At this point the Midtarsal joint locks
  - Peroneus Longus fires and 1st Ray plantarflexes
  - Foot resupinates into propulsion.
### Reports

#### Quick Report

<table>
<thead>
<tr>
<th>Static Analysis</th>
<th></th>
<th>Dynamic Motion Analysis</th>
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<tbody>
<tr>
<td><strong>Weight Distribution Analysis</strong></td>
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<td><strong>Dynamic Gait Balance</strong></td>
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<tr>
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<td>Score:</td>
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<tr>
<td>Right Percentage:</td>
<td></td>
<td>Actual</td>
<td>Normal</td>
</tr>
<tr>
<td>Difference:</td>
<td></td>
<td>Left:</td>
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</tr>
<tr>
<td>Score:</td>
<td></td>
<td>Right:</td>
<td>33%</td>
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<td><strong>Areas of High Pressure</strong></td>
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<td>Midstance:</td>
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<td></td>
<td>Left:</td>
<td>35%</td>
</tr>
<tr>
<td>Right Red Percentage:</td>
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<tr>
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<td><strong>Body Balance</strong></td>
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<td>Right:</td>
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<td>Left Percentage Out of Area:</td>
<td></td>
<td>Total:</td>
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<td>Right Percentage Out of Area:</td>
<td></td>
<td>Score:</td>
<td>4 - Severe</td>
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<tr>
<td>Bottom Percentage Out of Area:</td>
<td></td>
<td><strong>Gait Symmetry</strong></td>
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<td>Total:</td>
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<td>Difference:</td>
<td>25%</td>
</tr>
<tr>
<td>Score:</td>
<td>20 - Normal</td>
<td>Score:</td>
<td>5 - Severe</td>
</tr>
</tbody>
</table>

Total: 61 - Moderate Abnormalities
Full Report

- Provides a printable outcome measurement assessment for:
  1. Medical Records
  2. Insurance company claims and proof of medical necessity
  3. Patient records
  4. 2nd Opinions
  5. Marketing new patients
  6. Building referrals
  7. Medical Legal protection
Dynamic Analysis (Walking) Dynamic Mass Displacement

This test compares your dynamic mass displacement pattern to normal and determines the extent of differences. This provides insight into how your feet and body perform while in motion by looking at the mass displacement (weight), motion (velocitv of motion), migratory pressure analysis (how your weight and pressure transfers throughout the foot) and plantar surface (pressure on the bottom of your foot). Abnormalities may result in stretched ligaments flattening of the arch, poor mechanical function causing many potential issues from the foot through the spine.

Dynamic Gait Analysis

<table>
<thead>
<tr>
<th></th>
<th>LEFT</th>
<th>RIGHT</th>
<th>NORM</th>
<th>DIFF</th>
<th>SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heel Contact</td>
<td>30%</td>
<td>62%</td>
<td>27%</td>
<td>47%</td>
<td>9 out of 25 Severe</td>
</tr>
<tr>
<td>Midstance</td>
<td>36%</td>
<td>38%</td>
<td>40%</td>
<td>6%</td>
<td></td>
</tr>
<tr>
<td>Propulsive</td>
<td>25%</td>
<td>0%</td>
<td>33%</td>
<td>41%</td>
<td></td>
</tr>
</tbody>
</table>

An analysis by the 3DO image scanner is capable of measuring each phase of your gait (walk). The phases of gait are divided into 3 distinct functions.

Heel Contact Phase (27%): This represents the position of the heel as it contacts the ground. Heel positioning is critical to foot mechanics as it acts as a shock absorber. Abnormal contact position may represent condition(s) that cause both foot and limb problems. Examples include: Heel pain caused by heel spurs, bursitis and inflammation, arch pain (Plantar Fasciitis), lower leg rotational conditions that cause knee problems, Sciatica – Hip bursitis – Liggament Pain – Neck, upper, mid and lower back pain. Any and all of these possible mechanical problems can result from abnormal rear foot position.

Midstance Phase (40%): This phase of the gait cycle is a critical area of the walking cycle. During this phase the entire foot is in contact with the floor surface. The foot is changing from a shock absorber to a weight bearing stabilizer. If the normal rearfoot to midfoot joint locking does not occur, then excessive motion (pronation and instability) occurs. When this condition is present, the arch collapses (pronates) and causes the foot to abnormal motions in all three body planes. This condition may be responsible for a variety of biomechanical problems within the foot and weight bearing skeletal structure (ankle-leg-knee-pelvis-spiina-head).

Propulsive Phase (33%): The propulsive phase of gait is critical as it provides the function of propulsion (pushing off) of your body when walking. The 1st Ray (big toe) stabilizes weight transfer. Hypomobility (excessive motion and instability) lead to accelerated pronation and abnormal weight transfer from the lassar metatarsal heads (other toes). Abnormal condition may cause or lead to poor balance while walking, stumbling, poor performance in running, tennis, golf and other athletics.

Gait Symmetry

<table>
<thead>
<tr>
<th></th>
<th>% DIFF</th>
<th>SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>50%</td>
<td>4 out of 10 Severe</td>
</tr>
</tbody>
</table>

Your scan compares your phases of gait of each foot to each other and calculates the percentage difference in symmetry. Symmetry (equal) in your gait is a very significant indication of your overall foot and body balance. Large differences in symmetry may produce significantly greater stress on one side of your body resulting in pain syndromes and degenerative joint disease (arthritis).
Orthotic Comparisons

Bio-Engineered – Medical Grade Corrective Orthotics Using 3DO (Best)

- Requires 3D impression and proper diagnosis
  - Mass analysis – motion analysis – Pressure analysis (linear and sheer pressure)
  - Body balance analysis – symmetry – 3D geometry (static and dynamic).

- Stabilizes and effects load bearing joints of the body at the highest level attainable by controlling all three body planes.
  - Provides maximum frontal plane correction (alignment) of Subtalar and Midtarsal Joints.

- Uses Rearfoot Posting and pelvic balancing which encourages proper mass migration. This influences and improves wedge locking of STJ/MTJ and levels short leg syndromes.

- Maximizes 1st Ray function to reduce pronatory forces which leads to excessive transverse plane limb pathomechanics.

- Uses the highest memory thermoplastic to ensure correction by repetitive weight loading.

- Technicians are able to analyze static and dynamic data as seen on 3DO client server (doctors office), thereby ensuring best correction.
Orthotics by negative casting, foam box and 3D Laser Imaging
- Dependent on negative casting technique which is prone to error
- Static analysis only – No dynamic assessment of foot / limb function

Accommodative Orthotics (Moderate Control)
- Reduce plantar pressures and provide moderate support
- Good for elderly and hypersensitive feet
  - Example Amfit Orthotics

Pre-Fabricated Insoles (Poor Control)
- Work on premise all feet work the same. Many times they are referred to as Orthotics.
- Made of shock absorbing materials to reduce impact shock loading but do not provide correction.
Orthotic Efficacy

Orthotic efficacy is dependent on many factors. The better the diagnostic quality and manufacturing criteria, the more likely the Orthotic will be able to have more effect on complex load bearing joints.

The most critical flaw, is the quality of the 3D impression of the foot, followed by errors in balancing and positive mold alterations by the technician. If the frontal, sagittal and transverse plane deformities are not accurately acquired and if there is error in the manufacturing process then errors occur leading to less than expected outcomes. Using intelligent imaging software to reduce human error in the 3D imaging and manufacturing, maximizes biomechanical control.
Thermo-pressed Orthotics

- Best quality available
- Hand made
- Thermo-pressed for maximum memory
- Fully guaranteed 100% patient satisfaction
- 48 – 72 Hour Production

Orthotics (25 types)
- Walking/Running (linear movement)
- Rotational Sports (transverse movement)
- Work boots
- Diabetic / Hypersensitive Foot
- Style (Oxford & Pump)
- Oxford Tie Shoe
- Skiing / Snowboarding
- Ice Hockey / Inline skating
- UCBL
- Accommodative
- Major Sports
CNC Milling

- 3DO ports to CAM software for 3 Axis Milling through production software.
- Problem is plastic memory is not as good as thermo-pressed.
- Cost of production is higher
- Higher cost of maintaining machinery.
Injection Molding

- Historically plastic has poor memory and bottoms out quickly.
- Expensive up front cost but lower orthotic shell cost.
- Difficulty in adjusting or modifying orthotic shells.
- Requires special skills to manage machinery.
Common Questions Asked

How do you image the apex of a high arch in a rigid cavus foot if the calibrated conductive foam does not approximate the highest part of the arch?

Generally the area being discussed here is at the most medial apex of the medial midfoot arch (Midtarsal Joints). Since we are talking about a very small area, without using deeper foam, we developed a method for converging all plantar data points (data axis interpolation). We migrate these data points to define the apex with a high degree of accuracy.

What can I do to image a patient with a wide angle and base of gait on the imaging media (pad)?

Have them stand along the width of the media. Please understand that mass displacement and balance will be incorrect since our default imaging is along the long axis of the media pad. In a future version of software we are planning to give you the option of scanning in either the long axis or width axis.

What can I do if the patient can not walk across the imaging media?

Capture the Static only. When it comes to the dynamic gait, simply tap your foot on the media (pad) to cycle through the gait cycle. Make any appropriate notes to the technician in the Ordering Text Box.

How do I know if I acquired good images?

What you see is what you get. If they look bad on the monitor, they will also look bad to us as well.
Conclusion

• 3DO offers an affordable, portable and durable multipurpose 3D Imaging Solution that surpasses the competition.
  – Outcome measurement for education, medical legal protection, insurance verification.
  – Increase office efficiency by tasking what was done by the doctor to the medical staff.
  – Improve patient care while improving profits
  – Introduce Ergonomic (Integrated) Footwear to your patients
  – Internet compatible (e-commerce) with encrypted security

• All products fully guaranteed. . .
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