ATHLETIC FOOTWEAR
Advantages, Anatomy, & Important Features

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1) Advantages of Using Footwear
   a) Protect the Plantar Surface of the Foot
   b) Provide Traction
   c) Provide Motion Control
      i) Heel Stabilization
      ii) Midfoot Support
   d) Cushioning
      i) Attenuation of Impact Forces

2) Shoe Anatomy
   i) UPPER
      (1) Vamp
      (2) Quarter Panels
         a) Usually leather for Dress and Casual shoes
         b) Combination of nylon and suede for Athletic
   ii) LOWER
      (1) Outsole
         a) Leather commonly used for Dress shoes
         b) Foam materials used for midsole with Casual and Athletic
            i) Rubberized outsoles for Athletic
   iii) Sockliner (or insole)
      (1) Used with all three categories of footwear
      (2) Functions
         a) Decrease friction between the sock and the shoe
         b) Absorb moisture
         c) Decrease pressures acting on the plantar surface of the foot by increasing surface area
      (3) Thickness ranges from 3 to 5 millimeters

3) IMPORTANT SHOE FEATURES FOR THE CLINICIAN TO CONSIDER WHEN ADVISING THE PATIENT/CLIENT!
   a) Motion Control
      i) All footwear designed to provide some degree of motion control
         (1) Counter is primary feature
            a) Component of the Quarter Panels of the UPPER
            b) Acts to stabilize the calcaneus and restrict rearfoot or tarsal mechanism movement
      ii) Athletic shoes provide an enhanced level of motion control
         (a) As a result of early anecdotal literature
      iii) Shoe features designed to provide motion control
         (a) Heel Counter
            b) A plastic cup within the rear of the shoe that encircles the calcaneus
(c) Counter covered by suede in an athletic shoe - termed the “foxing”
(2) Rearfoot Stabilizer
   (a) Reinforcement at the junction between the counter and the midsole
      (i) Accomplished by extending the sides of the molded insole or using a separate plastic piece.
iv) **To provide complete motion control**, it is critical to limit the amount and rate of foot pronation in both the rearfoot and midfoot, which requires both:
   (1) Rearfoot stabilization features
   (2) High lacing pattern with proper shoe fit, especially in the midfoot region
v) Other Techniques used by the athletic shoe industry to provide motion control:
   (1) Use of midsole density variations (DUO-DENSITY MIDSOLE) in an attempt to control foot motion, primarily rearfoot pronation.
   (2) Use of last sculpting as a method to provide increased support to the midfoot region
      (a) This feature can dramatically increase the fit in the midfoot region
      (b) Sculpting of the last, unfortunately, narrows the last bottom in the midfoot region and thus, a patient’s foot orthoses may not seat properly within the shoe.

**b) CUSHIONING**
   i) The function of the midsole is to provide cushioning by acting as a protective layer between the foot and the ground that 1) attenuates the shock of impact and 2) reduces the magnitude of localized pressure peaks by distributing the forces over a larger area of plantar surface.
   ii) Why is cushioning important?
      (a) During walking, the magnitude of the ground reaction resultant force acting on the body is approximately 1.25 times body weight. While running, the resultant force can reach levels as high as 2 to 3 times body weight in experienced runners.
   iii) Materials used in Midsole construction
      (a) Dress shoes
         (i) Leather outsole with heel piece
      (b) Athletic and Casual shoes
         (i) Foam materials
            1. Ethylene Vinyl Acetate (EVA)
            2. Polyurethane (PU)
         (ii) Athletic shoe enhancements: Gas, Gel, & Fluid
      (c) How do midsoles provide cushioning or energy transformation?
         (i) At impact, the pressure of the foot compresses the midsole and these forces acting on the midsole do work against the viscoelastic material. Some of the work becomes strain energy that is stored in the elastically deformed material while the remainder of the work is dissipated as heat.
         (ii) When the load is removed, the material undergoes elastic recovery to its original shape. Thus, a portion of the stored strain energy is recovered in the form of work done by the midsole on the lower extremity/foot and the remainder of the strain energy is dissipated as heat secondary to the viscous resistance to recovery.
iv) Do athletic shoe enhancements have a significant effect on cushioning properties of shoe?
   (1) The answer would appear to be no!
      (a) In a study on 6 female runners using an accelerometer to estimate the forces acting
          the lower extremity during walking and running
      (b) The results for 3 different shoes with various midsole combinations (air/foam,
          gel/foam, or foam-only) indicated no difference in any of the midsole materials
          tested.

v) When does the amount of cushioning provided by the shoe begin to diminish (the
    durability of the midsole) or when is it time to buy a new pair of shoes?
   (1) The amount of activity effects both the degree of cushioning provided by the midsole as
       well as the durability of the midsole material
   (a) Day-to-Day Effect
      (i) The daily effect of running on the amount of midsole cushioning provided by the
          shoe.
      (ii) Secondary to heat build-up within the midsole, the midsole can lose 25% to 30%
           of its cushioning properties during a three (3) mile run.
   (b) Long-Term Effect
      (i) The effect of activity on the durability or life of the midsole
      (ii) The daily effects of heat build-up within the midsole causes the foam material
           and enhancements to eventually denature leading to a reduction in the resiliency
           of the midsole material.
           1. Similar to a shock absorber designed for an automobile, with repeated use the
              springs within the shock absorber lose their resiliency secondary to heat
              build-up. Heat build-up causes the metal to denature, thus reducing their
              effectiveness to absorb energy. How fast this denaturing process occurs is
              based multiple factors including; the number of miles the car is driven, the
              terrain it is driven over, as well as the loads carried.
      (iii) The durability of the midsole material will depend on a multitude of factors,
           including:
           1. The weight of the user
           2. How often the shoes are used
           3. The number of miles or hours of activity that the shoes are worn daily,
           4. The type of activity that the shoes are used for (ie; walking, running,
              aerobics, etc.)
           5. The types of external surfaces that the shoes are used on
   (iv) Approximate guidelines for long-term midsole durability
       1. Values below are estimates for a loss of 50% of the cushioning properties of
          the midsole based on a 150 lb. runner averaging a 7.0 mph pace:
          a. EVA or PU will provide 400 to 450 miles
             a) Air/PU combination will provide a 850 to 900 miles

6) Footwear Recommendations
   a) Pronatory or Excessive Mobility Foot Type
      i) Stabilization of the rearfoot and midfoot
         (1) A firm counter -rearfoot stabilizer with a snug heel fit
         (2) Midfoot control using high lacing pattern with proper amount of midfoot snugness
      ii) Duo-Density midsole
         (1) Must use enhanced sock liner or foot orthosis to extend the effect of the duo-density
             midsole to the foot
      iii) True arch bandage or all leather upper, if severe pronator
          (1) Casual shoe
(2) If Athletic shoe, then consider cross-trainer or aerobic style shoes
b) Supinatory or Excessive Stability Foot Type
   (1) Midsole cushioning
   (2) Use of enhanced sock liner or foot orthoses
       (a) Increase the contact area between the foot and the floor of the shoe
       (b) Provide enhanced cushioning through plantar pressure reduction