



# PROSTHETIC FEET

OVER THE PAST DECADE, OPTIONS IN PROSTHETIC FEET HAVE EXPANDED TO MORE THAN 50 DIFFERENT MODELS. TODAY, AMPUTEES HAVE A WIDE ARRAY OF FEET TO CHOOSE FROM, DESIGNED FOR WALKING, DANCING, CYCLING, GOLFING, SWIMMING, SNOW SKIING AND RUNNING. HEAVIER WOOD AND STEEL MATERIALS HAVE BEEN REPLACED BY LIGHTWEIGHT PLASTICS, AEROSPACE ALLOYS AND CARBON-FIBER COMPOSITES. MUCH LIKE THE HUMAN FOOT, MANY OF TODAY'S PROSTHETIC FEET CAN STORE AND RETURN SOME OF THE ENERGY GENERATED DURING WALKING. OTHER KEY ATTRIBUTES INCLUDE TOE AND HEEL SPRINGS THAT ALLOW MORE NATURAL MOVEMENT AT THE ANKLE, SHOCK ABSORPTION, MULTIAXIAL ROTATION, ADJUSTABLE HEEL HEIGHTS AND WATERPROOF MATERIALS.

**H**ow can you select the right foot for your lifestyle? A number of factors must be considered, including your amputation level, age, weight, foot size, activity level and occupational needs.

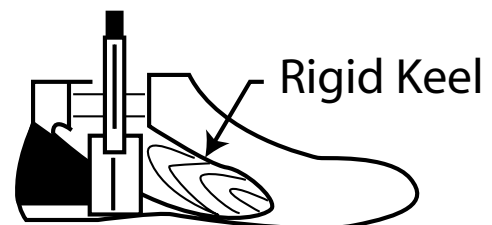
Structurally, prosthetic feet can be divided into two groups: those with a rigid connection to the prosthetic shank (nonarticulated) and those with a hinged ankle mechanism (articulated). In terms of function, prosthetic feet can be categorized in the following groups:

- SACH
- Elastic (flexible) keel
- Single-axis
- Multiaxis
- Dynamic-response.

**SACH and Elastic Keel Feet.** The most basic prosthetic feet come in two types: Solid Ankle Cushioned Heel (SACH) and elastic keel configurations. These designs consist of crepe neoprene or urethane foam molded over an inner keel and shaped to resemble a human foot. Because they have no hinged parts, these

basic feet are inexpensive, durable and virtually maintenance-free. These feet offer cushioning and energy absorption but do not store and return the same amount of energy as dynamic-response feet do. SACH and elastic keel feet are designed for amputees who do a limited amount of walking with little variation in speed. They are used most often on a first or preparatory prosthesis and are often later replaced by a more dynamic type of foot.

The SACH is the simplest type of nonarticulated foot. The name refers to a rubber heel wedge that provides a minimal amount of ankle action by compressing under load during the early part of the stance phase of walking. The keel is rigid, which provides midstance stability but little lateral movement. The SACH is available in various heel heights so it may be worn with different shoes.



Elastic (flexible) keel feet allow motion similar to that of SACH feet. In addition, they allow the forefoot to conform to uneven terrain but still remain stiff and stable during standing and walking.

Articulated prosthetic feet may be single-axis or multiaxis in their design. "Axis" refers to motion in one or more of three different planes, similar to the movement of the natural foot:

**Internal and external rotation** — The clockwise and counterclockwise rotations of the leg while the foot is in contact with the ground.

**Inversion and eversion** — The inward and outward (side to side) motions of the ankle and leg while walking.

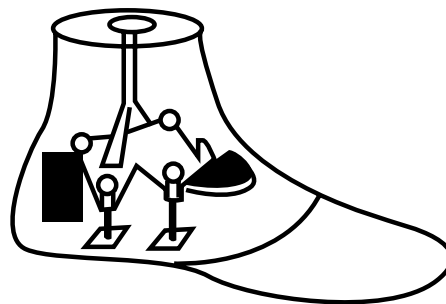
**Dorsiflexion and plantarflexion** — The up and down movements at the ankle that enable the leg to move forward over the foot, pushing the forefoot to the ground.

Prosthetic feet that have movement in two or three axes provide increased mobility at the ankle, which helps accommodate uneven surfaces.

**Single-Axis Feet.** The articulated single-axis foot contains an ankle joint that allows the foot to move up and down, enhancing knee stability. The more quickly the full sole of the foot is in contact with the ground, the more stable the prosthesis becomes. This is beneficial for users with higher levels of amputation, from the knee to the hip. The wearer must actively control the prosthesis to prevent the knee from

buckling, and the single-axis ankle-foot mechanism reduces the effort required. Unfortunately, the single-axis ankle adds weight to the prosthesis, requires periodic servicing and is slightly more expensive than the most basic SACH foot. For these reasons, it is most appropriate for individuals whose major concern is stability.

**Multiaxis Feet.** Although similar to the single-axis in terms of weight, durability and cost, the multiaxis foot conforms better to uneven surfaces. In addition to the up and down mobility of the single-axis, the multiaxis foot can also move from side to side. Since the added ankle motion absorbs some of the stresses of walking, this helps protect both the skin and the prosthesis from wear and tear. It has been particularly well-received by hikers, golfers, dancers and others who need significant mobility for their work or recreational needs.

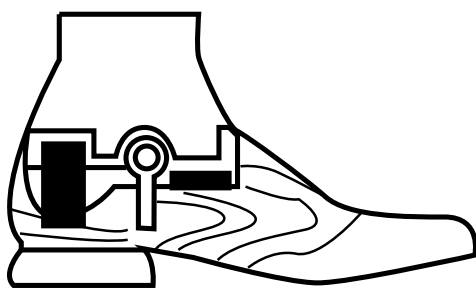


Multiaxis Foot

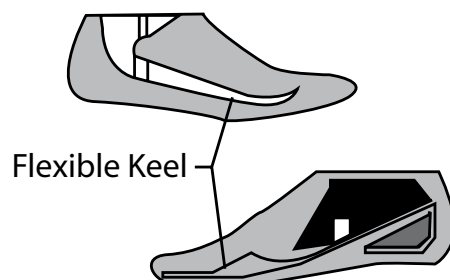
**Dynamic-Response Feet.** People with more active lifestyles typically prefer these more responsive feet. They are ideal for amputees who can vary their walking speed, change direction quickly

or walk long distances. Dynamic-response feet store and release energy during the walking cycle. They provide a subjective sense of push-off for the wearer, a more normal range of motion and a more symmetric gait. Some dynamic-response feet feature a split-toe design that further increases stability by mimicking the inversion/eversion axis of the human ankle and foot. The comfort and responsiveness of a dynamic foot can also encourage an individual to advance from a minimal activity level to a moderate activity level. Further, some have been shown to reduce impact on the heel of a sound foot.

Just as there is no single tool that is perfect for every job, there is no single foot that is perfect for every amputee. Knowing your options will enable you to discuss this issue clearly with your prosthetist. Evaluate the pros and cons of different feet so you can make the best choice for your individual aspirations and abilities.



Single Axis



Two Types of Dynamic-Response Feet

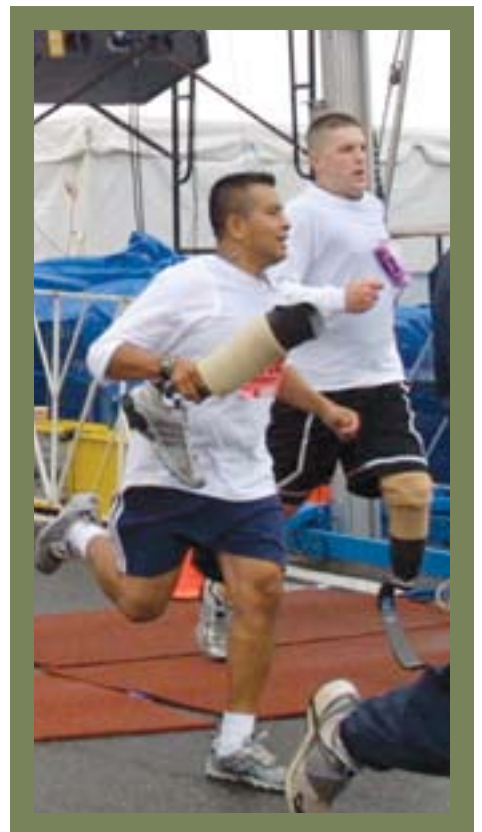


Photo by Spc. Lorie Jewell