Tel.: 1 877 622-2472
Fax: 1 855 860-5595
info@waramps.ca

Prosthetic Knees for Adults

There are many prosthetic knees on the market to suit the different needs of amputees. The type of knee chosen will depend on a number of factors, including age, height, weight, level of amputation and activity level of the amputee.

Amputees often think the "best" knee for them is the most advanced and expensive one. That is not usually the case when all of the above factors are taken into consideration.

When you compare knees, there are three main questions to ask – is the basic structure a single axis or polycentric design? Is there any stance control provided by a friction brake feature or a manual locking feature? And is the swing phase control a basic single-speed mechanical type or a pneumatic or hydraulic one?

Learning more about the different types of knees available will enable you to confidently discuss the different options with your prosthetist. It is important to let your prosthetist know what types of activities you would like to take part in while using your prosthesis.

Most knees are made up of a combination of the features listed below. For example, a polycentric structure with a hydraulic control. When two or more features of different basic designs are incorporated into one knee, the knee is usually referred to as a "hybrid" design.

Single Axis Knees

Single axis knees are the most basic of knees – they act like a door hinge that bends freely, and they do not have any stance control ("stance" is when you stand and put weight on the knee). They are low-cost, lightweight and relatively durable because of their simplicity. They are frequently used in prostheses for children as children are very energetic and outgrow their limbs quickly. Adults who do not live close to a prosthetic centre to provide upkeep for their prosthesis may prefer this knee because it is simple and reliable.

Single axis knees have a couple of limitations. Because the knees are free-swinging and do not have stance control, amputees must use their own muscle power to keep them safe and stable when standing on them. Young children who have tremendous energy do not seem to have a problem with this, but older adults might find it difficult to control the knee. In addition, as they are simple hinge-type joints, they can only be set up to walk optimally at one speed, but the reality for an amputee is that they walk at different speeds.

Ottobock 3R90 Single Axis Knee

The limitation of the one-speed swing phase can be addressed by adding pneumatic or hydraulic control units that allow for variable speed walking. The limitation of the lack of stance control can be addressed by locking knee or safety knee features.

Locking Knees

Some individuals do not have adequate control to manage a bending knee or good enough hip control to stabilize a single axis knee that does not have stance control. These individuals are, therefore, fitted with a manual-locking knee to provide the stability they

Ottobock 3R40 Locking Knee

need. A manual-locking knee can be locked to keep the leg straight when walking and, by the pull of a lever or cable, unlocked to bend the leg for sitting. There is some inherent danger in using a locked knee when walking – in the event of a fall, it is impossible to control the direction of your fall with a straight, locked leg. A locked knee also creates a stiff-legged gait, forcing the amputee to walk with a pronounced limp. Prosthetists consider a locked knee as a last resort, but when stability is a serious issue, a locked knee can be the only option that permits an amputee to walk.

Stance-Control "Safety" Knees

Stance-control knees, often called "safety knees," typically contain a weight-activated friction brake that stops the knee from bending. These knees swing freely when there is little or no weight on the prosthesis, but when weight is applied to the knee, they lock. Because the knee does include a single axis bending function, it is preferable to using a locked knee for walking.

Endolite Phoenix

They are appropriate for amputees who have some, but limited, control over their knee. For example, some amputees can control the prosthesis confidently for only a few steps and they tire quickly (such as an individual with a high level amputation who has weakness due to poor blood circulation). Stance-control knees provide safety if such an amputee mistakenly tries to step on a partially bent knee when walking: when they apply their weight to the partially bent knee, the brake will prevent the leg from collapsing underneath them.

The braking function does create drawbacks. In a natural walking gait, individuals start to flex their knees before taking their weight entirely off their leg to initiate a step, but this is not possible with this knee; it cannot be flexed at all with weight on it so a normal gait cannot be achieved. The braking feature also forces the amputee to walk slowly and take small steps.

Stance control are the knees of choice for certain amputees. They are frequently used for a new amputee's first prosthesis and are often replaced with a more functional alternative if the amputee's walking ability increases.

Polycentric Knees

Endolite 4-Bar Knee

Polycentric knees, often referred to as "four bar" knees, are the most mechanically complex design with multiple axes of rotation. They can be set up to be very stable during early stance phase, yet easy to flex to initiate the swing phase or to sit down.

Another feature of polycentric knees that amputees like is that because of the knee design, the leg's overall length shortens when a step is initiated. With the leg slightly shorter, there is less likelihood that the amputee will stub a toe on the floor as the leg swings through. Polycentric knees are suitable for a wide range of amputees, from those with the potential to be independent walkers in their homes and communities to more active walkers. Various versions of the knee are good choices for amputees who cannot walk securely with other knees, who have bilateral leg amputations, or who have long residual limbs or knee disarticulation amputations.

A standard polycentric knee will have a simple mechanical swing control that provides an optimal single walking speed. However, many polycentric knees incorporate a pneumatic or hydraulic unit to permit variable walking speeds.

Pneumatic or Hydraulic Knees

More active amputees will use a prosthetic knee with a pneumatic or hydraulic unit incorporated into a single axis or polycentric design.

These units are usually made up of pistons inside cylinders containing air (pneumatic) or fluid (hydraulic). They control the swing function of the knee, giving amputees the ability to increase or decrease their walking speed to walk comfortably. As the amputee speeds up, the valve in the cylinder closes up, gradually limiting the flow of air or fluid and thus limiting flexion. With limited flexion of the knee, the amputee can walk faster. The opposite occurs when the amputee slows down – the valve opens up, allowing the air or fluid to flow more easily and enabling the leg to flex more and swing forward more slowly to match the slower gait.

Pneumatic and hydraulic controls permit more natural gait patterns. Of the two, hydraulic systems tend to hold up better than pneumatics for the more highly active amputee. These controls are also used in computerized knees.

Microprocessor-Controlled Knees

Microprocessor-controlled knees (MPKs) use computer technology to enhance the function of basic mechanical knee designs, including single axis and pneumatic and hydraulic functions.

With the regular function of pneumatic and hydraulic units, the knee has to gradually increase or decrease its walking speed. You cannot instantly go from very slow to very fast and have the knee change from one extreme to another quickly. Computerized technology means these changes in speed can occur almost instantly, making the knee function more naturally.

Some MPKs use a computer-regulated valve to adjust the swing phase resistance of a pneumatic cylinder. Another design uses the computer to control swing phase function and stance phase stability. More advanced systems use multiple sensors to send messages about changes in walking back to the microchip 50 times per second.

MPKs create a more natural gait, with amputees reporting that they don't have to think about each step they take. Some of the knees currently on the market are Kenevo, C-Leg Compact, C-Leg, Genium and X3 from Ottobock; Rheo, Power Knee and Symbionic Leg from Össur; Orion and Smart IP from Endolite; Plié from Freedom Innovations; Hydracadence from Proteor; and Rel-K from Rizzoli Ortopedia. The drawback to this type of knee is its high cost.