

# What's New in Prosthetic Knees?



*The C-Leg by Otto Bock  
Health Care*

*Total Knee Small  
Wonder by Ossur*

*GeoFlex Knee by  
Ohio Willow Wood*

by Julie Wiest

Stairs coming up. Slow down. Bend knee and lift right leg to first stair. Lock right knee, bend left knee and lift leg to second stair. Uneven terrain ahead. Walk slowly and be careful not to fall. Try to avoid bumpy spot.

Imagine having to plan your every move like this. For people who have had a leg amputated above the knee, thinking and planning their every move may be essential to their mobility. Without biological knees, their bodies cannot think for them and compensate for their every move. They have to try to replace the functions of a biological knee with mechanical parts, and it quickly becomes clear that the way these parts function affects their gait, their ability to do certain activities, the ease with which they move around, and their safety.

Since every amputee is different and requires different accommodations for different needs, there are many options in knee prostheses. All prosthetic knees, however, are not created equal. Some are more dynamic, but not as safe; some are very durable, but not as dynamic; some require a high level of fitness to control; and, of course, some are more expensive than others. The choice between the many types of knees available is, therefore, not an easy one to make. The latest and most expensive knee is not necessarily the best choice for every amputee. When deciding what type of prosthetic knee is best, amputees need to consider a variety of factors, including their age, height, weight, activity level, length of amputation and mobility needs. In addition, they must consider the structure of the knee, its stance phase (the time that the

leg is on the ground and supporting the body) control and swing phase (the time the leg is off the ground and, perhaps, taking a step) control, and how its characteristics and features fit their lifestyle. Because of the wide variety of choices and consumer needs, prosthetists and rehabilitation specialists can help amputees choose the best prosthetic knees for their individual requirements. Moreover, they can teach amputees how to use their new knees properly, which is key in avoiding discomfort, stumbling and falling.

### Single-Axis Knees

Single-axis knees are the lightest and most durable prosthetic knees. This type of knee is ideal for children because of its durability and inexpensiveness, as children tend to outgrow their prostheses nearly every year. Most companies offer a variety of single-axis knees. Fillauer-Hosmer offers many single-axis knees with varying features, including friction and stabilizing sensitivity adjustments, weight-activated brakes and wear adjustments.

Though the most basic single-axis knee requires the most muscle power to operate and only allows users to walk at one speed, these problems can be reduced with fluid-controlled knees – either pneumatic or hydraulic – that automatically increase or decrease the swing phase resistance as the amputee changes walking speed. Otto Bock Company Group recently improved its single-axis 3R80 modular knee joint,



*The Endolite Turntable by Blatchford/Endolite*

which is fluid-controlled and has weight-activated stance phase stability. Ossur offers the Mauch hydraulic knee systems that have swing phase control, stance control and manual locking modes of operation in a variety of configurations, including the GaitMaster Low Profile, the GaitMaster Standard and the Mauch XG Graphite. The Mauch line's yielding stance phase control reduces the risk of falling and allows the amputee to descend stairs or ramps and sit more naturally.

Fillauer-Hosmer offers the Entegra Knee frame, which is compatible with most hydraulic knee control units, and the Entegra SV Knee, a smaller version of the Entegra Knee (measuring only 7 inches tall) and most suitable



*The Entegra SV Knee by Fillauer-Hosmer*

for smaller patients. Hitting the market this summer is Fillauer-Hosmer's miniature hydraulic swing phase control unit.

For the most stability, an amputee may choose a manual-lock knee, which is locked straight for walking and creates a limp. To unlock the knee for bending, a release lever



*Mauch VG Frame by Ossur*



*The Ultimate Knee by Jim Smith Sales, Inc.*



or cable is pulled. This can be awkward but may be the best option for the elderly or those with little muscle power or little hip control. Jim Smith Sales, Inc., offers the Ultimate Knee, a weight-activated hydraulic knee that is lightweight and durable; and, with minimal training, an amputee can use this knee as a manual-lock, stance-phase or yielding knee.

Fillauer-Hosmer offers the Single Axis Locking Knee, a manual-lock knee. Blatchford/Endolite offers the StanceFlex ESK, a stance-control knee with a manual-lock option that has a stance-flex feature with a weight-activated mechanism and a wide variety of swing-control options.

A stance-control knee swings more freely when little or no weight is applied, but has a weight-activated friction brake to stop knee motion when needed. This brake stops the knee from collapsing when weight is applied to a partially bent knee. Since this type of knee does not swing freely when there is much weight applied to it, the amputee with a stance-control knee must walk slowly and take small steps. Ohio Willow Wood's stabilized knee has weight-activated stance control, is fully adjustable, and has an extension assist design that features a quiet, stainless steel wave spring. Fillauer-Hosmer offers the Weight Activated Locking Knee and the Stabilized Pyramid Knee, both stance-control knees.

### Polycentric Knees

Polycentric knees provide stable stance control and more swing phase control than the friction brake stance-control knees. They are easier to flex when weight is applied during walking. The basic type of a polycentric knee is designed for a single walking speed, but amputees may opt for fluid swing phase controls that allow for multiple speeds of walking. Polycentric knees, however, contain parts that may need to be serviced or replaced more often than those of other types of prosthetic knees.

Blatchford/Endolite offers the Slim Profile 4-Bar Knee Disarticulation, which features smooth central alignment with friction for added security. The knee can be adjusted to suit various activity levels and offers pneumatic swing control for a natural gait or semi-automatic knee lock for the less-active amputee. Also offered by the company are the SERVO pneumatic swing phase control knee and the Stanceflex Uniaxial Knee Chassis (SFEUK), a hydraulic knee.

Fillauer-Hosmer offers the durable MightyMite Knee, designed for larger children and petite adults, which features gliding, non-locking, polycentric flexion and easy rotation adjustment, as well as a variety of proximal attachments and four extension bias options.

Ossur has four options within the Total Knee Geometric Locking System, as well as the latest addition to the Total Knee line,

TKO 1500, a more cost-effective knee for less active amputees that allows its user to initiate flexion while the foot is still on the ground. The knees are all based on a geometric design, with a locking system, that simulates true knee motion and has a variety of features for different activity and mobility levels, including a stance-flex feature that acts as a shock absorber. The Total Knee Small Wonder, a special knee designed for children, is two-thirds the size of the original Total Knee and comes in five colors.

Ohio Willow Wood recently made several adjustments and improvements to its GeoFlex knee, a friction-controlled, polycentric knee. In addition, it created the GeoLite knee, which is based on the design of the GeoFlex knee, but is shorter, lighter and does not offer stance flexion.

Different knees feature various options. Weight-activated brakes respond to the amount of weight applied to the prosthetic knee to prevent falling and provide more stability through ranges of resistance corresponding to varying applications of weight. Friction, sensitivity and yield (or



*The Total Knee Small Wonder by Ossur*



*GeoFlex Knee by Ohio Willow Wood*

yield speed) can be adjusted to resist motion when needed and to increase or decrease the knee's ability to respond to changes in weight application and gait speed. Adjustable extensions can be attuned to



*GeoLite Knee by Ohio Willow Wood*



*The Intelligent Prosthesis Plus by Blatchford/Endolite*

suit the needs of the amputee for bending movement of the knee that increases or decreases the angle between the residual limb and the prosthesis. Blatchford/Endolite offers the Endolite Turntable, an option that can be added to most Endolite knees and offers 360 degrees of rotation. It allows an amputee, among other things, to sit cross-legged, put on and tie shoes more easily, and get in and out of cars more easily.

### **Knees of the Future**

New technology is emerging, and computerized knees may be the future. These knees compensate for changes in walking speed and provide safety and comfort for their users. Amputees who use computerized knees have a more natural gait, can sit and stand with ease, can kneel and can walk on all types of terrain without worry. Prosthetic companies are rapidly developing new designs, and there will certainly be even more options in computerized prosthetic knees soon.

Blatchford/Endolite offers the Endolite Hi-Activity knee, which features a computer-aided design, and the Intelligent Prosthesis Plus, which is programmed to automatically adjust the swing of the knee to the amputee's walking speed to reduce walking effort and gait deviations. Newest to the company is the Adaptive System (not currently available in the United States but expected to be soon), a microprocessor-controlled knee that has both hydraulic and pneumatic chambers.

This knee senses changes in force and angle and adapts accordingly. It can be individually programmed for walking, ramps, stairs, standing and stumbling.

Otto Bock Company Group offers the C-Leg System, a microprocessor-controlled swing and stance hydraulic knee introduced to the United States in 1999 and, according to the company, the first and only of its kind. This knee-shin system is individualized for each amputee and automatically adapts to his or her movements by taking measurements and making valve adjustments 50 times per second. The C-Leg System is recommended for those with moderately active to active physical activity levels.

Ossur is currently developing a new knee in conjunction with the Massachusetts Institute of Technology (MIT) and Hugh Herr. It will feature a new rotary braking system, computer software and a sensor system that will process information about the user's gait pattern from 200 to 1,000 times per second and make adjustments accordingly. This knee is still in the development stage and not yet offered.

With constant new advancements in prostheses, soon amputees may never again

have to contemplate their every move. However, the best prosthetic knee for one amputee is not necessarily the best for every amputee, and the possibilities should be thoroughly researched to find the most suitable solution. ■

### **Companies mentioned in this article:**

Blatchford/Endolite  
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Fillauer-Hosmer  
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