What is osseointegration?
Osseointegration is derived from the Greek word *osteon*, which means bone, and the Latin *integrare*, to make whole.
In fact, osseointegration is an alternative method of attaching a prosthetic limb to an amputee’s body.

When was this attempted?
The first attempts at osseointegration were begun in Sweden in the late 1950s by Dr. P.I. Brånemark with dental applications. The technique was then applied to facial prostheses such as ears, noses and hearing aids, and subsequently for joint replacements in the hand and silicone prosthetic attachments for thumbs and fingers.
In the 1990s, Professor Rickard Brånemark’s team applied this technology to transfemoral amputees as well as upper-limb patients. Since that time, the Swedish team from the Sahlgrenska University Hospital and Integrum AB in Gothenburg have fitted approximately 200 amputees worldwide. Osseointegration is also performed in other parts of the world, including England, Germany and Australia.

How does it work?
Osseointegration consists of a two-stage surgical procedure. This is the most commonly used technique (OPRA: Osseointegrated Prosthesis for Rehabilitation of Amputees), which was originally developed by Brånemark.
In the first stage, a threaded titanium implant is inserted into the marrow space of the bone of the residual limb. The implant is called a “fixture.” This fixture will become integrated into the bone over time; in other words, it will become part of the bone.
In the second stage, which takes place 6 months later, a titanium extension known as an “abutment” is attached to the fixture and brought out through the soft tissues and skin. The prosthesis can then be directly attached to the abutment. With both stages of surgery a very strict rehabilitation program is required. Professor Brånemark’s team has defined a regimented protocol to ensure a successful outcome. Part of this protocol includes a very gradual and progressive weight-bearing on the prosthesis. This begins with technical aids and aims for complete integration of the prosthesis into daily activity over a 6-month period.
A safety component called a “failsafe” is integrated as a prosthetic component and will release itself to prevent fracture of the bone or excessive forces on the implant if a fall occurs.

What are the advantages?
- No socket – therefore, no sweating or skin irritations caused by the socket
- No pain, pressure or discomfort caused by the socket
- Easy to don and doff the prosthesis
- Excellent suspension
- No restriction of hip movement
- Comfort in the sitting position
• Osseoperception – a more natural sensation of the prosthetic limb
• Increase of bone and muscle mass

What are the disadvantages?
• Long rehabilitation process: in total, it may take up to 18 months for the entire process to be complete
• Risk of infection
• Risk of fractures and loosening of the implant
• Poor cosmesis due to permanent abutment
• No high-impact activities permitted, such as running or jumping
• Swimming in public facilities is not recommended
• Daily care of the abutment skin area is required

Who is it for?
Originally, this technology was recommended for transfemoral patients who experienced complications when using a conventional socket-type prosthesis. These difficulties may have had varied causes such as allergies, obesity or skin problems.

Medical conditions such as osteoporosis, diabetes, peripheral vascular disease, hip contractures or excess weight (more than 110 kilograms, or 242 pounds) are all contraindications for this approach.

This technology can also be used for upper-limb amputees.

Further developments
In the United Kingdom, clinical testing is being performed for a one-step surgical implant procedure called Intraosseous Transcutaneous Amputation Prosthesis (ITAP); this would shorten the rehabilitation process.

In Germany, from 1999 to 2009, about 37 people underwent the Endo-Exo Femur Prosthesis procedure. This intramedullary prosthesis (implant) has a unique spongiosa (porous) metal surface for osseointegration, which is implanted without cement, and therefore provides a different approach.

Is osseointegration a promising treatment for amputees?
In a study done in the 1990s and later in 2001, lower-limb amputees reported that the main reasons for not wearing their prosthesis, aside from energy expenditure, were socket-related problems such as discomfort, perspiration and skin problems.

Therefore, eliminating the need for a socket could virtually eliminate many of the reasons for not being able to use prosthesis.

As one can conclude, there is still a lot of research and development to be done in this field. The technique is still in evolution and there are many exciting possibilities for the future. This procedure has not yet been performed in the United States or Canada.

Editor’s Note: This article is intended for educational purposes only. The views represented in this article are not necessarily those of the Amputee Coalition.