CLINICAL REHABILITATION (PROSTHETIC LIMBS)

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Introduction

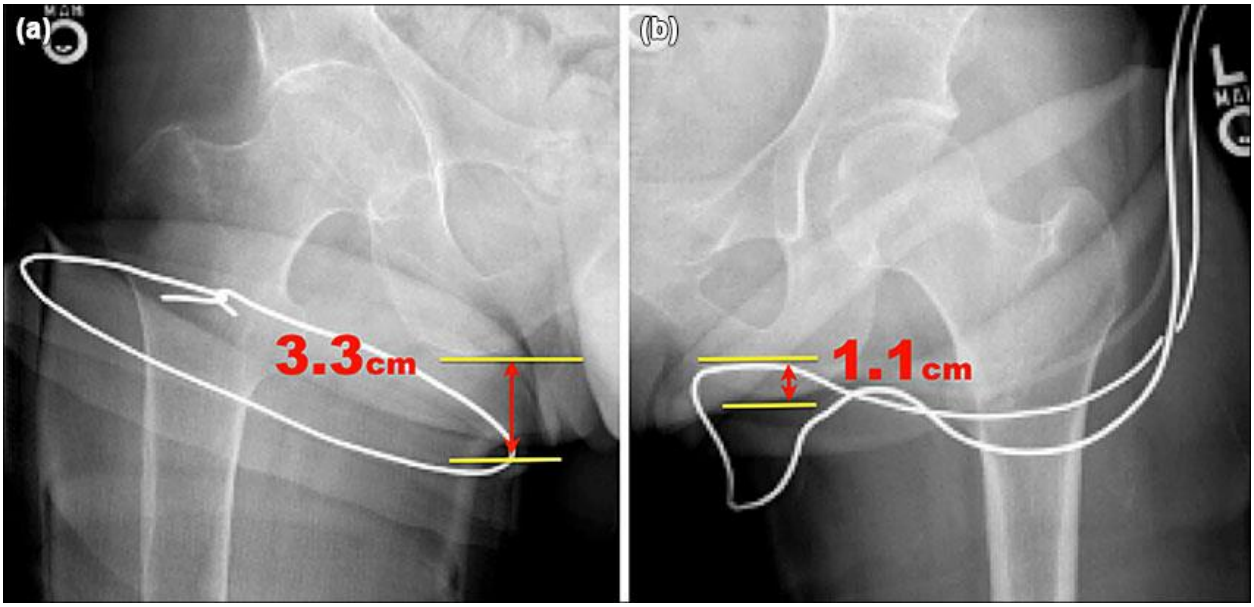
Prosthetic limbs are walking aids used to reinforce the leg of a person, which probably has been cut-off and cannot sustain the weight of an individual or even for those born with bone deformities (Beckerle, Willwacher, Liarokapis, Bowers and Popovic, 2019). These limbs are attached to a leg to make them strong and capable of performing their functions normally. Above knee amputation is also known as transfemoral amputation. This process involves surgical removal of the lower part of the leg from above the knee joint when the leg has been severely damaged in an accident, a disease or by trauma. An amputation is performed in order to remove the affected part to avoid infection of the rest part of the leg or even to prevent the spread of infection. The major causes of above knee amputation are diabetes, cancer, trauma, which has caused the lower part of the leg to crash severely, and peripheral vascular disease (Beckerle et al., 2019). This kind of amputation is performed by an orthopaedic surgeon, and it is conducted when there is a low blood supply to the lower parts of the leg or when there is a severe infection, which prohibits a lower level surgery (Kanakaris and Giannoudis, 2011). The report explores through the use of prosthetic limbs for amputee rehabilitation, which is used precisely on above the knee rehabilitation. The report will further look through the challenges and the situation currently being faced by the process of rehabilitation and the required measures that should be taken to deal with the current state of rehabilitation (Patiño, Rôa, and Espinal, 2015). The report will highlight the available methods that are used for prosthetic limb attachment for transfemoral amputation. Moreover, it is important to look at the effect of this procedure, how a prosthetic socket is developed and the technologies that are being used to support this amputation process as well as the sensor technologies that are applied in regard to prosthetic socket designing.

Literature review

The design of the prosthetic limb depends on the residual part and its shape. The first and oldest prosthetic design is the specific surface-bearing socket (Beckerle et al., 2019). This design is specifically patellar tendon bearing, which was adopted as the first standard for knee amputees. These sockets were developed in two versions; we have the supracondylar patella tendon bearing and supracondylar/suprapatellar patella tendon-bearing version (Chinnathurai, 2010). The difference between these two models is that the latter had its anterior wall more extended such that it covered the whole patella. The second design to specific surface bearing was the patellar

tendon Kugel socket. This type had a higher proximal medilateral wall when a comparison is made to other types of SSB. These types of sockets usually apply loads on a specified region which is prone to the tolerance of high-pressure values. This factor led to the invention of total surface bearing sockets. The TSB came to offer some distribution of load on the affected area hence avoiding high stresses that occur to the affected part and gives the comfort by fitting it to the surface.

The other type of a socket for the transfemoral amputees is a sub-social quadrilateral socket. This type of socket was designed to bear the ischial weight as well as a quadrilateral shape of the surface. Recently, the sub-social quadrilateral socket has been replaced by ischial containment sockets. This type of socket has different modes of alignment in which it can be developed to depending on the intended mode of prosthetic limb design that is being required by a patient. The shape and type of socket design depends on the following parameters. They include; energy expenditure, the stride length, the width of the stride, the overall percentage of the swing, the velocity of swing, the cadence and the range of motion as well as the stance.



Source: https://www.rehab.research.va.gov/jour/2013/509/jrrd-2012-01-0003.html

The latest technologies in prosthetics are the biopic and non-bionic technologies. The bionic technology uses a motor powered system which is adjusted and controlled to work in line with the needs of the amputee (Chinnathurai, 2010). These technologies used are; The BiOM Ankle System which is designed in such a manner that it increases the mobility with a revolutionary

technology for propulsion hence it helps in reducing energy demands as well it reduces the stress in a body. The second technology is the power knee which is designed in such a way that it has a motor powering technique as a knee prosthetic which serves to provide the user with symmetry, endurance and provision of strength to withstand the body weight (Edelstein and Moroz, 2011; Patiño, Rôa, and Espinal, 2015). The Proprio Foot is the third bionic technology for prosthetics. It has a lifelike powered ankle motion, which serves to give heightened stability to the body, and more so gives easier mobility to the amputee (Kanakaris and Giannoudis, 2011). The Symbionic leg system is a bionic leg system which has been designed through a combination of a Proprio powered knee and the Theo microprocessor knee. This is a very hi-tech leg system for the amputees (Chinnathurai, 2010).

Source: https://www.science.org.au/curious/people-medicine/bionic-limbs

The other technology is the non-bionic systems (Hutson, 2017). The first one in this category is the C-leg. The C-leg is the current standard device for prosthetic care. It is a microprocessor-controlled knee which has been designed to function like a real leg. It has its characteristics matched to a normal leg and functions in accordance with the amputee's anticipation on it depending on the motions he wishes to make (Cumming, Barr and Howe, 20016). The second non-bionic technology is the Genium. This technology has been the most recent to be made in the world of microprocessor technologies (Hutson, 2017). The Genium technology is designed for high activity amputees. The Theo knee is the third amputee technology. This one has a sophisticated knee which allows for normal movement and functioning during an activity (Hutson, 2017). Moreover, there is also an Orion Knee which serves with onboard programming and offers a responsive technology which helps to achieve a relaxed gait. The last type of amputee technology is the Helix 3D Hip (Cumming, Barr, and Howe, 20016). This technology incorporates revolutionary technology which allows natural walking patterns while incorporating the pelvic rotations.

Transfemoral amputation has its advantages to the amputee. First of all, it has the advantage of creating a longer mechanical lever that is needed for strength by an individual. This is because it has a longer stretch than the normal leg (Cumming, Barr, and Howe, 20016). It also has a benefit of leaving more of the normal adductor attachment, which helps in minimization of the contractures. The third benefit linked to transfemoral amputation is that it helps in creating a longer limb, which is important for seating support and transfers. Transfemoral other than having the highlighted benefits, it has also its drawbacks (Edelstein and Moroz, 2011). For instant, when one has a very long transfemoral amputation, it makes him or her experience difficult in padding the residual limb. The other drawback is that it doesn't allow adequate space for other prosthetic components. It tends to occupy much of the space that would be used by these components. The last drawback attached to long amputation is that it creates a complex leg length and hinders prosthetic situations that are required for a knee centre (Edelstein and Moroz, 2011).

In conclusion, it is worth noting that transfemoral amputation has advanced with time, and it has developed a very efficient technique for rehabilitating individuals with an above knee amputation. The latest technology has enhanced the mobility of joints and fixing of the prosthetic limbs which adequately solves the malfunction that could have come with the loss of a leg or part of the thigh which could cause the removal of part of a whole leg. Transfemoral amputation, therefore, has come to help in the restoration of a functional unit of a leg which may have been lost due to unavoidable circumstances.

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