Review article / Artykuł przeglądowy

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Rotationplasty procedure

Zabieg plastyki rotacyjnej

ABSTRACT

Rotationplasty is surgical intervention performed especially on children suffering from a malignant tumour of the femur or a proximal femoral focal deficiency (PFFD). The lower limb's proximal part is removed and the remaining distal part is rotated 180° and reattached. Then the ankle joint functions as the knee joint.

The aim of the study was to present the possibilities of rotationplasty surgery in the reconstruction of the lower limb, as well as its techniques and solutions.

Rotationplasty enabled a patient to reach a satisfying functional status.

Keywords: rotationplasty, orthopedic surgery, amputations

STRESZCZENIE

Plastyka rotacyjna to zabieg wykonywany przeważnie u dzieci ze złośliwym nowotworem kości udowej lub niedorozwojem bliższego jej końca. Polega na usunięciu proksymalnej części kończyny dolnej i przyszyciu w jej miejsce zrotowanej o 180° części dystalnej. Wówczas staw skokowy spełnia funkcje stawu kolanowego.

Celem pracy było przedstawienie możliwości, technik i rozwiązań plastyki rotacyjnej w rekonstrukcji kończyny dolnej.

Plastyka rotacyjna umożliwia pacjentom osiągnięcie satysfakcjonującego stanu funkcjonalnego.

Słowa kluczowe: plastyka rotacyjna, operacja ortopedyczna, amputacje

INTRODUCTION

Rotationplasty is a surgical intervention rarely performed. The case often concerns children who suffer from proximal femoral focal deficiency (PFFD) or malignant tumours of the hip joint, the femur, the knee joint and/or the proximal tibia [1-3]. In this procedure a proximal part of the lower limb is removed and a distal part of the lower limb is rotated by 180° and reattached in its place, then the ankle joint functions as the knee joint (fig. 1). Therefore, a dorsiflexion of the ankle joint replaces a flexion of the knee joint, and a plantar flexion of the ankle joint replaces an extension of the knee joint [4-10].

Fig. 1 The appearance of the lower limb after rotationplasty
Source: [11]

AIM

The aim of the study was to present the possibilities of rotationplasty surgery in the reconstruction of the lower limb, as well as its techniques and solutions.

ROTATIONPLASTY METHODS

The best known methods of performing rotationplasty were introduced by the German orthopedist Winfried Winkelmann, and they are:

- Winkelmann's AI rotationplasty,
- Winkelmann's AII rotationplasty,
- Winkelmann's BI rotationplasty,
- Winkelmann's BII rotationplasty [3, 5].

The choice of method depends on the indications and the location of the pathology.

Winkelmann's AI rotationplasty

Winkelmann's AI rotationplasty is performed in the case of disorders located in the distal end of the femur. In this procedure, about two-thirds of the femur and the small upper portion of the tibia are removed. The quadriceps and the hamstrings are also rejected, except for the rectus femoris origin and the hamstrings origins. Then the rectus femoris origin is sutured to the gastrocnemius and the hamstrings origins are sutured to the proximal tibia's extensor retinaculum (fig. 2) [3, 5].

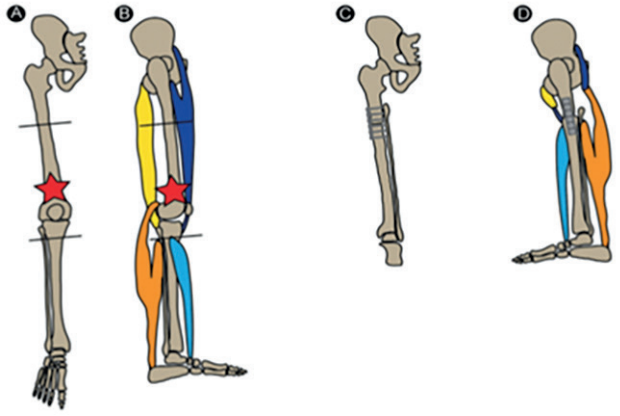

Fig. 2 Winkelmann's AI rotationplasty (yellow – hamstrings, dark blue – quadriceps, light blue – tibialis anterior, orange – gastrocnemius)

Source: [5]

Winkelmann's AII rotationplasty

Winkelmann's AII is applied when the pathology is placed in the area of the proximal tibia. The distal part of the femur and about two-thirds of the proximal tibia are removed then. The removal includes the quadriceps insertion, the hamstrings insertions, the tibialis anterior muscle besides its insertion and the triceps surae muscle. The Achilles tendon is preserved.

Thus, the saved part of the quadriceps is attached to the Achilles tendon and the hamstrings are attached to the tibialis anterior muscle insertion (fig. 3) [3, 5].

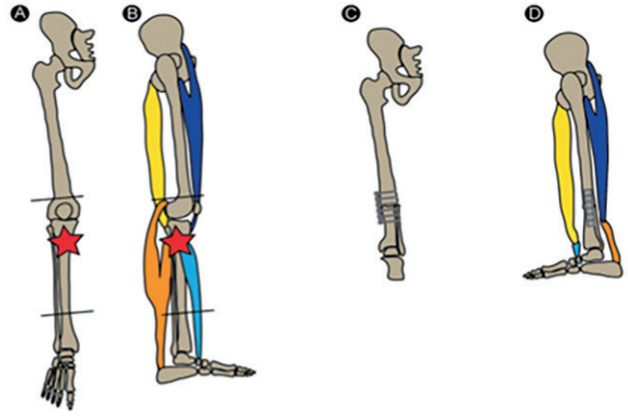

Fig. 3 Winkelmann's AII rotationplasty (yellow – hamstrings, dark blue – quadriceps, light blue – tibialis anterior, orange – gastrocnemius)

Source: [5]

Winkelmann's BI and Winkelmann's BII rotationplasty

Both methods of rotationplasty - Winkelmann's BI and Winkelmann's BII - are recommended for patients who suffer from pathology located in the proximal femur. In both procedures about a three quarters of the upper part of femur is resected. The lower portion of the limb, i.e. the distal femur, the knee joint and the ankle joint are saved. The difference between these methods is that Winkelmann's BI is executed with preservation of the ischium, and in Winkelmann's BII method the ischium is removed. Regardless of the choice of the procedure, the removal includes the iliopsoas insertions, the gluteus maximus insertions, the quadriceps muscle besides its insertion and the hamstrings besides its insertions. In the both methods the muscles are sutured similarly. The iliopsoas is transferred to the hamstring insertions and the gluteus maximus is transferred to the quadriceps insertion (fig. 4) [3, 5].

Rotationplasty requires the sciatic nerve to be retained and intact, so the muscle can function properly (fig. 5) [12, 13]. The sciatic nerve is looped and placed between the muscles. Screws or nails and a metal plate are used to connect the bones. This aspect needs to be taken into consideration when it comes to preparing a post-surgery physiotherapy program [5, 13, 14].

The rotationplasty procedures are constantly modified. Winkelmann's methods are not the only ones that can be performed.

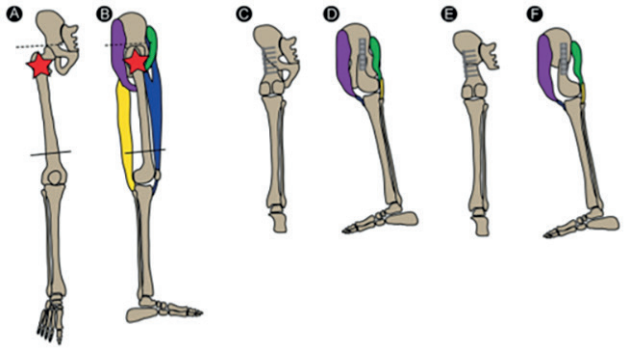

Fig. 4 Winkelmann's BI and BII rotationplasty (yellow – hamstrings, dark blue – quadriceps, purple - gluteus maximus, green – iliopsoas)
Source: [5]

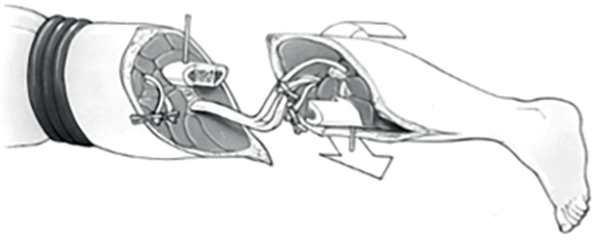

Fig. 5 The sciatic nerve after rotationplasty
Source: [7]

ROTATIONPLASTY OUTCOMES

The advantages of rotationplasty include: absence of phantom pain, a retained ability to grow bone and good functional results [5, 7, 9, 12, 15].

Phantom pain is characteristic of classic amputations. It significantly makes it difficult for the patient to function and fully participate in a physiotherapy program. Phantom pain occurs as a result of peripheral nerves injuries. In rotationplasty the sciatic nerve and its branches are retained and intact, so that there is no phantom pain [11, 17, 18].

The epiphyseal cartilage, which is responsible for longitudinal bone growth, is also preserved. So when the surgery is performed on a young person whose ossification is not finished yet, rotationplasty lets the bones which have been operated on grow as the child grows. While surgery is planned, measurements of the lower limbs are made to estimate the length of the bones and the height that the patient will achieve in adulthood, when their ossification will be finished. Thereby, the level of rotated ankle joint will remain at the same height as the knee joint of the healthy lower limb, and there will be no need to reoperate [7, 17, 19, 20].

Research shows that patients after rotationplasty function well and undertake various sport activities, including tennis, horse riding, judo, athletics and rollerblading [6, 21-24]. They achieve better functional results than patients after lower limb amputation [2, 8, 18, 25].

It should be mentioned that the loss of a part of lower limb and its unusual cosmetic appearance may be a significant psychological burden for a patient and make him or her feel rejected. Although a rotationplasty is highly functional reconstruction, a cosmetic point of view may not always be acceptable for a patient [3, 5, 7, 18, 22].

SUMMARY

Rotationplasty is a limb salvage option which provides good functional results in patients. It eliminate concerns over phantom pain and limb length discrepancy. It does not seem to reduce mental wellbeing, but it needs to be emotionanally accepted by a patient. It is very important to draw attention to the little known surgical treatment method that is rotationplasty and to discuss its outcomes.

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