

Physiotherapy treatment for rotationplasty

Postępowanie fizjoterapeutyczne w plastyce rotacyjnej

ABSTRACT

Rotationplasty is a surgical intervention generally performed in children but its use is rare, especially in children. In this procedure the proximal part of the lower limb is removed and its distal part is rotated 180° and reattached. To increase the patient's chances of returning to daily activities, it is necessary to implement individual physiotherapeutic management.

The aim of the study was to present the schemes and methods of physiotherapeutic treatment in the rotational plastic surgery performed.

The physiotherapeutic program implemented in the course of rotationoplasty should include preoperative, post-operative pre-prosthetic and post-operative post-prosthetic rehabilitation. It is also important to prevent and treat potential post-operative complications.

Keywords: rotationplasty, physiotherapy, physical therapy, preoperative physiotherapy, post-operative physiotherapy

STRESZCZENIE

Plastyka rotacyjna to zabieg wykonywany rzadko, przeważnie u dzieci. W procedurze tej usuwa się proksymalną część kończyny dolnej, a jej dystalną część rotuje się o 180° i przyszywa w miejsce usuniętego fragmentu. By zwiększyć szanse pacjenta na powrót do codziennych aktywności, konieczne jest wprowadzenie indywidualnego postępowania fizjoterapeutycznego.

Celem pracy było przedstawienie schematów i metod fizjoterapii przy przeprowadzonym zabiegu plastyki rotacyjnej.

Program fizjoterapeutyczny wdrażany przy wykonywaniu plastyki rotacyjnej powinien zawierać rehabilitację przedoperacyjną, pooperacyjną przed zaprotezowaniem i pooperacyjną po zaprotezowaniu. Ważne jest także zapobieganie i leczenie potencjalnych powikłań pooperacyjnych.

Słowa kluczowe: plastyka rotacyjna, fizjoterapia, fizykoterapia, fizjoterapia przedoperacyjna, fizjoterapia pooperacyjna

INTRODUCTION

Rotationplasty is a surgical intervention which is performed especially in children. As the lower limb's proximal part is removed and its distal part is rotated by 180° and reattached, the ankle joint functions as the knee joint. Therefore, a flexion of the knee joint is replaced by a dorsiflexion of the ankle joint, and its extension is replaced by a plantar flexion (fig. 1) [1-7].

Patients after rotationplasty function well and they achieve even better functional results than those who underwent a lower extremity amputation [3, 5, 8-14].

An individual physiotherapy program should be applied to increase a patient's chances of returning to his daily activities.

Physiotherapy for the patients after rotationplasty, as it does in other surgical procedures, should include:

- a) preoperative management,
- b) post-operative pre-prosthetic management,
- c) post-operative post-prosthetic management,
- d) prevention and treatment of post-operative complications.

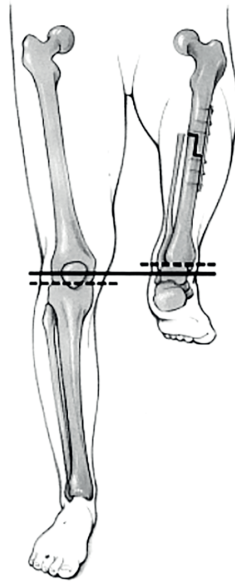


Fig. 1 The lower extremity after rotationplasty. The ankle joint is placed at the level of the knee joint Source: [4]

AIM

The aim of the study was to present the schemes and methods of physiotherapeutic treatment in performed rotational plastic surgery.

PREOPERATIVE MANAGEMENT

Because rotationplasty is planned in advance, it creates the possibility of patient preparation before surgery and for its consequences. The implementation of preoperative management allows the maintenance of the patient in good physical condition, which means: respiratory and cardiovascular functions, maintaining joint range of motions and increasing muscle strength, thereby it is easier to move and to use orthopedic aids.

In the preoperative period antithrombotic exercises, breathing exercises and active exercises (with or without resistance) for healthy extremities should be applied. For a diseased lower limb it is necessary to introduce exercises which allow:

- a) an increased range of plantar flexion motion and strength of the muscles which perform this movement,
- b) a maintained range of dorsiflexion motion and strength of the muscle which performs this movement [1, 2, 15, 16].

Increasing of range of plantar flexion motion is necessary, because when using a prosthesis, the ankle joint replaces the knee joint, and then it is positioned in plantar flexion which exceeds the physiological range of motion [4]. The normal range of plantar flexion measures 45°. Afterwards a rotationplasty angle of 70° should be sought (fig. 2) [4, 17]. The range of 70° should not be exceeded, because then the risk of damage to the ankle joint as a result of a fall increases [4].

Ankle dorsiflexion after rotationplasty replaces the knee flexion. A range of 20° of this movement should be main-

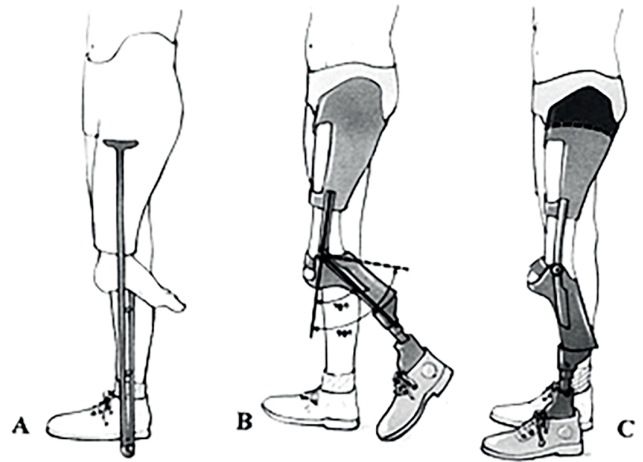


Fig. 2 The appearance and the mobility of the lower limb with prosthesis Source: [4]

tained. At the same time the strength of the muscle, which performs this movement, should be increased to make it easier for the patient to carry the weight of the prosthesis [4].

POST-OPERATIVE PRE-PROSTHETIC MANAGEMENT

15 days after rotationplasty, when post-operative swelling resolves, the lower limb operated on may be immobilized in a cast for 2 months until a radiographic examination shows bone healing [1, 4]. During this period the exercises for healthy extremities should be continued. Active exercises with resistance for healthy lower extremity are particularly important, because they transfer a contralateral tension to the immobilized lower limb [17].

Moreover, the first day after surgery the patient should be equipped with the crutches and start learning to walk without weight being put on the leg that has been operated on [9].

When the cast is removed, it is advisable to toughen the skin areas which are exposed to the pressure and abrasions caused by the prosthesis, i.e. the dorsal and plantar surfaces of the foot [3]. Exercises which increase range of motion and strength of the hip joint and the ankle joint of the leg operated on should be introduced. Due to a lack of complete bone union, weight-bearing exercises for the lower limb operated on should be avoided [4, 9, 18, 19]. The patient should receive a temporary prosthesis, which has a hinge protecting against hyperextension of the “new” knee, but at the same time allows it to bend. Over time, it is possible to implement balance exercises.

POST-OPERATIVE POST-PROSTHETIC MANAGEMENT

Full weight-bearing on the lower limb operated on can be begun, when the bone is completely healed, which is about 2 months following the rotationplasty in the case of children and about 3-4 months after the surgery in the case of adults [1, 4]. After this time, the temporary prosthesis should be re-

placed with the final prosthesis [13]. With its use, the patient should start learning to walk on uneven terrain using it, starting with easier conditions, gradually moving on to more difficult ones, for example, climbing stairs or walking on gravel.

During the first 3 weeks following the removal of the cast, the patient should use two crutches for support while walking. After this period one can begin walking with one crutch, until being stable enough to walk with no help only with the use of the prosthesis.

As the ankle joint replaces the knee joint and the shape of the lower limb is changed, the patient can find it uncomfortable while lying in bed on back. To improve comfort, they can put a folded towel, a pillow or a roller under the rotated foot. While resting, the patient should not remain in this position too long to prevent hip flexion contractures [1].

PREVENTION AND TREATMENT OF POST-OPERATIVE COMPLICATIONS

Physiotherapy program should include prevention and treatment of post-operative complications. The most common complications after rotationplasty are: lower limb ischemia, sciatic nerve injury, wound necrosis and/or infection, delayed bone union and pseudoarthrosis. When the patient is immobilized for a long time, there is a risk of contractures [2, 4, 6, 19-21]. A physiotherapist's mission is to prevent them by early verticalization and mobilization.

PHYSICAL THERAPY LIMITATIONS

Besides the exercises, physiotherapy may prove to be problematic. The young age of the patient, metal elements that connect the bones, malignant disease and potential chemotherapy limit the possibilities of using physical therapy methods such as: magnet therapy, ultrasound therapy, laser therapy, light therapy and heat therapy [11, 22-26].

SUMMARY

Rotationplasty is a limb salvage option which provides good functional results in patients. Like any other surgical intervention it requires the implementation of a physiotherapy program. The aim of this paper is to propose a physiotherapy treatment plan in the pre- and post-operative period.

REFERENCES / LITERATURA

1. Banaś B, Kowalczyk B. Rehabilitacja dzieci z wrodzonym brakiem bliższego końca kości udowej leczonych zmodyfikowaną plastyką rotacyjną według Van Nesa. *Chir Narz Ruchu Ortop Pol*. 2006;71(4):313-315.
2. Bernthal NM, Monument MJ, Randall RL, Jones KB. Rotationplasty: Beauty is in the Eye of the Beholder. *Oper Tech Orthop*. 2014;24(2):103-110. <https://doi.org/10.1053/j.oto.2013.11.001>
3. Hillmann A, Gosheger G, Hoffmann C, et al. Rotationplasty – surgical treatment modality after failed limb salvage procedure. *Arch Orthop Trauma Surg*. 2000;120(10):555-558. <https://doi.org/10.1007/s004020000175>

4. Kotz R. Rotationplasty. *Seminars in Surgical Oncology*. 1997;13:34-40. [https://doi.org/10.1002/\(SICI\)1098-2388\(199701/02\)13:1<34::AID-SSU6>3.0.CO;2-5](https://doi.org/10.1002/(SICI)1098-2388(199701/02)13:1<34::AID-SSU6>3.0.CO;2-5)
5. Rota V, Benedetti MG, Okita Y, et al. Knee rotationplasty: motion of the body center of mass during walking. *Int J Rehabil Res*. 2016;39(4):346-353. <https://doi.org/10.1097/MRR.0000000000000195>
6. Sawamura C, Hornicek FJ, Gebhardt MC. Complications and risk factors for failure of rotationplasty: review of 25 patients. *Clin Orthop Relat Res*. 2008;466(6):1302-1308. <https://doi.org/10.1007/s11999-008-0231-6>
7. Toussaint-Thorin M, Constantinou B, Colpart M, et al. Support in rehabilitation following Van Ness rotationplasty: About one case. *Ann Phys Rehabil Med*. 2013;56:278-286. <https://doi.org/10.1016/j.rehab.2013.07.735>
8. Grimsrud C, Killen C, Murphy M, et al. Long-term outcomes of rotationplasty patients in the treatment of lower extremity sarcomas with cost analysis. *J Clin Orthop Trauma*. 2020;11(1):149-152. <https://doi.org/10.1016/j.jcot.2019.06.003>
9. Gupta SK, Alassaf N, Harrop AR, Kiefer GN. Principles of rotationplasty. *J Am Acad Orthop Surg*. 2012;20(10):657-667. <https://doi.org/10.5435/JAAOS-20-10-657>
10. Hillmann A, Hoffmann C, Gosheger G, et al. Malignant Tumor of the Distal Part of the Femur or the Proximal Part of the Tibia: Endoprosthetic Replacement or Rotationplasty. *J Bone Joint Surg*. 1999;81A(4):462-468.
11. Jackson TM, Bittman M, Granowetter L. Pediatric Malignant Bone Tumors: A Review and Update on Current Challenges, and Emerging Drug Targets. *Curr Probl Pediatr Adolesc Health Care*. 2016;46(7):213-228. <https://doi.org/10.1016/j.cppeds.2016.04.002>
12. Le JT, Scott-Wyand PR. Pediatric limb differences and amputations. *Phys Med Rehabil Clin N Am*. 2015;26(1):95-108. <https://doi.org/10.1016/j.pmr.2014.09.006>
13. Mahmoud A, Aboujaib MF, Meda MR. Long-term follow-up of patients with rotationplasty. *Int J Surg Case Rep*. 2021;79:295-298. <https://doi.org/10.1016/j.ijscr.2021.01.045>
14. Scheepers LG, Storcken JO, Rings F, et al. New Socket-Less Prosthesis concept facilitating comfortable and abrasion-free cycling after Van Ness rotationplasty. *Prosthet Orthot Int*. 2015;39(2):161-165. <https://doi.org/10.1177/0309364613515494>
15. Agarwal M, Puri A, Anchan C, et al. Rotationplasty for bone tumors: is there still a role? *Clin Orthop Relat Res*. 2007;459:76-81. <https://doi.org/10.1097/BLO.0b013e31805470f0>
16. Badhwar R, Agarwal M. Rotationplasty as a limb salvage procedure for malignant bone tumours. *Int Orthop*. 1998;22(2):122-125. <https://doi.org/10.1007/s002640050222>
17. Fiodorenko-Dumas Ż, Baściuk I, Bogut B, Dumas I. *Kinezyterapia w praktyce fizjoterapeuty*. Wrocław: Górnicki Wydawnictwo Medyczne; 2009.
18. Dumont CE, Schuster AJ, Freslier-Bossa M. Borggreve-Van Ness rotationplasty for infected knee arthroplasty - A case report. *Acta Orthop*. 2010;81(2):268-270. <https://doi.org/10.2174/1874325001913010013>
19. Winkelmann WW. Type-B-IIIa hip rotationplasty: an alternative operation for the treatment of malignant tumors of the femur in early childhood. *J Bone Joint Surg Am*. 2000;82(6):814-828. <https://doi.org/10.2106/0004623-200006000-00008>
20. Groundland JS, Binitie O. Reconstruction After Tumor Resection in the Growing Child. *Orthop Clin North Am*. 2016;47(1):265-281. <https://doi.org/10.1016/j.joc.2015.08.027>
21. Sawamura C, Matsumoto S, Shimoji T, et al. Indications for and surgical complications of rotationplasty. *J Orthop Sci*. 2012;17(6):775-781. <https://doi.org/10.1007/s00776-012-0278-9>
22. Bauer A, Wiecheć M. *Przewodnik metodyczny po wybranych zabiegach fizykalnych*. 2nd ed. Poznań: Merkmed Rehabilitacja S.C.; 2008.
23. Kiwerski J. *Rehabilitacja medyczna*. Warszawa: Wyd. PZWL; 2007.
24. Kochański JW, Kochański M. *Medycyna fizykalna*. Gliwice: PHU TECHNOMEX; 2009.
25. Kuliński W, Zeman K. *Fizjoterapia w pediatrii*. Warszawa: Wyd. PZWL; 2012.
26. Woźniewski M. *Fizjoterapia w onkologii*. Warszawa: Wyd. PZWL; 2012.