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Van Nes rotationplasty. Case Report. Theme update

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ABSTRACT

The objective of this work is to develop Van Nes rotationplasty as a therapeutic option in osteoarticular tumors of the lower limbs surrounding the knee and to present the first case in which this technique was used in Uruguay. Clinical case: this is an 8-year-old boy, who consulted for a pathological diaphyseal fracture of the right femur. He was diagnosed with undifferentiated osteosarcoma of the non-metastatic femur, whose response to neoadjuvant chemotherapy was doubtful. Finally, it was decided to perform a Van Nes plasty after a Winkelmann resection type AI. Conclusion: Van Nes plasty is a procedure that should be considered as a valid therapeutic option in tumors surrounding the knee, mainly in children. It is a unique biological reconstruction procedure with excellent functional results.

KEYWORDS: Van Nes, Rotationplasty, reconstruction, osteoarticular tumors.

ARTICLE DETAILS

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INTRODUCTION

This paper addresses the first case of Van Nes rotationplasty performed in Uruguay on a pediatric patient with non-metastatic, undifferentiated osteosarcoma. It also provides an update on this reconstruction technique.

Osteosarcomas are rare tumors that produce tumoral osteoid and clinically cause pain and progressively growing masses in children (1-3). In the United States, approximately 400 new cases are diagnosed annually, making it the most common primary bone cancer in children and adolescents (4). Ewing's sarcoma and osteosarcoma account for about 5% of childhood malignancies. Although forty years ago, the survival rate for pediatric bone sarcomas was low, today, about 70% of patients survive, highlighting the need for functional and durable limb-preserving alternatives (2,3).

The good response to chemotherapy in some osteosarcomas has facilitated limb-sparing surgeries (5,6). However, when wide resection is not feasible, rotationplasty emerges as a valid therapeutic option with very good functional outcomes (7,8).

Rotationplasty, introduced by Borggreve in 1930 (9), is used to salvage affected limbs by rotating the tibia 180 degrees in relation to the limb's longitudinal axis and using the ankle joint as the knee, where an infrapatellar prosthesis is placed. In 1950, Van Nes applied this technique in cases of congenital femoral hypoplasia or partial femoral agenesis (10). In the 1980s, Salzer and collaborators (11) established it as a valid option for functional reconstruction after osteoarticular tumor resections around the knee (12,13).

CLINICAL CASE

This case involves an 8-year-old boy with no prior medical history who initially sought consultation for persistent knee pain for three months. After an initial X-ray that was interpreted as normal (Image 1), he returned a week later due to increased pain, loss of function, and swelling in the right

thigh. A subsequent X-ray revealed a diaphyseal fracture in the femur over an aggressive lesion (Image 2).

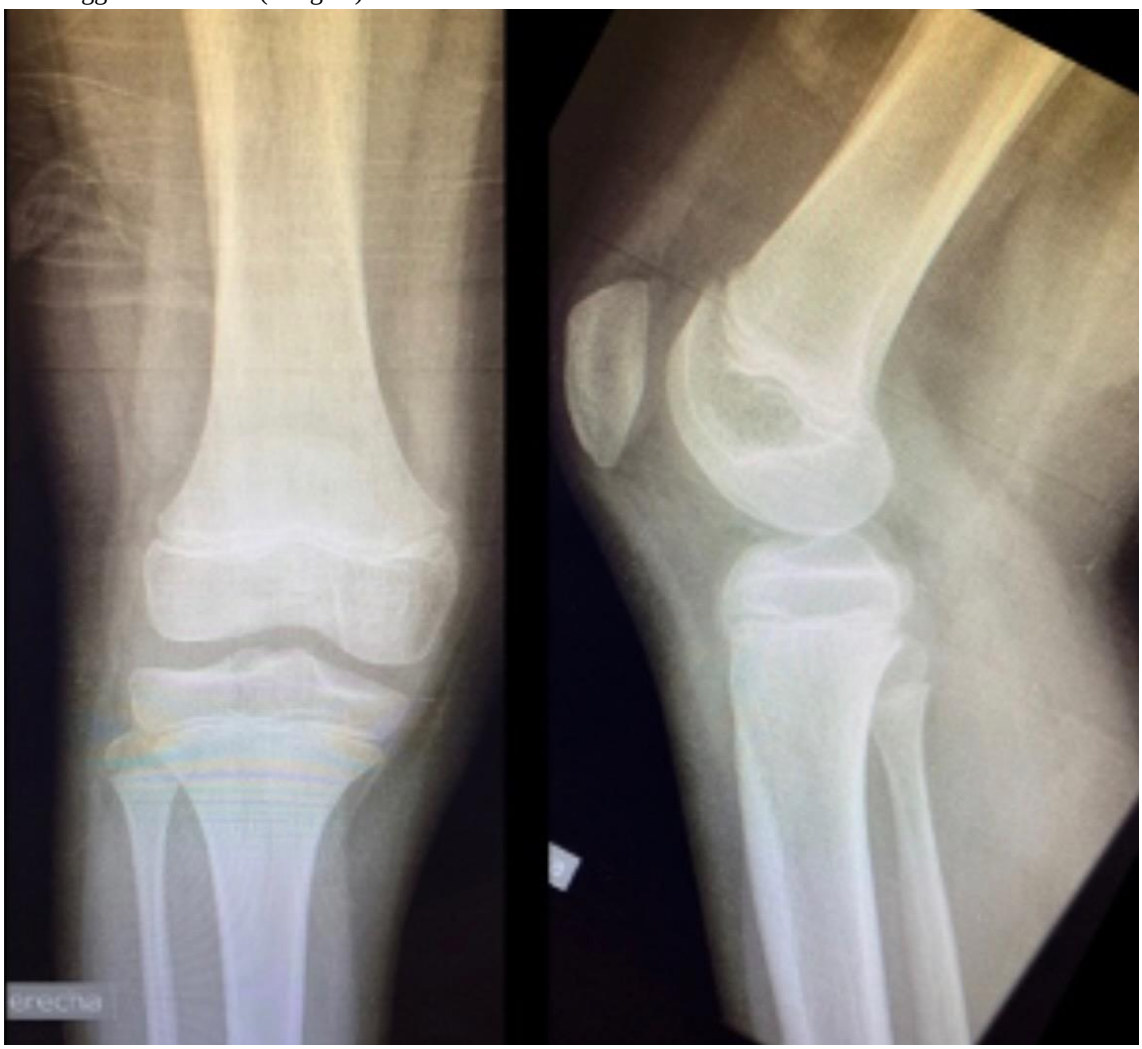

Image 1. Initial x-rays, interpreted as normal. The periosteal reaction is observed in the femoral shaft.

Faced with the suspicion of osteosarcoma or Ewing's sarcoma, additional imaging studies were conducted, including CT scans, MRIs (Image 2), and laboratory tests. The histopathological analysis of the biopsy confirmed a pleomorphic undifferentiated sarcoma in the femoral diaphysis with no evidence of metastasis.

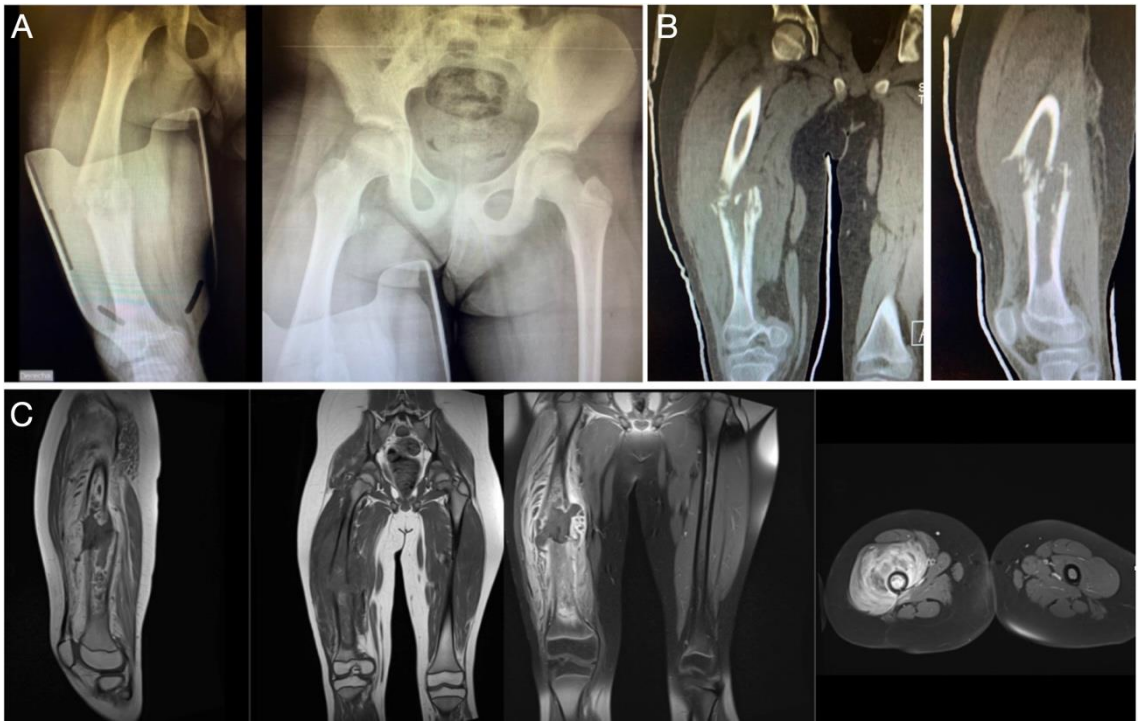

Image 2. A Rx pathological fracture of the femur. B Coronal and sagittal tomographic reconstruction where cortical destruction is seen. C MRI in sequence T1. Transverse and coronal sections of the femur, where a mid-diaphyseal lesion with a mass of soft tissues is observed and MRI T2 sequence in coronal and axial sections of the femur at the level of the lesion. Femoral lesion is observed, with extension of soft tissues and great perilesional edema.

Neoadjuvant polychemotherapy (PQT) was initiated according to the Brazilian protocol for non-metastatic osteosarcoma. However, after two cycles of PQT, imaging studies showed tumor progression with extensive femoral diaphyseal destruction (Image 3).

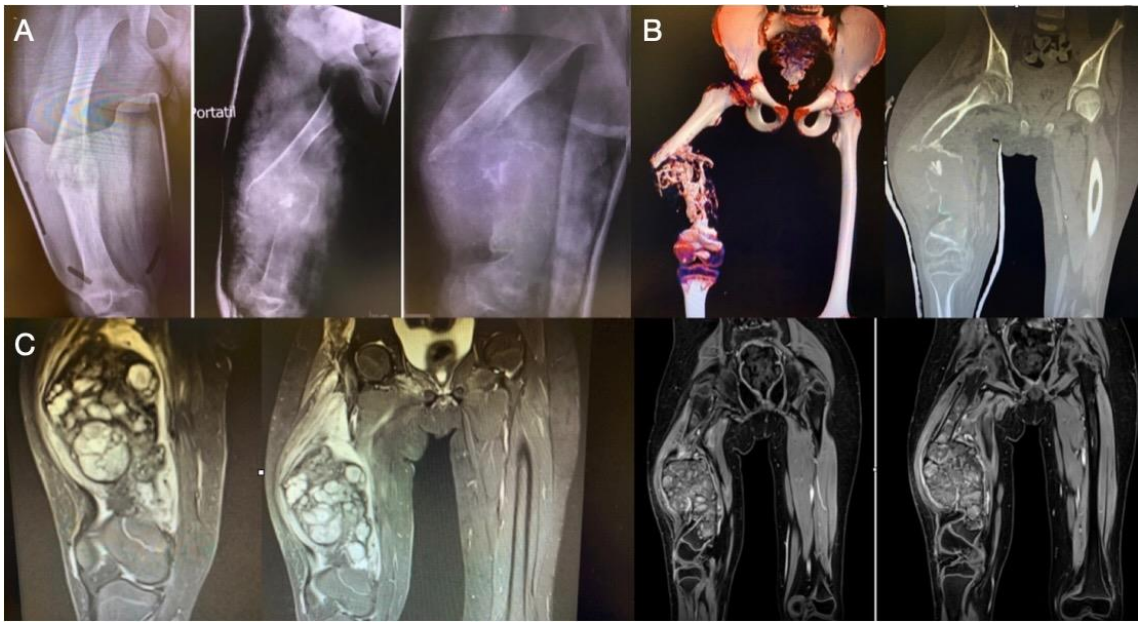

Image 3 imaging controls after neoadjuvant chemotherapy. Initial Rx. A Rx at 8 weeks and 12 weeks. B Coronal CT and 3D reconstruction. C MRI. In all of them, an increase in bone injury and soft tissue mass is observed.

Faced with this situation, tumor resection surgery, Winkelman type AI, followed by Van Nes rotationplasty, was performed. The patient experienced good postoperative evolution (Image 4).

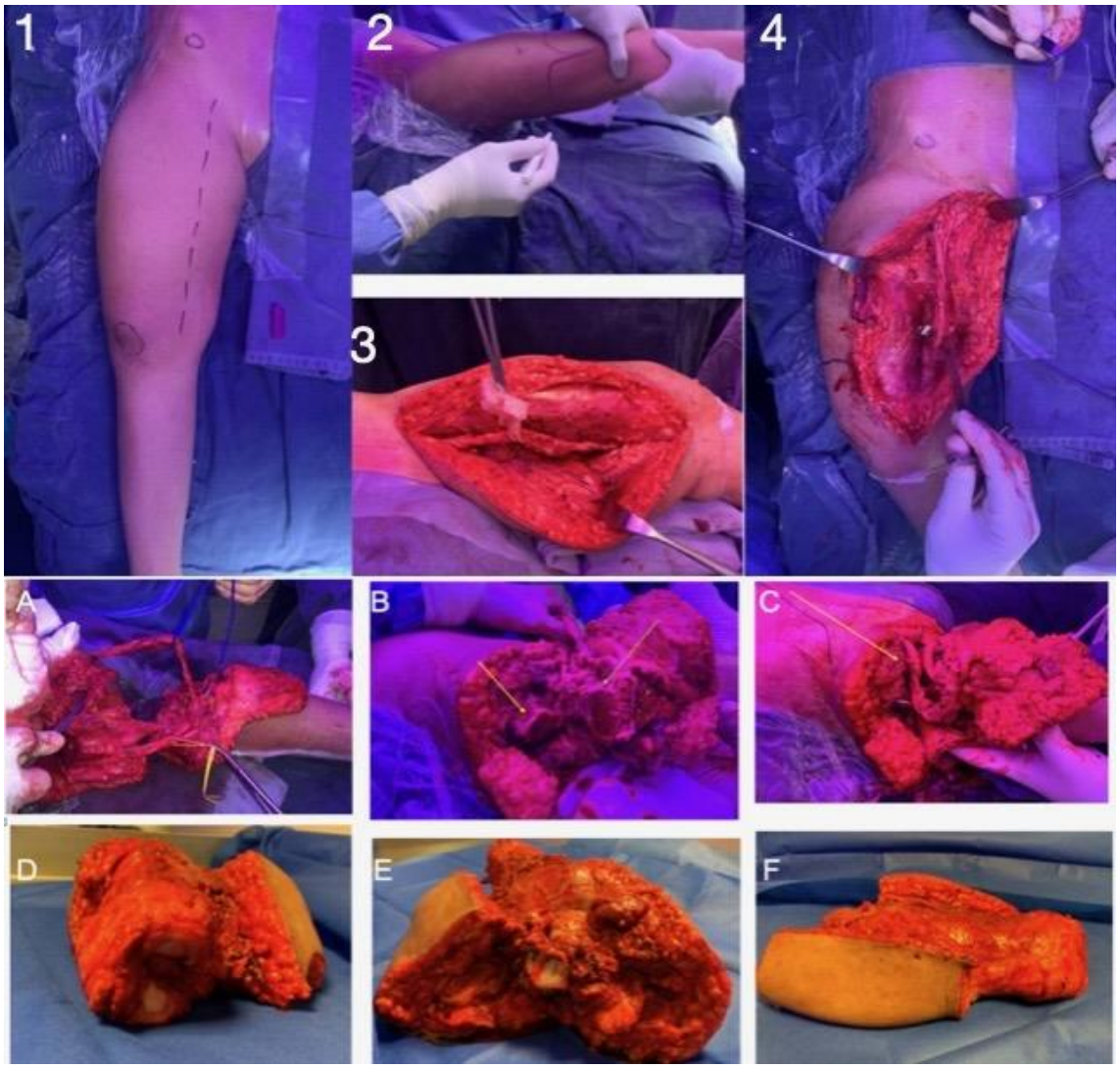

Image 4. 1 The approach to be taken. 2 Black arrow, biopsy path. Medial longitudinal incision, 3 and 4 where the superficial femoral bundle is dissected and repaired. To. After tumor resection, the femoral vascular bundle is seen in blue. In yellow in the sciatic nerve and its divisions, CPE and CPI. B. The bloody surfaces of the femur (yellow arrow) and tibia (green arrow) are observed after osteotomies. C. The coiled vasculonervous bundle is observed after 180º rotation (yellow arrow). The osteosynthesis plaque is also observed. D, E, F. Resection piece.

Rehabilitation focused on ankle and hip mobility with the initial use of a walker. Adjuvant chemotherapy continued, and the patient was discharged after 30 days. Subsequent follow-ups showed consolidation and fusion between the bone segments. At three months, the patient began using an adapted prosthesis, allowing him to resume his daily and school activities (Image 5).

Image 5 A Rx 1,3 and 7 months of evolution. B Gait rehabilitation. C Starting to use his prosthesis at 3 months and resuming his school activity D.

DISCUSSION

Van Nes rotationplasty stands out as a biologically simple and durable reconstruction method, offering rapid rehabilitation that allows patients to return to an active life, including participation in sports, with excellent long-term outcomes (12-16).

This technique involves rotating the lower leg and foot by 180 degrees, adjusting the length, fusing the tibia with the proximal femur, and positioning the foot in place of the knee, with the ankle joint assuming the knee's function in flexion-extension (17). The main goal of rotationplasty is to improve mobility for patients who will use a prosthesis. By positioning the ankle in this way, a functional knee is created, and the sensory response of the toes significantly aids in adaptation and physical rehabilitation (17).

While there are other successful reconstruction techniques, such as resection arthrodesis, articular allografts, and prosthetic replacements, rotationplasty is particularly notable in specific cases. It can be considered for patients with congenital limb deficiencies, proximal tibial or distal femoral deficiencies, post-traumatic conditions, infections, or post-tumor prosthesis or knee surgery sequelae.

In orthopedic oncology, the primary indication for rotationplasty is bone sarcomas in the lower limbs that require resection of the knee or hip due to their juxta-articular location. It is also applied in cases involving resection of the distal femoral or proximal tibial growth plates, where prosthetic reconstruction after tumor resection is not feasible (18,19). Rotationplasty is preferred in immature skeletons due to the complications that other techniques can cause during a child's growth (20).

In these circumstances, both patients and surgeons emphasize the importance of obtaining a definitive and biological reconstructive surgical option with good long-term functional outcomes in young and active individuals. Quality of life after rotationplasty shows improved functionality, results, and adaptation to daily life with the use of a prosthesis, compared to other techniques such as amputation or tumor prostheses (20).

In 1986, Winkelmann classified rotationplasty into two main types, A and B, which are further subdivided into five subtypes depending on the location of the lesion within the lower limb (21,22). In this patient, a type AI rotationplasty was performed, preserving the major neurovascular axes.

Van Nes rotationplasty involves significant physiological changes in the load-bearing function of the ankle, which assumes the role of the knee in flexion-extension. Although there is an increase in load on the posterior facet of the talar dome, there is no observed increase in the incidence of tibioastragaline osteoarthritis (23).

The absolute primary contraindication for rotationplasty is sciatic nerve dysfunction, as it often must be resected to achieve adequate oncological margins. The success of rotationplasty depends on preserved foot sensitivity, a wide range of ankle mobility, and adequate plantar flexion to fulfill the future knee's function. The lack of these elements results in the child's inability to use the transtibial prosthesis, rendering the surgery ineffective.

Unlike the sciatic nerve, vascular involvement by the tumor is not always a contraindication, provided that an intercalary resection of the vessels and subsequent anastomosis can be performed.

To provide sufficient strength in ankle flexion-extension after rotationplasty, two musculotendinous reconstructions are recommended. The placement of the gastrocnemius heads in the anterior fascia of the thigh or in the rectus femoris. Additionally, the anterior and posterior tibial muscles, as well as the peroneal muscles, remain fixed to the tibia and fibula, providing ankle dorsiflexion, though in some cases they must be fixed to the hamstring fascia. However, after these procedures, a 30% decrease in average muscle strength should be anticipated (24).

It is crucial to provide detailed information about the procedure to patients and their families, including the postoperative physical appearance, risks, complications, and the physical rehabilitation process. The patient's emotional state before surgery is also fundamental, as rotationplasty carries significant emotional weight, especially in pediatric patients (25).

Although most patients in published series are satisfied with the treatment and show a good psychological response and reintegration into social life, there have been reports of severe depression, lack of acceptance of the new body image, and difficulty in relating to peers (26).

Postoperative complications may include vascular problems, compartment syndrome, sciatic nerve paralysis, wound necrosis, pseudoarthrosis, delayed bone healing, and rotational malalignment (15,27,28). Despite these possible complications, the functional outcomes of rotationplasty are generally favorable compared to amputation or other limb-salvage procedures. Adaptation to the new limb function is gradual, and many patients can walk unassisted and resume normal activities within 6 to 12 months after surgery (18).

Long-term evaluations reveal that rotationplasty does not significantly affect patients' psychosocial lives, and many maintain an active and functional lifestyle. However, it is essential to provide continuous physical and psychological support throughout the preoperative and postoperative process to ensure successful adaptation and full reintegration into daily life (29).

CONCLUSION

This paper presents the first case of Van Nes rotationplasty in Uruguay, a complex procedure that is not frequently chosen as a treatment method despite its highly positive results, especially in patients still undergoing skeletal development.

Although rotationplasty involves a significant morphological change, it offers numerous advantages, making it a valuable therapeutic alternative instead of resorting to above-knee amputation, especially in children and young adults.

The proper selection of the patient is crucial for this type of procedure. The preoperative evaluation must rule out any biological factors that could contraindicate the procedure. Additionally, the psychological aspect of the patient and their family environment is emphasized. It is essential to have a supportive environment and a multidisciplinary professional approach to address the appearance of the new limb and facilitate the patient's rehabilitation. This comprehensive approach contributes to a successful adaptation and a better quality of life for those undergoing Van Nes rotationplasty.

REFERENCES

I. Hawkins M, Draper G, Kingston J. Incidence of second primary tumours among childhood cancer survivors. Br J Cancer. 1987 Sep;56(3):339–47.

II. McIntyre JF, Smith-Sorensen B, Friend SH, Kassell J, Borresen AL, Yan YX, et al. Germline mutations of the p53 tumor suppressor gene in children with osteosarcoma. J Clin Oncol. 1994 May;12(5):925–30.

III. Meyers PA, Gorlick R. Osteosarcoma. Pediatr Clin North Am. 1997 Aug;44(4):973–89.

IV. Grimer RJ, Taminiau AM, Cannon SR, Surgical Subcommitte of the European Osteosarcoma Intergroup. Surgical outcomes in osteosarcoma. J Bone Joint Surg Br. 2002 Apr;84(3):395–400.

V. Salunke AA, Chen Y, Tan JH, Chen X, Khin LW, Puhaindran ME, et al. Does a pathological fracture affect the prognosis in patients with osteosarcoma of the extermities? Bone Joint J. 2014;

VI. Abudu A, Sferopoulos NK, Tillman RM, Carter SR, Grimer RJ. THE SURGICAL TREATMENT AND OUTCOME OF PATHOLOGICAL FRACTURES IN LOCALISED OSTEOSARCOMA. Vol. 78, J Bone Joint Surg [Br]. 1996.

VII. Wang TI, Wu PK, Chen CF, Chen WM, Yen CC, Hung GY, et al. The prognosis of patients with primary osteosarcoma who have undergone unplanned therapy. Jpn J Clin Oncol. 2011 Nov;41(11):1244–50.

VIII. Jeon DG, Lee SY, Kim JW. Bone primary sarcomas undergone unplanned intralesional procedures—the possibility of limb salvage and their oncologic results. J Surg Oncol [Internet]. 2006 Dec 1;94(7):592–8. Available from: http://doi.wiley.com/10.1002/jso.20607

IX. Borggreve J. Kniegelenkersatz durch das in der Beinlängsachse un 180 gedrehte Fussgelenk. Arch Orthop Unfallchir. 1930;28:175–8.

X. Van Nes CP, Leiden, Holland. Rotation-Plasty for congenital defects of the femur. Making use of the ankle of the shortened Limb to control the Knee Joint of a Prosthesis. J Bone Joint Surg. 1950;32-B(Nº1):12–6.

XI. Bergmann Verlag JE, Salzer' M, Knahr', R Kotz K, Kristen H. Archives of Orthopaedic and Traumatic Surgery Treatment of Osteosarcomata of the Distal Femur by Rotation-Plasty. Vol. 99, Arch Orthop Traumat Surg. 1981.

XII. Hardes J, Gebert C, Hillmann A, Winkelmann W, Gosheger G. Umkehrplastik im operativen behandlungsplan der primär malignen knochentumoren: Möglichkeiten und grenzen. Vol. 32, Orthopade. 2003. p. 965–70.

XIII. Kotz R. Rotationplasty. Vol. 13, Seminars in Surgical Oncology. 1997.

XIV. Catani F, Capanna R, Benedetti MG, Battistini A, Leardini A, Cinque G, et al. Gait analysis in patients after Van Nes rotationplasty. J Biomech [Internet]. 1992 Jun;25(6):685. Available from: https://linkinghub.elsevier.com/retrieve/pii/002192909290208I

XV. Gottsauner-Wolf F, Kotz R, Knahr K, Kristen H, Salzer M. Rotationplasty for Limb Salvage in the Treatment of Malignant Tumors at the Knee A FoLLow-UP STUDY OF SEVENTY PATIENTS*. J Bone Joint Surg. 1991;73-A(Nº9):1365–75.

XVI. Cammisa FP Jr. The Van Nes tibial rotationplasty. A functionally viable reconstructive procedure in children who hace a tumor of the distal end of the femur. J Bone Joint Surg Am. 1990;70(12):1541–7.

XVII. Carrol K. Know you options: an explanation of the rotationplasty and tibia turn-up procedures. In Motion. 2005;15(2).

XVIII. van de Sande MAJ, Vochteloo AJH, Dijkstra PDS, Taminiau AHM. Van Nes-Borggreve Rotationplasty of the Knee. In: European Surgical Orthopaedics and Traumatology. Springer Berlin Heidelberg; 2014. p. 4135–47.

XIX. Winkelmann WW. Type-B-IIIa Hip Rotationplasty: An Alternative Operation for the Treatment of Malignant Tumors of the Femur in Early Childhood *. THE JOURNAL OF BONE AND JOINT SURGERY. 2000.

XX. Barr RD, Wunder JS. Bone and soft tissue sarcomas are often curable - But at what cost? A call to arms (and legs). Vol. 115, Cancer. 2009. p. 4046–54.

XXI. WW. Winkelmann. Rotationplasty. Orthop Clin North Am. 1996 Jul 27;27(3):503–23.

XXII. Winkelmann W. Hip Rotationplasty for Malignant Tumors of the Proximal PArt of the Femur. Journal of Bone and Joint Surgery. 1986;68-A(Nº3):362–9.

XXIII. Rosenbaum D, Eils E, Hillmann A. Changes in talocrural joint contact stress characteristics after simulated rotationplasty. Vol. 36, Journal of Biomechanics. 2003.

XXIV. RAYMOND M STEENHOFF MDt HEIN A M DAANEN BJ, M TAMINIAU PHDt LEIDEN THE NETHERLANDS AH. Functional Analysis of Patients Who Have Had a Modified Van Nes Rotationplasty*. J Bone Joint Surg. 1993;75-A(Nº10):1451–6.

XXV. Bernthal NM, Monument MJ, Lor Randall R, Jones KB. Rotationplasty: Beauty is in the 1 of the beholder. Oper Tech Orthop. 2014;24(2):103–10.

XXVI. Gupta SK, Alassaf N, Robertson Harrop A, Kiefer GN. Principles of rotationplasty. Vol. 20, Journal of the American Academy of Orthopaedic Surgeons. 2012. p. 657–67.

XXVII. Sawamura C, Hornicek FJ, Gebhardt MC. Complications and risk factors for failure of rotationplasty: Review of 25 patients. In: Clinical Orthopaedics and Related Research. Springer New York; 2008. p. 1302–8.

XXVIII. Baxter BT, Mahoney C, Johnson PJ, Selmer KM, Pipinos II, Rose J, et al. Concomitant Arterial and Venous Reconstruction with Resection of Lower Extremity Sarcomas. Ann Vasc Surg. 2007 May;21(3):272–9.

XXIX. Fayers PM, Weeden S, Curran D 1903 1985, European Organization for Research on Treatment of Cancer Study Group on Quality of Life. Rotationplasty-quality of life after 10 years in 22 patients. Acta Orthop Scand. 2002;73(1):85–8.