Rehabilitation After Endoprosthetic Reconstruction in Distal femur Osteosarcomas: A Review Article

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Abstract

Osteosarcomas are considered the most common primary bone tumor. Following lymphomas and brain cancers, it is considered the third most common cancer among children and adolescents, with an incidence of 3.4 per million people per year worldwide. Osteosarcomas are best treated with preoperative chemotherapy, surgery, and then postoperative chemotherapy. Patients frequently have some ongoing physical issues. These include the inability to perform an active range of motion, reduced muscle strength, gait abnormalities, impaired motor control, and limb-length discrepancies. In order to restore daily living activities, enhance quality of life, and enhance patients' psychological status, postoperative rehabilitation exercises are essential.The purpose of the current review article is to discuss postoperative rehabilitation strategies and exercise considerations for patients with distal femur osteosarcoma who had underwent endoprosthesis reconstruction.

Keywords: Osteosarcoma, bone tumor, endoprosthesis, rehabilitation, exercises.

1. Introduction

Osteosarcomas are considered the most common primary bone tumor. Following lymphomas and brain cancers, it is considered the third most common cancer among children and adolescents. They exhibit malignant mesenchymal cells and the formation of osteoid, or immature bone (Luetke et al., 2014; Misaghi et al., 2018).

The incidence of osteosarcoma is 3.4 per million people per year worldwide. The distribution of disease is bimodal, with the first peak happening in adolescence (average ages of 10 to 14 years for girls and 15 to 19 years for men) and the second peak happening in the elderly beyond age 65 (Mirabello et al., 2009).

Causes and risk factors

It is not clear what causes osteosarcoma. A history of radiation therapy or chemotherapy, Paget disease or a similar benign bone lesion, and genetic disorders such as hereditary retinoblastoma and Werner syndrome are among the risk factors for osteosarcoma (Luetke et al., 2014 ; Misaghi et al., 2018).

Clinical presentation

Patients complain of localized, dull aching pain for several months following an injury. Pain may be flactuating, but it never totally disappears, and it is commonly worse at night. Patients may also complain of systemic symptoms including weight loss, fever, exhaustion, or malaise, but they often do not. On physical examination, a soft tissue mass that is painful to palpation and demonstrates noticeable warmth, skin vascularity, or pulsations across the lesion is frequently seen (Simpson & Brown, 2018; Misaghi et al., 2018).

Patients frequently have some ongoing physical issues. These include the inability to perform an active range of motion, reduced muscle strength, gait abnormalities, impaired motor control, and limb-length discrepancies. But they continued to exhibit high levels of emotional acceptance and coping (Beebe et al., 2009).

Classifications of osteosarcoma

According to the Enneking System for Staging Osteosarcomas, it is classified into three stages based on tumor extent and aggressiveness (Enneking et al., 1980) (Table 1).

Table 1: Classifications of Osteosarcoma (Enneking et al., 1980)

Stage I	Stage II	Stage III
a low-grade tumor (which originates from the medullary cavity of the bone)	a high-grade tumor (which develops on the surface of the bone from the outer cortex)	distant metastasis or lymph node involvement
IA-intra compartmental	IIA—intra compartmental (remain within the bone)	
IB-extra compartmental	IIB-extra compartmental (extend beyond the bone)	

doi.org/10.31838/hiv23.03.132 Received: 03.11.22, Revised: 19.12.22, Accepted: 06.01.23.

Management of osteosarcoma

Orthopedic oncologists, clinical oncologists, physiotherapists, psychiatrists, and specialized nurses all collaborate in the multidisciplinary treatment of patients with osteosarcoma. Neoadjuvant chemotherapy, limb-sparing/salvage surgery, amputation, and adjuvant chemotherapy constitute the standard care for osteosarcomas. Prior to surgery, patients get neoadjuvant chemotherapy for 8 to 10 weeks. While postoperative chemotherapy is postponed for up to 21 days to allow for the healing of surgical wounds. Thereafter, 12 to 29 weeks of adjuvant chemotherapy are given (Luetke et al., 2014).

As long as there were no contraindications, limb salvage became the recommended course of therapy since its oncological results were equivalent to those of amputation (Rougraff et al., 1994). 90% of osteosarcoma patients had limb salvage surgery, with a 60% to 80% success rate (Bernthal et al., 2015; Reddy et al., 2015).

Limb-Salvage Surgery

After the removal of malignant bone tumors from the limbs, a surgical technique known as "limb-salvage surgery" is performed to restore bone and joint function (Xu et al., 2020).

Indications for Limb-Salvage Surgery (Xu et al., 2020)

- Chemotherapy is responsive to Enneking stages IIA, IIB, and III, and metastases are manageable.
- Favourable reaction to chemotherapy.
- A wide resection margin could be obtained.
- No affection to the main vascular nerve.
- The physical condition score (Karnofsky score) is >60, indicating high overall health.
- Sufficient soft tissue coverage **(Gerrand et al., 2016)**.
- The expected functional outcomes and survival rates are equal to or greater than those following an amputation in the same instance **(Cirstoiu et al., 2019)**.

2. Methods of Limb Salvage Surgery

Tumor endoprosthesis, autologous or allograft bone reconstruction, soft tissue reconstruction, resection arthrodesis, and rotationplasty (Xu et al., 2020).

Tumor Endoprosthesis

It is the method for limb-salvage reconstruction that is most frequently employed. For maximal stability and mobility following the removal of the distal femur tumour, it is advised to select either the assembled prosthesis or the rotating hinged custom prosthesis. Additionally, the fundamental health of the patient's bones should be taken into consideration while choosing between bone cement and cementless fixation (Figure 1) (Chen et al., 2005; Houdek et al., 2016).

Poor bone quality, insufficient size, and a remnant bone segment are the primary determining factors in choosing a cemented stem fixation.

Absolute contraindications to limb salvage include a massive tumour that surrounds major neurovascular systems, an incorrect biopsy method and/or subsequent site problems, insufficient soft-tissue covering, or a pathological fracture, which often signals significant contamination. On the other hand, relative contraindications include a very young child with a significant risk for limb length inequality (Cirstoiu et al., 2019).

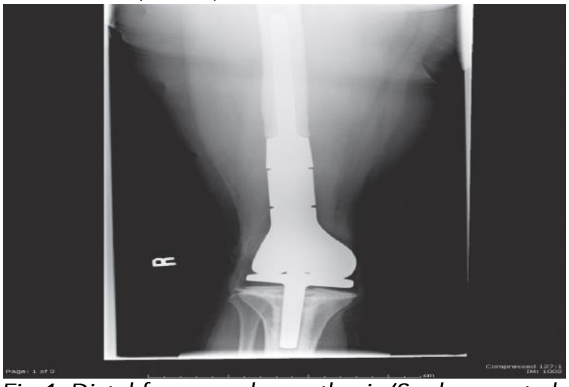

Fig.1: Distal femur endoprosthesis (Soeharno et al., 2018)

Musculoskeletal deficiency from surgery

Deficiency of bone and joint

Replacement after resection of the bone and joint necessitates the use of endoprosthesis (customized or modular), internal implants such as nails, plates, cement, allografts, composites, or combinations.

Muscle deficiency

Due to tumour involvement, the vastus intermedius muscle and a part of the vastus medialis or lateralis muscles had to be removed. This resulted in damage to the muscles' innervation because the nerve was involved in the tumour.

Nerve injury

- A nerve affected by a tumour has to be removed (saphenous nerve).
- Because major nerves had to be mobilized during the surgery, neuropraxia resulted.
- Long surgical operations put local pressure on nerves.
- Direct nerve injury brought on by non-surgical procedures like radiation.

Distal Femoral Endoprosthesis Rehabilitation Principles

If the site is healed, begin knee flexion range of motion exercises with CPM 5-7 days after surgery (Figure 2). The patient then begins active assisted exercises, and the therapist should emphasize on the range of knee extension.

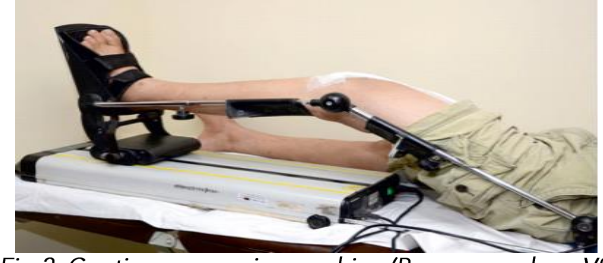

Fig.2: Continuous passive machine (Paramanandam, VS, Daptardar AA, 2016)

Using static contraction to strengthen the quadriceps and hamstring muscles, followed by open chain and closed chain exercises. Although the degree of quadriceps resection is an important factor determining the knee extension strength and the functional outcomes, other factors include the history of the deformity, the details of the surgical procedure changing the orientation and length-tension characteristics of the muscle fibers, the design of the prosthesis, the rehabilitation program, and postoperative periprosthetic scar tissue (Markhede & Stener, 1981;Tsuboyama et al., 1993).

Ambulation and self-transfer (from bed to chair) to improve daily living activities. Allow early weight bearing in the case of a cemented endoprosthesis and delay for at least 6 weeks in the case of a cementless endoprosthesis.

According to Carty et al. (2009), strengthening the knee extensor muscles and increasing the range of knee flexion are two crucial factors to concentrate on during the rehabilitation process.

The rehabilitation programme following endoprosthesis was divided into two phases by Morri et al., (2018):

Partial weight-bearing phase (1st–2nd month)

The primary goals of treatment were to regain fundamental lower-limb function, including walking, enhancing knee mobility, and strengthening the quadriceps muscle. To prevent the onset of extension lag, supine knee flexion-extension and quadriceps strengthening exercises were carried out with a ball while focusing particularly on the last degrees of extension.

Proprioceptive exercises in a sitting or standing position with a ball and rubber bands are required because all knee ligaments are resected, which affects knee joint proprioception.

Progressive weight-bearing phase (2nd–6th month)

Weight-shifting exercises while maintaining good body posture, motor control exercises by an elastic band, and standing on an unstable surface or balance board starting by standing on both limbs then gradually on one limb (Figure 3).

Fig.3: Exercises for patients with endoprosthetic knee replacement (Morri et al., 2018)

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