

# COMPLICATIONS OF HEMIPELVECTOMY FOR THE TREATMENT OF MUSCULOSKELETAL TUMORS

COMPLICAÇÕES DA HEMIPELVECTOMIA PARA O TRATAMENTO DE TUMORES MÚSCULOESQUELÉTICOS

COMPLICACIONES DE LA HEMIPELVECTOMÍA PARA EL TRATAMIENTO DE TUMORES MÚSCULOESQUELÉTICOS

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## ABSTRACT

Hemipelvectomy is a highly complex surgical procedure used mainly to treat musculoskeletal tumors, most of which are malignant tumors, located around or in the pelvic bones. Regardless of the surgical technique, hemipelvectomy still results in a high rate of complications. In this review article, we will discuss the main indications for hemipelvectomy, as well as the most frequent complications and surgical strategies to reduce associated morbidities. **Level of Evidence III; Review Article.**

**Keywords:** Hemipelvectomy; Bone Neoplasms; Muscle Neoplasms; Intraoperative Complications; Postoperative Complications.

## RESUMO

A hemipelvectomia é um procedimento cirúrgico de alta complexidade utilizado principalmente para o tratamento de tumores musculoesqueléticos, em sua maioria malignos, que estão localizados ao redor ou nos ossos da pelve. Independente da técnica cirúrgica, a hemipelvectomia ainda resulta em alta taxa de complicações. Nesse artigo de revisão, serão discutidas as principais indicações para a realização da hemipelvectomia, assim como as complicações mais frequentes e as estratégias cirúrgicas a fim de reduzir as morbidades associadas. **Nível de Evidência III; Artigo de Revisão.**

**Descritores:** Hemipelvectomia; Neoplasias Ósseas; Neoplasias Musculares; Complicações Intraoperatórias; Complicações Pós-Operatórias.

## RESUMEN

La hemipelvectomía es un procedimiento quirúrgico de alta complejidad que se utiliza principalmente para tratar tumores musculoesqueléticos, la mayoría malignos, localizados alrededor o en el hueso pélvico. Independientemente de la técnica quirúrgica, la hemipelvectomía presenta una alta tasa de complicaciones. Este artículo de revisión analizará las principales indicaciones para la hemipelvectomía, así como las complicaciones más frecuentes y las estrategias quirúrgicas para reducir la morbilidad asociada. **Nivel de Evidencia III; Artículo de Revisión.**

**Descriptorios:** Hemipelvectomía, Neoplasias Óseas; Neoplasias de los Músculos; Complicaciones Intraoperatorias; Complicaciones Posoperatorias.

## INTRODUCTION

Hemipelvectomy is a highly complex surgical procedure used mainly to treat tumors located in the pelvis, which can affect both children and adults. Different primary malignant tumors can arise in the bones of the pelvis, and the most common types include chondrosarcoma, Ewing's sarcoma, and osteosarcoma. Furthermore, pelvic metastasis of tumors from other primary origins can occur, mainly adenocarcinoma of the breast, prostate, kidney, lung, and intestine (which are preferably treated with radiotherapy).<sup>1</sup> Although osteoid matrix tumors exhibit good response to chemotherapy and tumors of mesenchymal and ectodermal origin exhibit good response to

both chemotherapy and radiotherapy, wide surgical resection is considered the gold standard for the treatment of these high-grade lesions. Chondrosarcoma is a type of tumor that often does not respond to neoadjuvant and adjuvant treatments, and therefore, surgical resection is the most indicated curative treatment.<sup>2</sup>

Hemipelvectomies can be internal, when the ipsilateral lower limb is preserved, or external, when the disarticulation of the ipsilateral limb is performed. In 1978, Enneking and Dunham described a classification system for the resection of sarcomas based on the region of the pelvis that is removed with surgery.<sup>3</sup> This classification can be divided into four types: type I – resection of the iliac wing

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(including or not the gluteal musculature), type II – resection of the periacetabular region (including or not the coxofemoral joint), type III - resection of the ischium and pubis, type IV - resection of the sacroiliac joint (Figure 1). The resection may involve a combination of these types, depending on the extension of the lesion.

Since the innominate bone is directly associated with several important structures, such as the bladder, intestine, ureter, and neurovascular bundles, hemipelvectomy is an extensive and complex surgical procedure characterized by numerous complications that can affect around 50% of cases, mainly type IV, which affects the sacral spine. The main complications include the presence of intra- and postoperative bleeding, infections, wound dehiscence with lymphorrhea, flap ischemia, deep vein thrombosis, sciatic neuritis, hernia of the pelvic viscera to the flank, and local tumor recurrence.<sup>1,4</sup>

Although hemipelvectomy results in a high rate of complications, it is still the most indicated treatment option for tumors in the pelvic bone, especially malignant tumors that do not respond to systemic and/or local therapy. It has been observed that the overall survival rates of patients undergoing hemipelvectomy are higher compared to those who underwent conservative treatment with chemotherapy and radiotherapy.<sup>4,5</sup> In this review, we will describe the main complications of hemipelvectomy for the treatment of musculoskeletal tumors, as well as surgical strategies to reduce associated morbidities.

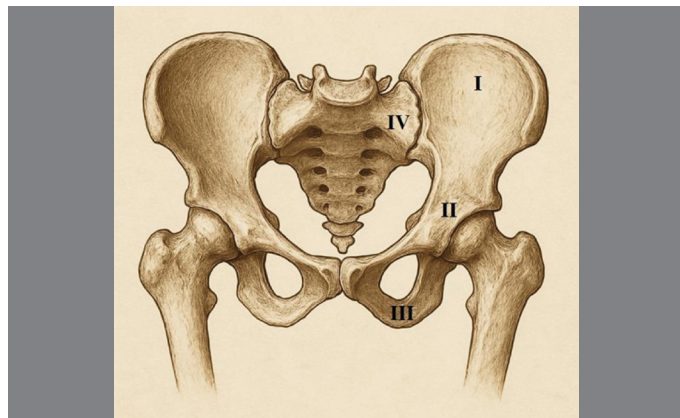
### Internal hemipelvectomy

Internal hemipelvectomy involves resection of a bone tumor in the innominate bone, preserving the ipsilateral lower limb. The selection of the surgical incision and the patient's intraoperative positioning depend on the anatomical region to be addressed. In type I, the incision is ilioinguinal, following the iliac crest to the sacroiliac joint, associated with a lateral incision. The incision for type II hemipelvectomy is ilioinguinal, associated with an anterolateral incision of the femur. For type III, the ilioinguinal incision is made associated with two longitudinal incisions, and a pfanistil may be performed. In type IV, the incision begins at the anterosuperior iliac crest and extends to the sacroiliac joint.<sup>1</sup>

Internal hemipelvectomy can be performed with or without replacement bone reconstruction. The goal of performing the bone reconstruction is to achieve better function and early rehabilitation for the patient. Reconstructions can be performed with bone allograft and/or autograft vascularized fibula for better graft integration, non-conventional endoprostheses, or customized three-dimensional (3D)-printed prostheses. (Figures 2 and 3)

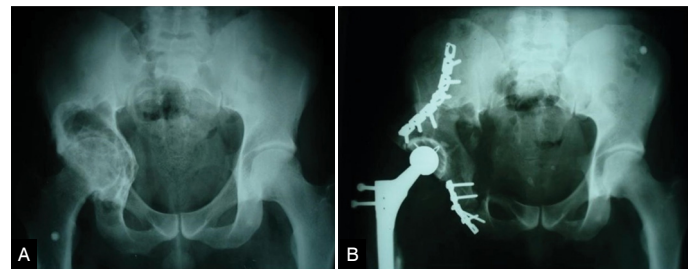
### External hemipelvectomy

Since limb salvage surgery is an increasing treatment choice over amputation, the external hemipelvectomy has decreased in



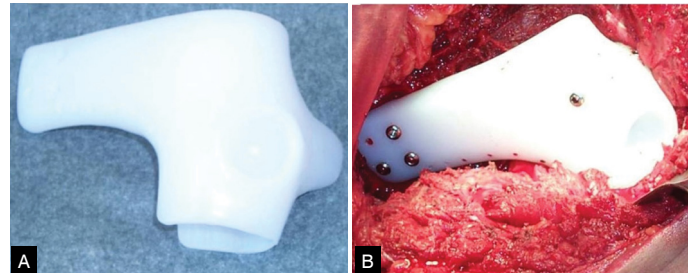
Source: Authors (Created by Artificial Intelligence).

**Figure 1.** The Enneking classification system for internal hemipelvectomy resections: type I (ilium), type II (periacetabular region), type III (ischium and pubis), and type IV (sacrum).



Source: Image database of Instituto Nacional de Traumatologia e Ortopedia.

**Figure 2.** Endoprosthetic reconstruction following tumor resection. A) Preoperative imaging showing a chondrosarcoma tumor in the right proximal femur. B) Postoperative imaging showing limb reconstruction with endoprosthesis and locking plates.



Source: Image database of Instituto Nacional de Traumatologia e Ortopedia.

**Figure 3.** 3D-printed custom prosthesis. A) 3D-printed model for bone reconstruction. B) Reconstruction with 3D prosthesis inserted into the defect after chondrosarcoma resection.

recent years. However, external hemipelvectomy is still indicated for cases where it is not possible to maintain a safe surgical margin or when there is tumor involvement of the neurovascular bundle.<sup>4</sup> To perform this surgical procedure, the anterior incision begins 5 cm from the anterosuperior iliac spine to the pubic tubercle, and the second incision begins in the same place as the first, passing over the greater trochanter in parallel with the gluteal line until it meets the previous incision.<sup>1</sup>

### DISCUSSION

Hemipelvectomy is a surgical procedure indicated for treating malignant bone tumors located in the pelvic region. Although it results in better overall survival rates compared to chemotherapy and radiotherapy alone, this surgical procedure is highly complex and presents many clinical complications. The most common complication related to hemipelvectomy is infection, both superficial and deep.<sup>6-25</sup>

Benatto et al. observed an infection rate of 36% and reported that bone reconstruction, acetabular resections, and prolonged surgical time were associated with increased infection rates and, consequently, hospital costs.<sup>6</sup> The authors also reported a 16% rate of immediate postoperative death. Guder et al. described an infection rate of 61.9% in their study, in which three patients required amputation due to complications of postoperative infection.<sup>14</sup>

Karaca et al. reported that patients undergoing external hemipelvectomy were more susceptible to infection than those undergoing internal hemipelvectomy.<sup>7</sup> In addition, the authors showed that patients undergoing internal hemipelvectomy had higher survival rates compared with patients treated with external hemipelvectomy (97.0 months *versus* 25.7 months, respectively), which correlates with the tumor size. This may occur because external hemipelvectomy often results in a larger resected area, with ligation of blood vessels and consequently less local perfusion.

Some studies reported that the risk of infection in internal hemipelvectomy is higher with reconstruction of the bone defect, using prosthesis or allograft.<sup>19,24</sup> In some cases of persistent infection,

removal of the prosthesis is necessary, or even external hemipelvectomy is indicated subsequently. Ogura et al. observed that the extension of the tumor, blood transfusion, iliac artery injury, and use of allograft were risk factors for complications of infection.<sup>25</sup>

Another common complication of hemipelvectomy is symptomatic visceral hernia, notably in type III hemipelvectomy, which results from the removal of bone and adjacent soft tissue, consequently causing fragility of the abdominal wall. The use of polypropylene mesh to strengthen the abdominal wall is an option to prevent the occurrence of hernias, in addition to providing adequate surgical closure.<sup>5</sup> The use of allograft and 3D printed prostheses has been an option in the reconstruction of type III hemipelvectomies, reducing the rate of visceral hernia.<sup>13,14,26-30</sup> Another common complication is the presence of residual tumor due to limited surgical margin, resulting in disease recurrence, especially for tumor types that do not respond to adjuvant treatment.<sup>14,25,29</sup>

An increase in the development and improvement of surgical techniques to minimize complications and reduce morbidity of hemipelvectomies has been observed in recent years.<sup>8,15,18,21,23,25,28,31-34</sup> Among these techniques, 3D reconstructions for better surgical planning and 3D printed prostheses are a promising avenue in orthopedic oncology. These prostheses can be customized according to the extent of the bone loss. Benady et al. observed that 3D

printing of customized models and instruments for cancer patients provided better delimitation of the surgical margins, resulting in more effective surgery.<sup>8</sup>

## CONCLUSIONS

Hemipelvectomy is the most indicated surgical treatment for bone tumors located in the pelvic region, especially for large tumors that do not respond to chemotherapy and radiotherapy. Despite this, it is a procedure that results in several complications, especially infections. New technical approaches have been developed to minimize these effects. However, they are not yet widely adopted in clinical practice due to their financial cost.

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