



Results and surgical experience obtained from 50 patients treated through hemipelvectomy

Resultados y experiencia quirúrgica obtenida de 50 pacientes tratados mediante hemipelvectomía

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Abstract

Introduction: external and internal hemipelvectomies are infrequent and complex surgical procedures performed for primary and metastatic musculoskeletal neoplasms of the pelvis, as well as for infections and severe injury, whose characteristic is its association with a high incidence of complications. **Objective:** to share the experience generated from the largest Mexican casuistry reported so far in relation to a very infrequent and complex procedure. **Material and methods:** retrospective and descriptive study in a series of cases that analyzes the indications and evolution of 50 patients treated by different varieties of hemipelvectomy. Complications were categorized and functional outcome assessed in patients undergoing internal hemipelvectomy. **Results:** 90% of the patients required hemipelvectomy for neoplastic reasons whose most frequent diagnosis was chondrosarcoma. Initially, 27 hemipelvectomies were external and 23 internal. Due to death, 7 patients could not be evaluated in their evolution. Complications related to wound healing occurred in 53.5% of the cases and thromboembolic phenomena in 6% of the patients. Necrotizing fasciitis produced 100% lethality. **Conclusions:** prolonged surgical time, aggressive tissue management, proximity to naturally contaminated orifices, difficulty in closing dead spaces, as well as compromised patients in different aspects, are the main causes of the high incidence of complications related to hemipelvectomies. These are infrequent and complex procedures that easily become complicated and whose main indication is neoplastic.

Keywords: external hemipelvectomy, internal hemipelvectomy, musculoskeletal neoplasms, complications.

Level of evidence: IV.

Resumen

Introducción: las hemipelvectomías externa e interna son infrecuentes y complejos procedimientos quirúrgicos realizados ante neoplasias musculoesqueléticas primarias y metastásicas de la pelvis, así como por infecciones y trauma severo, cuya característica es su asociación a una alta incidencia de complicaciones. **Objetivo:** compartir la experiencia generada de la casuística mexicana más grande reportada hasta el momento en relación a un procedimiento muy infrecuente y complejo. **Material y métodos:** estudio retrospectivo y descriptivo en una serie de casos que analiza las indicaciones y evolución de 50 pacientes tratados mediante las diferentes variedades de hemipelvectomía. Se categorizaron las complicaciones y se evaluó el resultado funcional en pacientes sometidos a hemipelvectomía interna. **Resultados:** el 90% de los pacientes requirió hemipelvectomía por motivo neoplásico cuyo diagnóstico más frecuente fue condrosarcoma. Inicialmente 27 hemipelvectomías fueron externas y 23 internas. Debido a muerte, siete pacientes no pudieron ser evaluados en su evolución. Complicaciones relacionadas a cicatrización se presentaron en 53.5% de los casos y fenómenos tromboembólicos en 6% de los pacientes. La fascitis necrosante produjo 100% de letalidad. **Conclusiones:** tiempo quirúrgico prolongado, manejo agresivo de tejidos, cercanía a orificios naturalmente contaminados, dificultad para cerrar espacios muertos, así como pacientes comprometidos en varios aspectos, son las principales causas de la alta incidencia de complicaciones relacionadas a las hemipelvectomías. Son procedimientos infrecuentes y complejos que fácilmente se complican y cuya indicación principal es neoplásica.

Palabras clave: hemipelvectomía externa, hemipelvectomía interna, neoplasias musculoesqueléticas, complicaciones.

Nivel de evidencia: IV.

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How to cite: Sánchez-Torres LJ, Espinoza VA, Moctezuma RR, Martínez RGM, Aguayo ILE, Pérez PPL, et al. Results and surgical experience obtained from 50 patients treated through hemipelvectomy. Orthotips. 2024; 20 (1): 6-14. <https://dx.doi.org/10.35366/114210>

Received: 01-16-2023. Accepted: 09-05-2023.

Introduction

The term hemipelvectomy was coined by Kellogg Speed in 1932,¹⁻³ and according to the definition of Ariel and Hark, it is that procedure in which the entire innominate bone, contiguous soft tissues, and the rest of the lower limb, are resected like a single masse.⁴ It has been considered that Kocher in 1884 and Theodor Billroth between 1889 and 1891⁵⁻⁷ were the first to perform it, however, both patients died.⁵

Due to the complex anatomy of the pelvis, pelvic resections are difficult surgeries that require experience and a detailed preoperative plan.⁸

External hemipelvectomy, also known as hindquarter amputation, is a rare surgical procedure in which the lower limb is resected together with the corresponding iliac bone.^{8,9} If the iliac bone is completely resected, it is called classic external hemipelvectomy, but if the iliac wing is preserved, then it is known as modified external hemipelvectomy.

Internal hemipelvectomy is complete or partial resection of the iliac bone and soft-tissues with preservation of the affected limb.⁹ Aproximately 15% of all primary bone tumors are located in the pelvis.^{8,10}

External and internal hemipelvectomy are rare surgical treatment methods applied in primary tumors of the pelvis, pelvic metastasis, infections and severe injury.^{8,9} Osteosarcoma and Ewing sarcoma most commonly occur in childhood and chondrosarcoma occur more frequently in older adults.^{8,10,11}

The objective of this paper is to provide a broad overview of an infrequent but complex procedure, which is usually accompanied by a high incidence of complications, and from which an attempt has been made to recover the experience of an important and difficult to obtain casuistry.

Material and methods

This is a descriptive and retrospective study in a series of cases performed in 2 High Specialty Medical Units belonging to the Northeast National Medical Center, at the Mexican Institute of Social Security (Medical Unit of High Specialty in Traumatology and Orthopedics and High Specialty Hospital), and the private practice of the authors. The study analyzes the results obtained from a series of cases that represent all the patients submitted to hemipelvectomy

by the main author in the period from November 2005 to August 2022, corresponding then to a level of evidence IV.

Preoperative workup for each patient included medical history, clinical examination, routine blood tests, X ray, CT and MRI scans of the pelvis and in most cases of the whole body. Histological diagnoses were done either core needle or open biopsy. All procedures had the participation of the main author.

We analyze the evolution since surgery to complete wound healing. Age, diagnosis, type of hemipelvectomy and complications presented until the complete healing of the surgical wounds, were considered.

External hemipelvectomies were classified as classic and modified, and these in turn can be extended and/or compounded.

Pelvic resections in internal hemipelvectomies were classified using the system proposed by Enneking and Dunham.¹²

Surgical site collections: a) seroma, b). hematoma and c). abscess/infection, as well as complications related with wound healing and referred as skin damage and coverage alterations (SDCA), were classified as mild (grade 1), moderate (grade 2), and severe (grade 3). Regarding the collections, grade 1 complications were those that only required removing a maximum of 5 sutures for drainage and healing until secondary closure, grade 2 complications were those that required removing more than 5 sutures for drainage and staying with bed cures until secondary closure or preferably new closure in the operating room, and grade 3 complications were those that required drainage/debridement and cures in the operating room with new closure on the surgical wound. SDCA were classified as grade 1 when there was superficial suffering that time resolved, grade 2 was when debriding was required without producing an opening with communication towards the pelvic cavity, and finally grade 3 when skin damage produced this communication. The use of antibiotics was personalized based on each situation.

Possible complications derived from visceral injuries were contemplated.

Functional status was obtained in those patients who underwent internal hemipelvectomy using the musculoskeletal tumor society (MSTS) scoring system.¹³

Deaths are reported based on the period in which they occurred. Intraoperative deaths are indicated in the respective table of complications as 1, those that occurred within the first 3 days (early postoperative period) as 2, and those that occurred after this period as 3.

All patients were followed up until their postoperative status was determined to be resolved or fully categorized.

Results

From November 2005 to August 2022, we treated 50 patients who underwent hemipelvectomy for different reasons of which 18 were women and 32 men. The age range was from 2 to 78 years old with a mean of 36.

The etiologies that motivated the care of these 50 patients were: chondrosarcoma (CSA) (n = 14), metastatic bone disease (MET) (n = 6), Ewing sarcoma (EWS) (n = 5), soft-tissue sarcoma (STS) (n = 5), osteosarcoma (OSA) (n = 4), giant cell tumor of bone (GCT) (n = 3), undifferentiated pleomorphic sarcoma (UPS) (n = 3), angiosarcoma (ASA) (n = 2), fibrosarcoma (FSA) (n = 2), congenital myositis ossificans (CMO) (n = 1), severe injury (INJ) (n = 3) and necrotizing fasciitis (NFA) (n = 2).

27 hemipelvectomies were external and 23 internal; of the latter, 2 were accessed through the utilitarian approach of Enneking and Dunham,¹² 1 through an ilioinguinal approach extended to the anterior aspect of the proximal thigh, and the rest through a single ilioinguinal approach.¹⁴ One of the patients who underwent internal hemipelvectomy using a single ilioinguinal approach required external hemipelvectomy 24 hours after the initial procedure due to thrombosis in the operated limb, then considering for definitive evaluation 28 external hemipelvectomies, 51 procedures, and 50 patients. None of the internal hemipelvectomies was reconstructed.

Considering the etiologies roughly, 5 of the external hemipelvectomies were for non-neoplastic reasons, of which 3 were covered by a posterior flap and 2 by an anterior flap. All external hemipelvectomies performed for neoplastic reasons (n = 23) were covered with a posterior flap.

There were 2 intraoperative deaths, the first (external hemipelvectomy) due to pulmonary thromboembolism and the second (internal hemipelvectomy) as a result of hypovolemia

due to bleeding. A patient undergoing internal hemipelvectomy with an added diagnosis of morbid obesity died in the intensive care unit 24 hours after his procedure due to myocardial infarction secondary to hemodynamic alterations. A patient who underwent external hemipelvectomy for necrotizing fasciitis died 3 days later as a result of abdominal sepsis, and another patient with the same diagnosis and for the same reason 10 days later. Another 2 deaths occurred 14 days after their respective surgery was performed; in one of the cases as a result of multiple organ failure after performing a compounded external hemipelvectomy that included a partial resection of the bladder in a patient who underwent multiple surgery for recurrent iliac chondrosarcoma, and the other case in a HIV positive patient who developed multilevel thrombosis including the lung, kidney and the limb opposite to the procedure (internal hemipelvectomy). In total, 7 of the 50 patients (14%) died before hospital discharge. If we transfer this incidence to non-neoplastic causes for hemipelvectomy, the percentage increases considerably (40%). Necrotizing fasciitis produced a 100% fatality rate.

In relation to complications in the healing process, of the 51 procedures, deaths (n = 7) and internal hemipelvectomy that became external, were excluded, considering then the latter as external. Of 43 hemipelvectomies evaluated 46.5% (n = 20) were

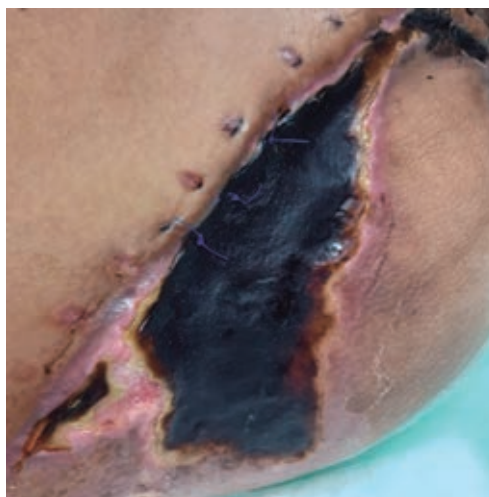


Figure 1: In hemipelvectomy for neoplastic origin, the priority is a resection with clean margins; this situation frequently compromises the quality of skin coverage. In non-neoplastic hemipelvectomy the search for coverage can also result in poorly vascularized flaps.

Table 1: This table shows the case number (1 to 25), gender, age, diagnosis, type of hemipelvectomy, and in patients who underwent internal hemipelvectomy, its functionality based on the MSTS system. Non-neoplastic diagnoses are noted.

| Case | Gender | Age | Diagnosis | Type of hemipelvectomy | Function MSTS score |
|------|--------|-----|-----------|-----------------------------|---------------------|
| 1 | Female | 56 | STS | CEH | — |
| 2 | Male | 74 | MET | MEH | — |
| 3 | Male | 17 | UPS | MEH | — |
| 4 | Male | 36 | GCT | CEH | — |
| 5 | Female | 12 | OSA | IH III | 30/30 |
| 6 | Male | 29 | CSA | IH I | 30/30 |
| 7 | Male | 22 | ASA | IH II + III | 17/30 |
| 8 | Male | 36 | CSA | EEH | — |
| 9 | Female | 78 | FSA | CEH | — |
| 10 | Male | 48 | ASA | IH I + II + III | — |
| 11 | Female | 15 | OSA | IH IIA + III | 21/30 |
| 12 | Female | 54 | STS | CEH | — |
| 13 | Male | 16 | EWS | EEH | — |
| 14 | Female | 43 | UPS | IH I + IIA + III | 15/30 |
| 15 | Male | 50 | MET | CEH | — |
| 16 | Male | 66 | CSA | CoEH | — |
| 17 | Female | 32 | GCT | IH I + IIA + III + IV → CEH | — |
| 18 | Male | 15 | OSA | CEH | — |
| 19 | Male | 35 | STS | IH I + II + III | — |
| 20 | Female | 24 | GCT | IH I + IV | 10/30 |
| 21 | Male | 39 | INJ | CEH | — |
| 22 | Male | 52 | MET | CEH | — |
| 23 | Male | 14 | EWS | CEH | — |
| 24 | Male | 30 | STS | IH III | 20/30 |
| 25 | Female | 50 | CSA | IH I | — |

CEH = classical external hemipelvectomy, MEH = modified external hemipelvectomy, EEH = extended external hemipelvectomy, IH = internal hemipelvectomy, CoEH = compounded external hemipelvectomy. (Enneking and Dunham's classification I/II/III/IV), and conversion to classical external hemipelvectomy = → CEH. Function score: dark gray for patients undergoing external hemipelvectomy, light gray for patients undergoing internal hemipelvectomy without follow-up for evaluation, and black in patients who died.

without complications and 53.5% (n = 23) presented complications categorized as follows: grade 1 seroma: 4 cases, grade 2 seroma: 1 case, grade 3 seroma: 1 case, grade 1 hematoma: 2 cases, grade 3 hematoma: 1 case, grade 1 abscess/infection: 2 cases, grade 3 abscess/infection: 7 cases, grade 1 SDCA: 1 case, grade 2 SDCA: 3 cases, and grade 3 SDCA: 1 case. Of the 43 hemipelvectomies finally evaluated about the healing process, 23 were external and 20 internal, with a rate of complications in relation to the total of 23.3% (n = 10) and 30.2% (n = 13), respectively, generating the 53.5% previously referred of the whole. If we separate them by the type of hemipelvectomy, 43.47% of external and 65% of internal hemipelvectomies presented complications (Figure 1).

One of the patients who presented grade 3 abscess/infection was under immunosuppression due to kidney transplantation; his diagnosis was angiosarcoma.¹⁵

There were no complications derived from visceral damage.

The type of hemipelvectomy performed in each case is detailed in Tables 1 and 2, as well as other variables evaluated in the patients.

Complications are detailed in Tables 3 and 4.

Of the patients who underwent internal hemipelvectomy, it was not possible to functionally evaluate 3 of the 19 cases who were susceptible to it. The patients evaluated presented a wide range between a maximum score of 30 and a minimum of 3, showing a mean of 15.5/30, using the MSTS scoring system¹³ (Figures 2 and 3).

Discussion

The present study shares the experience obtained after performing our first 50 hemipelvectomies. Indications, type of procedure, complications and associated situations are shown.

It cannot be denied that hemipelvectomies, regardless of their variety, are procedures characterized by a high incidence of complications.¹⁶ The indications for these procedures are scarce, however, all of them involve very complex medical situations that fully justify their performance. All the accompanying situations to a hemipelvectomy must be overlapped to compromised patients in several aspects.¹⁷

These are procedures characterized by long surgical times, aggressive tissue handling, proximity to contaminated natural orifices, as well as the creation of large dead spaces that can easily give rise to collections of a different nature and thus complicate the healing process, in some cases delaying adjuvant therapies.

Based on multiple publications in this regard, since internal hemipelvectomies were not reconstructed,

we suppose that the rate of complications in them was reduced. Reconstruction in internal hemipelvectomies increase the rate of infection⁹ or some other adverse events. Some of these possible complications could be generated both in the healing process and even after prolonged post-surgical periods derived from loosening or some other type of implant failure (including complications from allografts).^{16,18-22}

As the pelvis is a complex and highly vascularized surgical area, the risk of complications derived from this anatomical characteristic may also arise. Bleeding must be anticipated in planning with the anesthesiologist and the specialists who will receive the patient in the intensive care unit. On the other hand, antithrombotic therapy undoubtedly also plays an important role in the comprehensive management of these patients.

Table 2: This table shows the case number (26 to 50), gender, age, diagnosis, type of hemipelvectomy, and in patients who underwent internal hemipelvectomy, its functionality based on the MSTS system. Non-neoplastic diagnoses are noted.

| Case | Gender | Age | Diagnosis | Type of hemipelvectomy | Function MSTS score |
|------|--------|-----|-----------|------------------------|---------------------|
| 26 | Male | 21 | EWS | CEH | — |
| 27 | Male | 16 | CSA | CEH | — |
| 28 | Male | 42 | STS | CoMEH | — |
| 29 | Male | 42 | CSA | IH I + IIA + III | 14/30 |
| 30 | Female | 49 | UPS | IH IIA + III | 13/30 |
| 31 | Female | 2 | CMO | MEH | — |
| 32 | Male | 9 | CSA | IH I + II + III | 26/30 |
| 33 | Male | 25 | CSA | IH I + II + IV | 3/30 |
| 34 | Male | 20 | CSA | CEH | — |
| 35 | Male | 51 | FSA | CEH | — |
| 36 | Male | 62 | CSA | IH I + IIA + III | — |
| 37 | Male | 30 | INJ | CEH | — |
| 38 | Male | 40 | INJ | CEH | — |
| 39 | Male | 16 | NFA | CEH | — |
| 40 | Female | 64 | MET | IH I | 14/30 |
| 41 | Female | 53 | MET | CEH | — |
| 42 | Female | 14 | EWS | IH I + II + IV | — |
| 43 | Female | 52 | CSA | CEH | — |
| 44 | Male | 18 | EWS | IH I + IIA + III | 15/30 |
| 45 | Female | 62 | CSA | IH I | 16/30 |
| 46 | Male | 58 | CSA | IH I + IIA + III | — |
| 47 | Male | 65 | CSA | CEH | — |
| 48 | Male | 22 | OSA | IH IIA + F1 + F2 | 21/30 |
| 49 | Female | 47 | NFA | CEH | — |
| 50 | Female | 50 | MET | IH IIA + III | 13/30 |

CEH = Classical external hemipelvectomy. CoEH = compounded external hemipelvectomy. MEH = modified external hemipelvectomy. IH = internal hemipelvectomy. → CEH = conversion to classical external hemipelvectomy.

Function score: dark gray for patients undergoing external hemipelvectomy, light gray for patients undergoing internal hemipelvectomy without follow-up for evaluation, and black in patients who died.

Table 3: Complication rate from case number 1 to 25.

| Case | ∅ | Seroma | Hematoma | Abscess/Infection | SDCA | Thromboembolic event | Visceral damage | Death |
|------|---|--------|----------|-------------------|------|----------------------|-----------------|-------|
| 1 | — | 2 | — | — | — | — | — | — |
| 2 | — | — | — | 1 | — | — | — | — |
| 3 | — | — | — | 3 | — | — | — | — |
| 4 | — | — | — | — | — | — | — | — |
| 5 | — | — | — | — | — | — | — | — |
| 6 | — | 1 | — | — | — | — | — | — |
| 7 | — | — | — | 3 | — | — | — | — |
| 8 | — | 1 | — | — | — | — | — | — |
| 9 | — | — | — | — | — | — | — | — |
| 10 | — | — | — | — | — | — | — | 2 |
| 11 | — | — | — | — | 1 | — | — | — |
| 12 | — | — | — | — | — | — | — | — |
| 13 | — | — | — | — | 2 | — | — | — |
| 14 | — | 3 | — | — | — | — | — | — |
| 15 | — | — | — | — | — | — | — | — |
| 16 | — | — | — | — | — | — | — | 3 |
| 17 | * | — | — | — | — | → CEH* | — | — |
| 18 | — | — | — | — | — | — | — | — |
| 19 | — | — | — | — | — | * | — | 3 |
| 20 | — | — | — | 3 | — | — | — | — |
| 21 | — | — | 1 | — | — | — | — | — |
| 22 | — | — | — | — | — | — | — | — |
| 23 | — | — | — | — | — | — | — | — |
| 24 | — | — | 3 | — | — | — | — | — |
| 25 | — | — | — | — | 2 | — | — | — |

∅ without complications. SDCA = skin damage and coverage alterations. → CEH = conversion to classical external hemipelvectomy. Progressive intensity of wound complications 1/2/3. Death period: intraoperative 1, early postoperative period 2, and mediate postoperative period 3.

Coinciding with most of the publications, chondrosarcoma is the primary bone sarcoma that most frequently occurs in the pelvis and requires hemipelvectomy for treatment.^{9,16,23,24} The presentation of pelvic chondrosarcoma is nonspecific, and often asymptomatic until it becomes large enough to have a mass effect on the pelvic organs.^{25,26}

Unfortunately, there are serious traumatic situations that generate a great loss of tissue in the proximal regions of the limbs and whose only way to achieve adequate coverage is through external hemipelvectomies. We must consider that in these cases the traumatic event as such, could have generated the death of the patients and hemipelvectomy is a second chance at life.

Thromboembolic events can be explained by aggressiveness in the management of tissues and related structures required in most

hemipelvectomies, as well as by the neoplastic condition *per se*.

In the case of 100% of lethality when the cause was necrotizing fasciitis, we must assume that an infectious process with these characteristics is already considered to have a poor prognosis, perhaps an earlier request to consult such cases could have changed the outcome, however it does not to be an assumption.

In 2011 we published our first case series in which, in a small sample of 8 patients, complications in the healing process occurred in 75% of them.²⁷ Later, in 2013, with a larger sample (n = 15), our complication rate decreased to 57%.¹⁷ The complication rate that we currently obtained shows a slight improvement in relation to our previous report. The experience obtained has been applied in the following cases and the results can support it.

Our functional results are similar to those obtained by Kumal et al in 2019 (mean 16.5/30),¹¹

however his sample is smaller and included reconstruction, but their lower score was higher than ours.

The main goal of hemipelvectomy is to provide local tumor control while preserving patient's quality of life as much as possible.^{9,28,29} The anatomy of the pelvis is complex and challenges even the most experienced surgeon.⁸

We consider that the main limitation of the study is related to the recording of survival once the surgical aspect has been resolved; this is due to the different approach between participating hospitals and the multidisciplinary approach that is required in these patients.

Conclusions

Medical situations that require a hemipelvectomy are few, but the morbidity and mortality that

these procedures generate, should never be underestimated. This is a complex procedure that must be performed by a surgical team familiar with it. In the same way, it is important that the patient and their relatives know the characteristics of the proposed procedure and also the risks, complications, and expected results. Complication rates are high in pelvic resection surgery and the most common complications are derived from collections that easily become infected. Prolonged surgical time, aggressive tissue management, proximity to naturally contaminated orifices, difficulty in closing dead spaces, as well as compromised patients in different aspects, are the main causes of the high incidence of complications related to hemipelvectomies. These are infrequent and complex procedures that easily become complicated and whose main indication is neoplastic.

Table 4: Complication rate from case number 26 to 50.

| Case | ∅ | Seroma | Hematoma | Abscess/infection | SDCA | Thromboembolic event | Visceral damage | Death |
|------|---|--------|----------|-------------------|------|----------------------|-----------------|-------|
| 26 | — | — | — | 1 | — | — | — | — |
| 27 | — | — | — | — | — | * | — | 1 |
| 28 | — | — | — | — | 2 | — | — | — |
| 29 | — | — | — | — | — | — | — | — |
| 30 | — | — | — | — | — | — | — | — |
| 31 | — | 1 | — | — | — | — | — | — |
| 32 | — | — | — | — | — | — | — | — |
| 33 | — | — | — | 3 | — | — | — | — |
| 34 | — | — | — | — | — | — | — | — |
| 35 | — | — | — | — | — | — | — | — |
| 36 | — | — | — | — | 3 | — | — | — |
| 37 | — | — | — | — | — | — | — | — |
| 38 | — | — | — | — | — | — | — | — |
| 39 | — | — | — | — | — | — | — | 3 |
| 40 | — | — | 1 | — | — | — | — | — |
| 41 | — | — | — | — | — | — | — | — |
| 42 | — | — | — | — | — | — | — | — |
| 43 | — | 1 | — | — | — | — | — | — |
| 44 | — | — | — | 3 | — | — | — | — |
| 45 | — | — | — | 3 | — | — | — | — |
| 46 | — | — | — | — | — | — | — | 1 |
| 47 | — | — | — | — | — | — | — | — |
| 48 | — | — | — | — | — | — | — | — |
| 49 | — | — | — | — | — | — | — | 2 |
| 50 | — | — | — | 3 | — | — | — | — |

∅ without complications. SDCA = skin damage and coverage alterations. → CEH = conversion to classical external hemipelvectomy.
 Progressive intensity of wound complications 1/2/3.
 Death period: intraoperative 1, early postoperative period 2, and mediate postoperative period 3.



Figure 2: Tomographic reconstruction image of internal hemipelvectomy I + IIA + III.

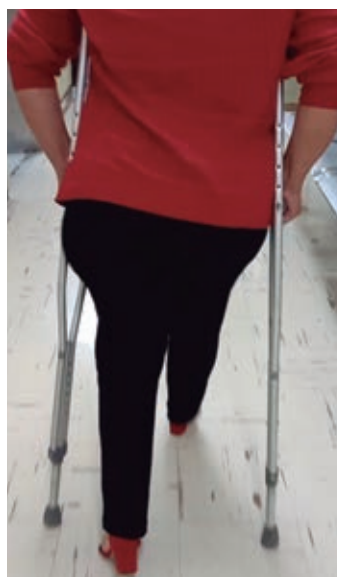


Figure 3:

The functionality obtained after an internal hemipelvectomy depends on many factors. This patient corresponds to the image in *Figure 2*.

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Conflict of interests

The authors declare no conflict of interest.