Pelvic Metastatic Disease: A Novel Technique for Reconstruction of the Posterior Acetabular Column

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Abstract

Background: Pelvic metastases often lead to significant morbidity due to acetabular destruction. Conventional methods may lack adequate support for the posterior acetabular column. This study evaluates a novel technique involving a retrograde ischioacetabular Schanz nail combined with the modified Harrington technique for enhancing stability in total hip arthroplasty (THA)

Surgical technique description: After intralesional resection of the acetabular metastatic lesion, we use an ischiatic counter incision to drill a Schanz pin along the posterior acetabular column. Then, we augment the osseous defect with polymethyl methacrylate and total hip arthroplasty, according to each patient compromise we add acetabular reinforcement rings or cages.

Methods: We reviewed records of 10 patients with harrington type II-IV lesions treated with this technique at Instituto Nacional de Cancerología from 2017 to 2023 at the Musculoskeletal tumors unit in Instituto Nacional de Cancerología, Bogota, Colombia. Using data acquired from medical history, we identified pain using VAS score in a follow up to 9 months. Outcomes measured included pain control (Visual Analog Scale) and functionality (Karnofsky Performance Status). Follow-up data, including radiological assessments and surgical notes, were analyzed for complications and reconstruction effectiveness

Result: Mean patient age was 59.2 years, with 70% female. Average survival was 18.9 months, with follow-up averaging 21.1 months. All patients showed improved pain control (100%), with six achieving full independence. No major complications or revisions were necessary. The longest survivor remains well at 7 years postoperatively

Discussion: The technique provides enhanced stability and reduces the need for revision, offering significant pain relief and structural support. It is effective for both short- and long-term survival patients with pelvic metastases.

Conclusion: The retrograde Schanz nail in the modified Harrington technique offers a reproducible and effective method for acetabular reconstruction in pelvic metastases, providing durable support and pain relief.

Introduction

Bone is the most frequently affected organ in metastatic disease, representing 60-84% of cases[1]. Multiple myeloma, prostate cancer, and breast cancer account for 75% of bone metastases, leading to a 150% increase in healthcare costs [1,2] . Although the monetary aspect is relevant, the main and primary issue if the impact on patients, how does bone metastasis afect patients? Pain is the most common symptom, affecting 75% of patients, while pathological fractures occur in 20%, significantly diminishing the quality of life and increasing the risk of mortality[1–4].

Pelvic lesions have a high prevalence, representing 40% of bone metastatic lesions. They have a higher incidence of complications, with patients developing severe, incapacitating pain quickly[2,5]. Although these lesions are highly symptomatic, surgical interventions have historically been less frequent compared to metastases in the long bones. However, this trend has gradually increased due to continuous improvements in the quality and prognosis of life for patients living with invasive cancer[6]. Periacetabular lesions are particularly symptomatic, with a varied range of treatment options, from observation and pharmacological interventions to surgical treatment, however there is no goldstandeard in the treatment of this lesions[1,7,8].

The main objective in surgical management is to achieve a stable construct that helps control pain while restoring load-bearing gait during the remaining survival period. These patients have a median postoperative survival of around 6 months; therefore, the treatment is primarily palliative[9]. Multiple factors are considered when deciding on the best surgical option, including prognosis and survival, severity of bone involvement, individual comorbidities, and response to

previous treatments[7]. Thanks to recent surgical advances in bone metastases, treating these lesions has become more manageable. However, periacetabular lesions remain a challenge.

In 1981, Harrington et al. first described a technique for treating symptomatic periacetabular metastatic lesions[10]. This technique involved intralesional resection and reconstruction of the periacetabular region using two threaded pins and cement augmentation, providing adequate support for total hip arthroplasty with acetabular rings and cages[10]. In this technique, the threaded pins were directed from the supracetabular region to the iliac bone. Due to the antegrade insertion, there is no support for the posterior column.

In the following article, we describe the outcomes of ten patients with periacetabular lesions treated using a modified Harrington technique, where the posterior column of the acetabulum is supported using a retrograde Schanz screw.

Patients and Methods

With previous ethical committee approval, we reviewed the medical records of 10 patients from our institution (Instituto Nacional de Cancerología) who underwent complex total hip arthroplasty (THA) combined with a modified Harrington technique to augment the posterior acetabular column using a retrograde ischioacetabular Schanz screw. The data collection period spanned from 2017 to 2023. We gathered basic demographic data, diagnosis, date of treatment, follow-up, and radiation therapy information (Table 1).

TABLE 1. PATIENT DEMOGRAPHICS

PATIENT	Sex	Age	Primary diagnosis	Laterality	Follow-up	Deceased
1	Female	61	Breast	Left	84 Months (7 years)	No
2	Female	61	Breast	Right	60 Months (5 years)	No
3	Male	73	Prostate	Right	2 months	2 months Postop

4	Female	70	Cervix	Left	4 months	4 months Postop
5	Female	68	Thyroid	Right	13 months	No
6	Female	60	Breast and thyroid	Right	20 months	2 years postop
7	Male	60	Prostate	Right	14 months	No
8	Male	48	Prostate	Left	2 months	3 months postop
9	Female	45	Lung (non-small cell)	Right	1 day	Day after postop
10	Female	46	Breast	Left	12 months	No

Patients underwent surgery for pain management, increased risk of fracture, and/or to regain full weight-bearing capability and lower extremity function. The surgeries were performed by two experienced musculoskeletal oncological surgeons (CSM and LCG). Preoperative radiotherapy was indicated for pain management and/or the presence of a large soft tissue component. Postoperatively, all patients received adjuvant local radiotherapy to ensure complete tumoral control and margin negativity.

TABLE 2. HARRINGTON CLASSIFICATION

CLASS	Description
TYPE I	Lateral cortices, superior and medial wall intact
TYPE II	Deficient medial wall
TYPE III	Deficient lateral cortices and superior wall
TYPE IV	Isolateral lesion that could be resected in an attempted curative procedure

Acetabular reconstruction with this modified technique was indicated for patients with an oncological diagnosis involving compromise of the posterior column of the acetabulum due to

metastatic disease. These patients had incapacitating pain unresponsive to radiotherapy, chemotherapy, and pharmacological optimization, had impending or preceding pathological fractures, and/or were unable to bear weight due to pain.

The extent of peri-acetabular osseous destruction in each patient was classified based on the Harrington classification (Table 2). Surgical reconstruction was planned accordingly[10]. Preoperative and postoperative information on pain and functional status, assessed using the Karnofsky Performance Status (KPS) was obtained for all patients during follow-up (range: 1 day to 84 months postoperative)[11]. Radiological assessment was based on two-plane radiographs of the pelvis, hip, and femur, as well as a CT and an MRI of the pelvis (Figure 1). Surgical notes were reviewed to determine the acetabular reconstruction technique, complications, and follow-up information (Table 3). Complications were classified according to Groslings and Gouma[12].

TABLE 3. PREOP AND POSTOP RESULTS

PATIENT	Harrington classification	Acetabular reconstruction	Preop Karnofsky	Postop Karnofsky	Pre-op Pain (VAS)	Pain last control (VAS)
1	II	Ring	60	90	7	0
2	III	Reconstruction plate	70	90	5	3
3	II – III	Cup	70	80	5	6
4	II - III	Cup	70	90	5	1
5	III	Cup	80	90	6	2
6	IV	Ring	70	70	5	3
7	II- III	Ring	80	90	6	0
8	III	Ring	50	50	9	6
9	IV	Ring	40	-	8	-
10	II - III	Ring	70	90	8	1

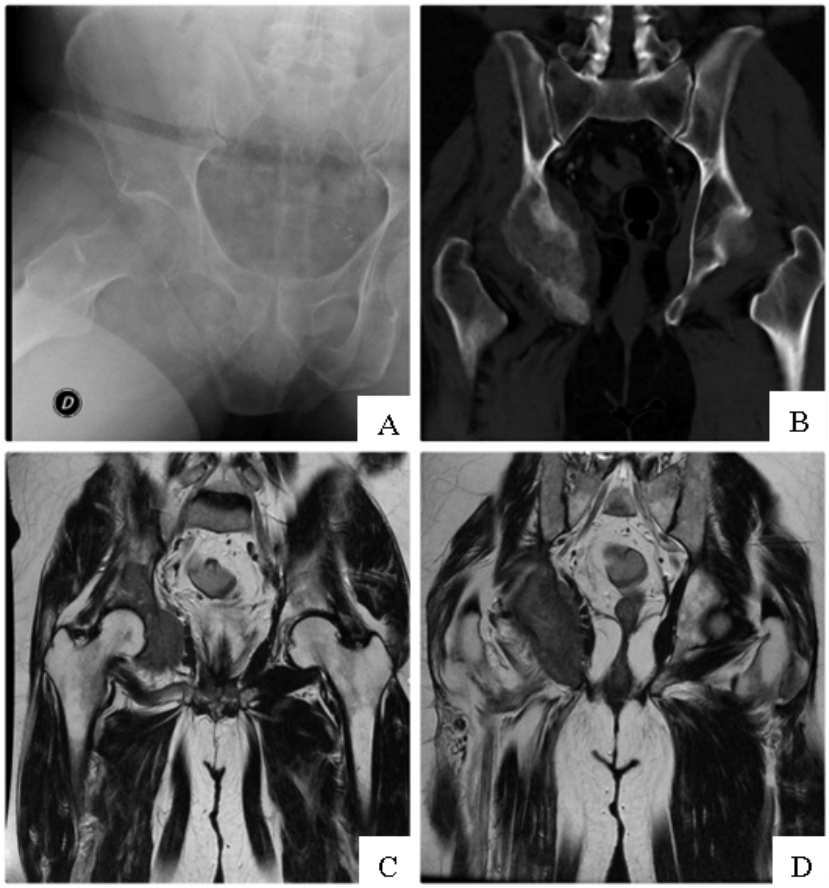

Figure 1. Preoperative images of a patient with posterior acetabular column involvement due to a metastatic lesion secondary to prostate cancer. (A) X Ray (B) CT scan (C) and (D) MRI

Surgical Technique

A urinary catheter was placed to monitor for inadvertent bladder lesions. Patients were positioned in lateral decubitus and secured with hip supports. After aseptic preparation and draping, an posterolateral incision of the hip (Kocher-Langenbeck approach) was performed [Figure 2]. This incision provides direct visualization of the dorsocranial aspect of the acetabulum and additionally provides direct visualization of the proximal region of the ischium.

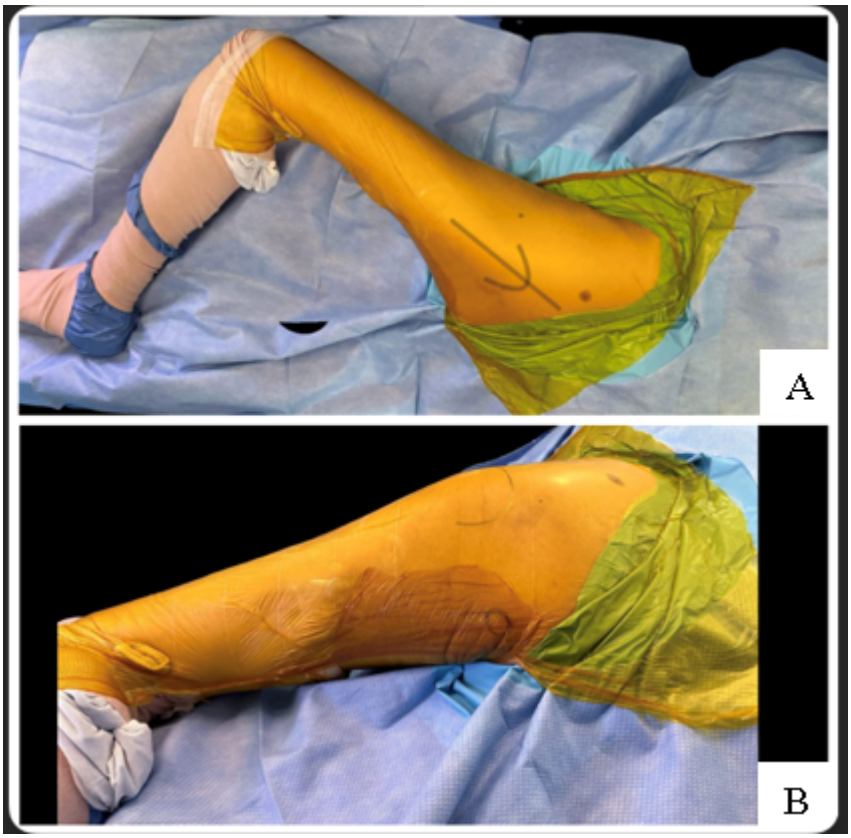

Figure 2. Intraoperative image (A) incision location (B) patient positioning

We began with the resection of the femoral head. Following this, an intralesional curettage of the metastatic lesion was performed under direct vision until no macroscopically visible tumor remained, and bleeding healthy bone was observed. Depending on the primary cancer, this step poses a high risk of bleeding; hence, preoperative embolization should be evaluated to decrease the risk of hemorrhage.

A second incision was made over the ischial tuberosity. First, we identified and protected the sciatic nerve through the main incision, then palpated the ischial tuberosity in the gluteal region where the incision was made [Figure 3]. Through this second incision, a 4x120mm Schanz screw was manually inserted retrogradely, running from the ischial tuberosity through the posterior acetabular column. Radiographic and clinical stability was verified, followed by filling and augmentation of the lesion with polymethyl methacrylate cement through the first incision to achieve additional structural support. Depending on preoperative planning for each patient, either

a total hip arthroplasty with acetabular ring reconstruction cage or ring, or a hemiarthroplasty with a double mobility cup, was performed to complete the extended hip arthroplasty [Figure 4].

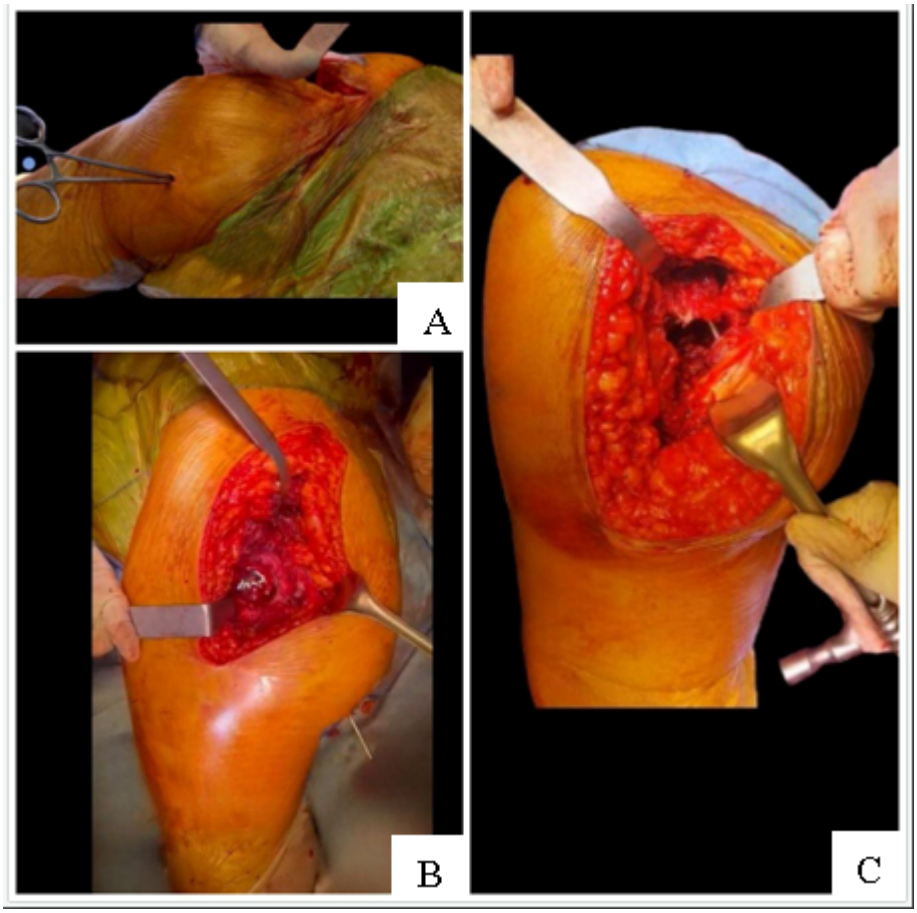

Figure 3. Interoperative images (A)Counter incision and orientation of the Schanz nail passing (B) direct visualization of the dorsocaudal aspect of the acetabulum for curettage and monitoring Schanz trajectory. (C) direct visualization of the Schanz final position

Results

The mean age of the patients was 59.2 years, and 70% of the patients were female (Table 1). Primary cancer diagnoses included breast cancer and prostate cancer, which together represented 90% of the metastatic lesions (4 and 3 cases, respectively). One patient had non-small cell lung cancer, one had cervical cancer, and two patients had thyroid cancer; one of these thyroid cancer patients had a second primary tumor, with metastasis reported as breast cancer.

In 60% of the cases, acetabular reconstruction required an additional ring or cage reconstruction along with the modified Harrington technique for posterior column augmentation. One patient required a 1/3 tubular plate to augment the anterior acetabular column, while the remaining 40% had a conventional acetabular cup (Table 3).

There were no intraoperative deaths or major complications such as neurapraxia or vascular damage. The average survival was 18.9 months after surgery (range: 1 day to 7 years). The first patient treated is still alive 7 years postoperatively and has not experienced any mechanical complications. Unfortunately, one patient died one day after surgery due to a heart attack, which was not related to the surgery. Additionally, one patient died 2 years after surgery, and three other patients died 2, 3, and 4 months after surgery, respectively.

Postoperatively, all patients received physical therapy. Postoperative X-rays showed excellent positioning of the augmentation and arthroplasty components (Figure 5). According to the Harrington classification, 40% of the lesions were classified as II-III, and 20% were classified as IV (Table 3).

Figure 5. (A), (C) and (E) Preoperative X rays (B), (D) and (F) Postoperative X rays of 3 patients depicting the adequate positioning of the Schanze through the posterior acetabulum wall .

The mean follow-up period was 21.1 months. Out of the 10 patients, six were followed up for more than a year. One patient passed away the day after surgery, two others died 2 months after surgery, and one more died 4 months after surgery (Table 1).

During the follow-up period, we observed a significant improvement in pain control as measured by the Visual Analog Scale (VAS). Of the 9 patients with follow-up data, 100% reported improvement in pain control. Seven of these patients experienced more than a 50% reduction in pain, while the remaining two patients (Patient 3 and Patient 8) showed partial improvement,

which was not statistically significant (Table 3). Patient 3 noted that pain was associated with the site of insertion of the Schanz nail but eventually subsided, with the previous hip pain almost completely resolved.

Regarding functionality, the Karnofsky Performance Status (KPS) was evaluated preoperatively and during follow-up (Table 3). All but two patients showed an improvement in functionality[11]. Six of the 9 patients who were followed up achieved full independence, requiring assistance only for physically demanding activities. The functionality of the two patients who did not show improvement remained stable. None of the patients presented with local infections or required additional interventions.

Discussion

The use of a retrograde Schanz screw through the ischioacetabular region for augmenting the posterior acetabular column in treating patients with Harrington lesions Type II-IV represents a novel technique. Metastatic pelvic involvement is common and associated with significant morbidity. Destruction of the acetabulum and peri-acetabular region exacerbates morbidity through impaired mobility and severe pain. Selecting the appropriate treatment based on the anatomical region involved is challenging, and there is a need for symptomatic control, a lasting acetabular construct, and early mobility to promptly relieve symptoms.

Several treatment strategies have been described, ranging from conservative non-operative management to surgical reconstruction. Conservative treatments, such as local radiotherapy, bisphosphonate therapy, and hormonal therapy, should be considered initially. However, if there is no improvement or symptoms exacerbate, surgical options become necessary. The goals of surgical reconstruction are not curative but focus on achieving a stable construct that allows full weight-bearing and pain relief[13,14].

Recent years have seen the development of various surgical techniques aimed at improving functional restoration for metastatic lesions. Particularly in Harrington Type II lesions, several authors have described using acetabular support rings in combination with total hip arthroplasty

(THA) or saddle prostheses[15,16]. Despite this, reconstruction failures and decreased functional status have been observed in a considerable number of patients, especially those reconstructed with saddle prostheses[17,18]. Therefore, surgical techniques have focused on augmenting pelvic support to reduce reliance on saddle prostheses and improve ring reconstruction support.

To date, most described techniques have not provided substantial mechanical support for the posterior column, as the ischium is not fully incorporated into the construct[9,13,19,20]. Few techniques address this issue effectively[21,22] . These techniques are used in conjunction with THA and aim to minimize the need for revision surgery. Generally, less than 20% of these arthroplasties require revision, provided that the tumoral disease is well controlled[22].

For instance, Lozano et al. described a technique for augmenting the medial and posterior acetabular wall using a similar approach, but they applied retrograde pins only for Type IV lesions and used Steinmann pins[9]. Our technique provides an alternative for Harrington lesions Type II through IV, addressing a major challenge in Type II lesions where mechanical failure associated with prosthetic failure is most significant. By using a Schanz screw, our approach offers a sturdier construct and avoids additional drilling in low bone density regions due to metastatic disease, thereby reducing the risk of early loosening and the need for revision.

In this series, we describe a modified Harrington technique for the augmentation and reconstruction of acetabular metastatic lesions classified as Harrington Type II through IV. This modification proves useful for both isolated posterior acetabular column compromise and articular involvement, utilizing a combination of a Schanz nail and acetabular ring/cage reconstruction. The most similar technique described in the literature is by Lozano et al., who used retrograde pins only for Type IV lesions and employed Steinmann pins[9]. Our technique offers an alternative for Harrington lesions Type II through IV, specifically addressing the issue of mechanical failure in Type II lesions. By employing a Schanz screw, our approach provides a sturdier construct and reduces the need for additional drilling in areas of low bone density due to metastatic disease, thus minimizing the risk of early loosening and subsequent revision.

As with classical and modified Harrington techniques, our augmentation uses few materials, maintaining a relatively low surgical cost while improving functionality and reducing complications. Among the six patients who survived to at least 12 months of follow-up, there was significant improvement in both pain and functionality. None of these patients required revisions, and no major mechanical complications were observed. All patients achieved early mobility and load-bearing gait. Although our results are similar to other modified Harrington techniques, this modification offers notable advantages. The use of a solid Schanz nail prevents loosening due to multiple drilling sites and provides a sturdier construct. The retrograde trajectory from the ischial tuberosity to the acetabulum offers a larger hardware-to-bone interface, facilitating earlier weight-bearing postoperatively, which is crucial for reducing morbidity and mortality in these patients.

Another advantage is the increased visualization. Adequate exposure during the insertion of the Schanz screw reduces the need for intraoperative fluoroscopy, thus decreasing surgical time. While these surgeries are palliative, advances in chemotherapy and radiotherapy have extended the life expectancy of patients with bone metastases. Despite the small sample size, two of our patients have had follow-ups of 5 and 7 years (Figure 6), respectively, and remain alive without mechanical issues or revisions. This suggests that our technique not only provides good mechanical support for patients with shorter postoperative life expectancy but also benefits those with a longer life expectancy.

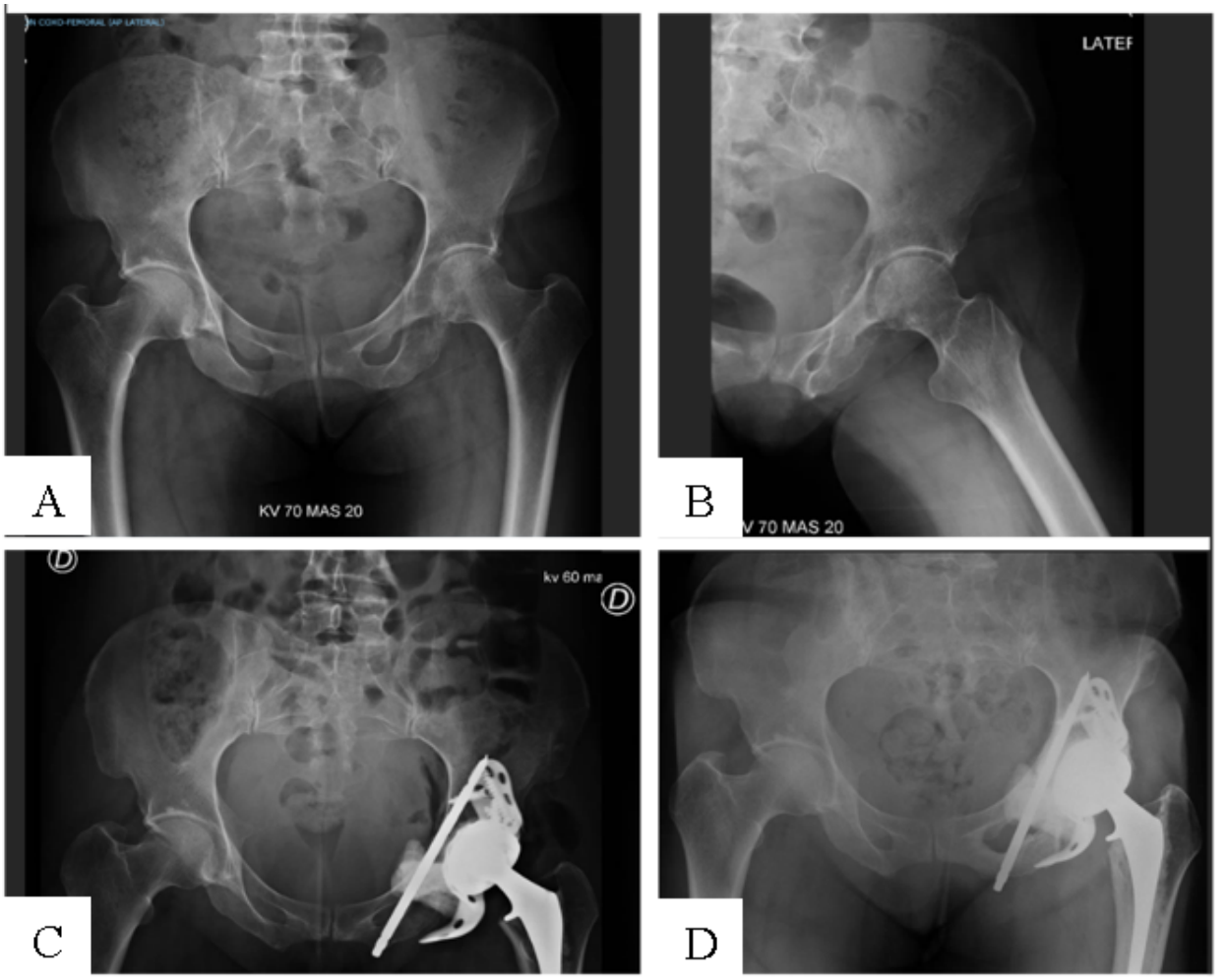

Figure 6. Patient 1 X rays (A) and (B) preoperative (C) and (D) 7 years postoperative during the last control.

Acknowledging our limitations, we note that our sample size is small, which is consistent with the high mortality rate of patients with metastatic pelvic lesions. Additionally, the complexity of this surgery imposes significant risks, underscoring the importance of careful patient selection. While there are similar techniques described in the literature, direct comparisons with other surgical methods are not feasible.

Conclusion

The use of a retrograde ischioacetabular Schanz nail for augmenting the posterior acetabular column in total hip arthroplasty (THA) offers a reproducible, safe, and effective technique for managing pelvic metastases that compromise the posterior column, including Harrington Types

II-IV. This approach achieves significant symptomatic improvement and provides a durable and stable reconstruction. The technique effectively addresses pain and enhances functionality, surpassing the life expectancy of most patients.

While longer follow-up studies are desirable, this technique demonstrates its value by extending the benefits of pain control and functionality beyond the typical survival period of patients with metastatic disease. Given the advancements in cancer treatments and the increasing life expectancy of patients with metastatic conditions, particularly those with prostate and breast cancer, it is essential to consider surgical interventions that offer long-term durability.

Future research with larger cohorts and extended follow-up periods is needed to confirm the optimal treatment strategies and long-term outcomes. Nevertheless, the promising results observed, including the absence of revision surgeries in patients with follow-ups of up to 5 years, suggest that this technique is viable for patients with longer life expectancies.