

# The Mantis Approach: A Novel Skin Incision Technique for Limb-Sparing Pelvic Musculoskeletal Tumor Surgery with Reduced Complications

Masanori Saito, Keisuke Ae

**INTRODUCTION:** Limb-sparing surgery for malignant pelvic tumors remains a highly invasive and technically demanding procedure due to the intricate three-dimensional anatomy of the pelvis and the proximity of critical neurovascular structures. Despite advancements in surgical techniques and perioperative care, high rates of perioperative complications, including deep infections and skin necrosis, persist. This study aimed to evaluate the effectiveness of a novel skin incision technique, the **Mantis Approach**, in reducing surgical complications in limb-sparing surgery for malignant pelvic tumors. The Mantis Approach is a modification of the traditional utilitarian approach, specifically designed to optimize tissue perfusion and surgical exposure through a unique incision trajectory.

**METHODS:** The novel skin incision technique is a modification of the traditional utilitarian approach. The new incision begins at the pubic bone, extends to the anterior superior iliac spine, then curves distally and dorsally, passing inferior to the greater trochanter and continuing toward the ischial bone in a single continuous line (Figure 1). Due to its resemblance to a praying mantis, we have termed this technique the "Mantis Approach" (Figure 2). We retrospectively analyzed 14 patients with malignant pelvic tumors who underwent limb-sparing surgery using the Mantis Approach between 2019 and 2023. The mean patient age was 56 years (range: 12–78 years), and the mean tumor size was 10 cm (range: 6–12 cm). Tumor locations were classified according to the Enneking system as P1 in 3 cases, P2 in 6 cases, P1/2 in 4 cases, and P2/3 in 1 case. The mean operative time was 311 minutes (range: 261–460 minutes), and the mean blood loss was 827 mL (range: 180–2400 mL). The mean follow-up period was 23 months (range: 2.5–61.5 months).

## RESULTS:

All 14 tumors were successfully resected according to preoperative plans without requiring additional supporting incisions. Postoperative complications included deep infection in 1 of 14 cases and mild fusion failure in 6 of 14 cases. There were no cases of skin necrosis. All complications were managed conservatively with needle aspiration or bedside re-suturing, and none required reoperation. Although the superior gluteal artery was sacrificed in 5 cases, no patients developed infections or skin necrosis requiring surgical intervention. Regarding postoperative activities of daily living (ADL), 2 patients could ambulate without a cane, 10 used a single cane, 1 used double canes, and 1 was wheelchair-dependent. At the final follow-up, 9 patients were alive, while 5 had died due to disease progression.

## DISCUSSION AND CONCLUSION:

Various skin incision techniques have been proposed for pelvic tumor surgeries; however, high rates of perioperative wound complications continue to be reported. The conventional utilitarian incision, though commonly used, creates a three-way junction that compromises blood supply and often necessitates extensive resection of the gluteal muscles for pelvic bone access. Additionally, incising the skin along the iliac crest to the sacral region disrupts posterior blood flow. Furthermore, the U-shaped approach (Enneking approach) from the pubic bone through the iliac crest to the sacrum requires preservation of the superior gluteal artery because cutaneous blood flow from the back and buttocks is disrupted. In contrast, the Mantis Approach aligns with the direction of the gluteal muscles, allowing it to be elevated as a musculocutaneous flap without transecting the muscles, thereby preserving tissue blood flow more effectively (Figure 3). Furthermore, when combined with osteotomy of the greater trochanter (Chanley's greater trochanteric inversion technique), it provides excellent visualization of the P1–P4 regions while preserving the gluteus muscles (Figure 4). Importantly, skin blood flow from the dorsal and sacral sides is maintained. Notably, even in the five cases where the superior gluteal artery was sacrificed, the preservation of posterior skin perfusion in the Mantis Approach appeared to mitigate the risk of severe wound complications.

The Mantis Approach demonstrated excellent surgical exposure and a low complication rate in this series of pelvic tumor resections. The limitations of this study include its retrospective nature and the relatively small sample size. Further prospective studies with a larger cohort are needed to validate these findings. Nevertheless, the Mantis Approach demonstrates promising potential as a versatile option for musculoskeletal oncologic surgery involving the pelvis, offering improved surgical exposure and a low complication rate.

