

## **TITLE PAGE**

Reconstruction of a Pelvic Floor Defect Using a Pedicled Tensor Fascia Lata Flap: A New Technique to Prevent Radiation Injury for Pediatric Patients with Advanced Pelvic Tumors

Running head (39 characters); Reconstruction of a Pelvic Floor Defect

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**Structured abstract** (196 words)

**Background:** In the treatment of pelvic tumors, pelvic floor defects due to a wide excision tend to increase the occurrence of such morbidities as radiation injury. The reconstruction of these defects would minimize the risk of such morbidities. Authors introduce a new technique for repairing a pelvic floor defect using a tensor fascia lata flap.

**Methods:** Two boys, 4 years old and 10 months old, respectively, presenting with pelvic rhabdomyosarcoma, underwent a tumor extirpation associated with a wide excision of the pelvic organs. After the removal of the tumor, a tensor fascia lata flap was designed on the right thigh. The pedicled rotation flap was subcutaneously elevated, guided to the intra-peritoneal cavity and was fixed to cover the superior aperture of the lesser pelvis.

**Results:** The flaps functioned well and postoperative radiation therapies consisting of 45 and 41.4 Gy, respectively, to the lesser pelvic cavity, were carried out without any complications. As a result, the necessary postoperative protocol combination therapies could be successfully

performed in a timely manner.

**Conclusion:** The pedicled tensor fascia lata flap is considered to be an alternative option for the stable repair of pelvic floor defects in order to prevent radiation injury.

**INDEX WORDS:**

pedicled tensor fascia lata flap, pelvic floor defects, advanced pelvic tumor, rhabdomyosarcoma, radiation injury, pediatric

## **Introduction**

The optimal surgical modality for pelvic tumors in children remains a matter of some controversy. [1-3] In some instances of advanced or recurrent tumors, a wide resection of both the tumor and the affected pelvic organs is required, which unavoidably results in defects of the pelvic floor. Such defects necessitate an adequate coverage and repair in order to achieve acceptable results. In addition, a combination of surgery, chemotherapy, and radiation therapy is required to achieve a long-term survival. [1, 4] It is especially important to prevent postoperative radiation injury, including radiation enterocolitis, because any delay in the planned protocol consisting of combination therapy may lead to an increased morbidity and mortality in such patients. [5] We herein describe a new technique to repair in pelvic floor defects to prevent the occurrence of postoperative radiation injury in the pediatric patients with pelvic tumor.

## **Patients and Methods**

### ***Patients***

Patient 1 was a 4-year-old boy with a diagnosis of rhabdomyosarcoma originating from soft tissue in the neighborhood of the prostate gland. He underwent a complete resection of the tumor subsequent to successful preoperative chemotherapy. In spite of undergoing postoperative intensive chemotherapy, intra-pelvic local recurrence invading the rectal wall occurred. As a result, we had to perform a complete pelvic exenteration with an end-colostomy and a continent urinary reservoir using an ileo-cecal intestine with a cutaneous appendicostomy. [6, 7]

Patient 2 was a 10-month-old boy with a diagnosis of rhabdomyosarcoma originating from the neck of the urinary bladder. After undergoing successful chemotherapy, a wide excision of the intrapelvic genito-urinary system was performed with the same continent urinary reservoir as was performed for Patient 1. In patient 2, the recto-perineal region was preserved.

In both patients, the defects of the pelvic floor were reconstructed

using pedicled tensor fascia lata flaps. The adverse effect of the postoperative radiation therapy to the tumor bed in the lesser pelvic cavity, including radiation enterocolitis, was evaluated, while the outcome of the newly formed pelvic floor and thigh morbidity were also investigated.

### ***Operative Technique***

Preoperatively, the location of the main perforators from the vascular pedicle was determined and marked with an ultrasound Doppler. The diameters of the superior aperture of the lesser pelvis were also measured based on the preoperative findings of computed tomography and/or magnetic resonance imaging.

Under general anesthesia, the patient was placed in either the lithotomy position or the supine position. First of all, the pelvic tumor and affected organs were removed via a lower abdominal approach and/or a perineal approach. After removing the pelvic structures, a tensor fascia lata flap was designed on the right lateral proximal thigh, and standard harvesting techniques were used for flap elevation (Figure 1). During flap

elevation, all fascia lata sheets showed a good blood supply from the subfascial and prefascial vascular plexus. The vascular pedicle was easily identified and preserved and the tissue plane between the tensor fasciae lata and the gluteal muscles was carefully identified. The size of the flap sheath measured 20 cm in length and 6 cm in width in Patient 1, and 10 cm and 4.5 cm in Patient 2. An adequate size of the tensor fascia lata flap was turned over, and then the pedicled rotation flap was subcutaneously elevated and guided to the intra-peritoneal cavity. At the recipient site, the flap sheet was used to reconstruct the missing pelvic floor structure. Finally, the flap sheet was fixed to cover the superior aperture of the lesser pelvis using 2–0 unabsorbable interrupted sutures (Figure 2).

In the lesser pelvis, a continuously closed suction drainage was placed and removed on about postoperative day 10. Figure 3 shows a schematic drawing of the reconstruction using the tensor fascia lata flap. A functional assessment of the range of motion of the donor thighs and ambulatory ability was done by the patients' parents, because the patients were too young to objectively evaluate them.

## **Results**

No pulmonary, circulatory or renal complications were observed in either patient. In addition, no significant donor site problems were found. All donor sites at the thighs could be closed directly and they all healed uneventfully. Both patients showed a satisfactory daily ambulatory ability without any support during the follow-up time, which was at least four years. The range of motion of the donor thigh and knee joint also maintained their full flexion and extension.

All pedicled flaps functioned well and the full dosage of postoperative radiation therapy, consisting of 45 and 41.4 Gy to the tumor bed in the lesser pelvic cavity, were carried out, respectively, with no complications. In both patients, no infections occurred in either the abdominal wounds or the lesser pelvic cavities. As a result, all postoperative protocol combination therapies could thus be performed in a timely manner and they are both doing well at this writing.

## **Discussion**



The overall survival rate in children with rhabdomyosarcoma, including all sites, has improved dramatically over the past several decades. Thanks to advances in such adjuvant therapies as chemotherapy and radiation therapy, approximately 70% of all patients with rhabdomyosarcoma are now expected to survive five years after their initial diagnosis. [8, 9]

Rhabdomyosarcomas of the retroperitoneum and pelvis in children are often large, invade adjacent structures, and are difficult to remove at the time of the initial diagnosis. As a result, a combination of surgery, chemotherapy and radiation therapy is essential to achieve a long-term survival for such patients. [1, 4, 10] However, postoperative radiation therapy for pelvic rhabdomyosarcomas may result in small bowel damage at an incidence of from 5–25%, and radiation injury to the small bowel sometimes makes it difficult to achieve a high degree of compliance for the required combination therapies according to the protocol guidelines. [4, 5, 11]

A resected and denuded pelvic floor due to an extended operation,

which is not amenable to a direct and primary closure, tends to increase the occurrence of such morbidity as radiation enteritis, fistula, small bowel obstruction, and perineal hernias. [5, 12, 13] A reconstruction of such defects using a variety of synthetic coverings is essentially hazardous due to the possibility of infection. As a result, autologous prosthetic tissue should be used to avoid fatal complications. [5, 14-17] In general, the reconstruction of the pelvic floor using various biological patches, including an omental flap, dura mater graft and muscular flap have all demonstrated a decrease in postoperative morbidities. [12, 15, 16, 18]

In pediatric patients, radiation therapy is normally recommended for pelvic rhabdomyosarcoma [4] and the use of the autologous prosthetic tissue for a definitive reconstruction of pelvic floor defects also minimizes the risk of radiation injury while also avoiding the problems associated with synthetic materials. However, for pediatric patients with pelvic tumors, the reconstruction of pelvic floor defects still remains a highly complex procedure. An omentum graft applied directly to the peritoneal cavity may not be able to effectively fill up the pelvic cavity, because the maturation of the omental tissue tends to be less complete in children than

in adults. Moreover, in such patients as our patient 1 who underwent a complete pelvic exenteration, complex surgeries through both an abdominal and perineal approach are normally required as described in Figure 3B. As a result, a reconstruction of pelvic floor defects using an abdominal wall muscular flap including the rectus abdominis muscle [12] may disturb abdominal procedures and also lead to an increase of postoperative morbidities.

The vascularized tensor fascia lata flap alone or in combination as a musculocutaneous flap is used for the reconstruction of various types of defects. [19-22] The tensor fascia lata flap receives a sufficient blood supply via the lateral circumflex femoral artery, which thus makes the flap a valuable tool that both resists infection and reduces the recovery time. [23] Because of its thick, strong fascia, the tensor fasciae lata is the preferred choice for reconstruction of tissue defects including the abdominal wall and inguinal region. [21, 24-26] Although the tensor fascia lata flap has been used for the reconstruction of the pelvis following hemipelvectomy, [27] its application for the reconstruction of pelvic floor defects has not yet been clinically documented.

The pedicled tensor fascia lata flap proved to be an effective alternative option for the repair in pelvic floor defects after surgery for pediatric pelvic tumors. The characteristics of this method are as follows:

- 1) The newly formed pelvic floor is strong and stable so that no complications associated with radiation injury occurred.
- 2) The operative procedure of the harvest of the flap is not too complicated and an adequate sized flap could thus be obtained.
- 3) Harvesting the flap and reconstructing the defect cause no problems for either the urinary diversion or colostomy procedures because the donor site is sufficiently distant from the abdominal wound.
- 4) This flap is also sufficiently resistant to infection, and therefore no sign of infection was observed in the lesser pelvic cavity.
- 5) No ambulatory disturbance was demonstrated at the donor site in our patients.

The treatment schedule for postoperative multimodal combination therapies should not be delayed due to a variety of postoperative complications. Therefore, the reconstruction of pelvic floor defects using a vascularized tensor fascia lata flap is considered to be a safe and effective modality for overcoming such disadvantages.

In conclusion, the pedicled tensor fascia lata flap was found to

achieve acceptable results for pelvic floor reconstruction. This technique is proposed as alternative option for the reconstruction of pelvic floor defects to prevent radiation injury occurring in pediatric patients presenting with pelvic tumor.

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## **Legends of illustrations**

Figure 1: Harvesting of the tensor fascia lata flap in patient 1.

Figure 2: The flap sheet is fixed to cover the superior aperture of the lesser pelvis in patient 1.

Figure 3: (A); A schematic drawing of the reconstruction using a tensor fascia lata flap. (B); An operative schematic drawing of a sagittal section in patient 1.

Abbreviations: C; end-colostomy, TFL; tensor fascia lata flap, UB; urinary reservoir with an appendicostomy.