

# An original external iliac artery reconstruction with internal iliac artery translocation in a blunt injury of the pelvic vessels in a 4-year-old child: A 12-year follow-up study

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## ABSTRACT

A 4-year-old child presented to the emergency department with an open-book pelvic fracture, blunt trauma to the right external iliac artery and vein, and contaminated abdomen due to jejunal tear. Arterial reconstruction with polytetrafluoroethylene was not considered because of caliber discrepancy of 6 mm compared with 3 mm of the child's external iliac artery and a 40% probability of graft infection. We used the ipsilateral internal iliac artery, which was dissected for 7 cm; the distal artery was translocated and anastomosed to the distal external iliac artery. At 12 years of follow-up, the artery grew with the patient, with no need for replacement. (*J Vasc Surg Cases and Innovative Techniques* 2019;5:492-6.)

**Keywords:** Pediatric vascular injury; Pelvic blunt trauma; Arterial reconstruction

The incidence of vascular trauma with blunt injury in pediatric patients was reported by Hamner et al<sup>1</sup> to be 0.4%. Associated intra-abdominal and extra-abdominal injuries were >75%, and 39 of the 101 vascular injuries also suffered from physiologic instability.<sup>1</sup>

We present here a case of a 4-year-old girl who arrived at the emergency department of the Assaf Harofe Medical Center (Zerifin, Israel) after a road accident. The patient suffered from hemorrhagic shock, open-book pelvic fracture, and right external iliac artery and vein contusion, with a jejunal tear.

Vascular blunt injury of the pelvis in infants presents the vascular surgeon with a challenge as to its treatment, mostly because the vascular reconstruction is performed in a contaminated environment. Not only that, the available synthetic polytetrafluoroethylene (PTFE) grafts are 6 mm, whereas the diameter of the external iliac artery in the pediatric population is 3 mm, making those grafts incompatible for anastomosis. Moreover, if indeed this graft were to be used, it would eventually have to be replaced to keep pace with the patient's growth.<sup>1-5</sup> In addition, the use of an artificial graft in a contaminated environment could, in 30% of the cases,<sup>1</sup> cause graft infection and thrombosis.<sup>2</sup> Thus, the use of autologous

grafts, such as a reverse saphenous vein, renal vein, internal iliac vein, or umbilical vein and internal iliac artery, is a preferred option.<sup>1-6</sup>

To prevent these manifestations in this case, we used the right internal iliac artery, which was dissected for 7 cm; the side branches were ligated, and the graft was translocated distally for anastomosis to the right distal external iliac artery. The patient also underwent several orthopedic operations in the follow-up period to overcome the right femoral nerve injury. We present here a 12-year follow-up of the blunt trauma injury to the pelvic vessels. The patient has consented to this publication.

## CASE REPORT

After a road accident, a 4-year-old child with multiple trauma, hypovolemic shock, pelvic blunt injury, and an open fracture of the left femur was admitted to the emergency department of the Assaf Harofe Medical Center (Zerifin, Israel). Blood pressure was 90/60 mm Hg, and the heart rate was 192 beats/min; the right femoral pulse was not palpable.

On arrival, the patient was treated by a multidisciplinary surgical team of pediatric, general, and orthopedic surgeons as well as vascular and plastic surgeons. She was intubated with mechanical ventilation and underwent hemodynamic resuscitation, including 9 units of packed cells.

A computed tomography scan demonstrated an open-book fracture of the pelvis and an open femoral fracture. External fixation of the pelvis and nailing of the left femur were performed. The right femoral nerve was damaged but was left untouched for further evaluation.

Computed tomography angiography did not demonstrate the right external iliac artery and vein, whereas a normal flow was noted at the abdominal aorta and the left iliac arteries and veins. On exploratory laparotomy, a jejunal tear of 10 cm from the Treitz ligament was discovered and sutured. A right medial visceral rotation was performed for exposure of the retroperitoneum. The aorta and right common and internal iliac arteries

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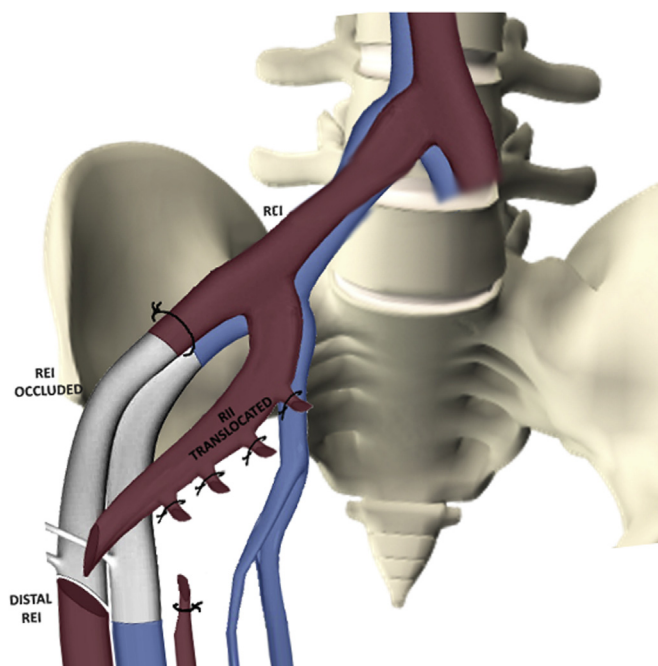
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**Fig 1.** A drawing of the surgical technique of translocated right internal iliac (RII) artery as replacement of the right external iliac (REI) artery, damaged by blunt trauma. RCI, Right common iliac artery.

were undamaged. The right external iliac artery and veins were contused beyond repair and therefore were ligated. The right internal iliac artery was dissected for 7 cm with ligation of the side branches to regain arterial blood supply to the right leg in the contaminated pelvis.

The distal internal iliac artery was translocated and anastomosed to the distal external iliac artery end to end in a spatulated position with Prolene 7-0 continuous suture (Fig 1). Anterior compartment fasciotomy was performed, and good Doppler signals were noted at the right dorsalis pedis and posterior tibial arteries. Follow-up was performed by continuous-wave Doppler 4 MHz and 8 MHz probes and by pulse arterial duplex ultrasound (Philips iU22; Philips Healthcare, Best, The Netherlands) with a 5-12 linear probe. This was performed once a month for the first year and twice a year for the next 11 years. Magnetic resonance angiography was performed 12 years after operation to demonstrate the arterial tree of the pelvis and groin and right leg as well as the collateral circulation of the arterial and venous flow of the leg and pelvis.

The postoperative Doppler ultrasound examination revealed a normal flow in the right femoropopliteal and tibial arteries; ankle-brachial pressure index was 1.0. The diameter of the femoral anastomosis was 3 mm. The postoperative right leg edema, due to ligation of the right iliac vein, was treated with elastic stockings.

During the 12-year follow-up, continuous-wave Doppler ultrasound demonstrated normal arterial waveform with an ankle-brachial pressure index of 1.1. Continuous-wave Doppler waveform at the end of the 12-year period was similar to the ones noted during the years of follow-up (Fig 2).

Duplex ultrasound imaging after 12 years demonstrated normal development in the length of the right translocated internal iliac artery, with a 3.2-mm diameter of the distal right external iliac anastomosis. The diameter of the translocated right internal iliac artery was 4.5 mm compared with 5.5 mm of the left normal external iliac artery (Fig 3).

Magnetic resonance angiography performed 12 years postoperatively demonstrated normal length of the translocated right internal iliac artery, which is thinner compared with the left external iliac artery. The left internal iliac artery developed collateral arteries to supply the right-sided pelvic organs after disconnection of the right internal iliac artery (Fig 4).

The patient limps slightly after surgery on the right leg tendons but otherwise leads a normal life.

## DISCUSSION

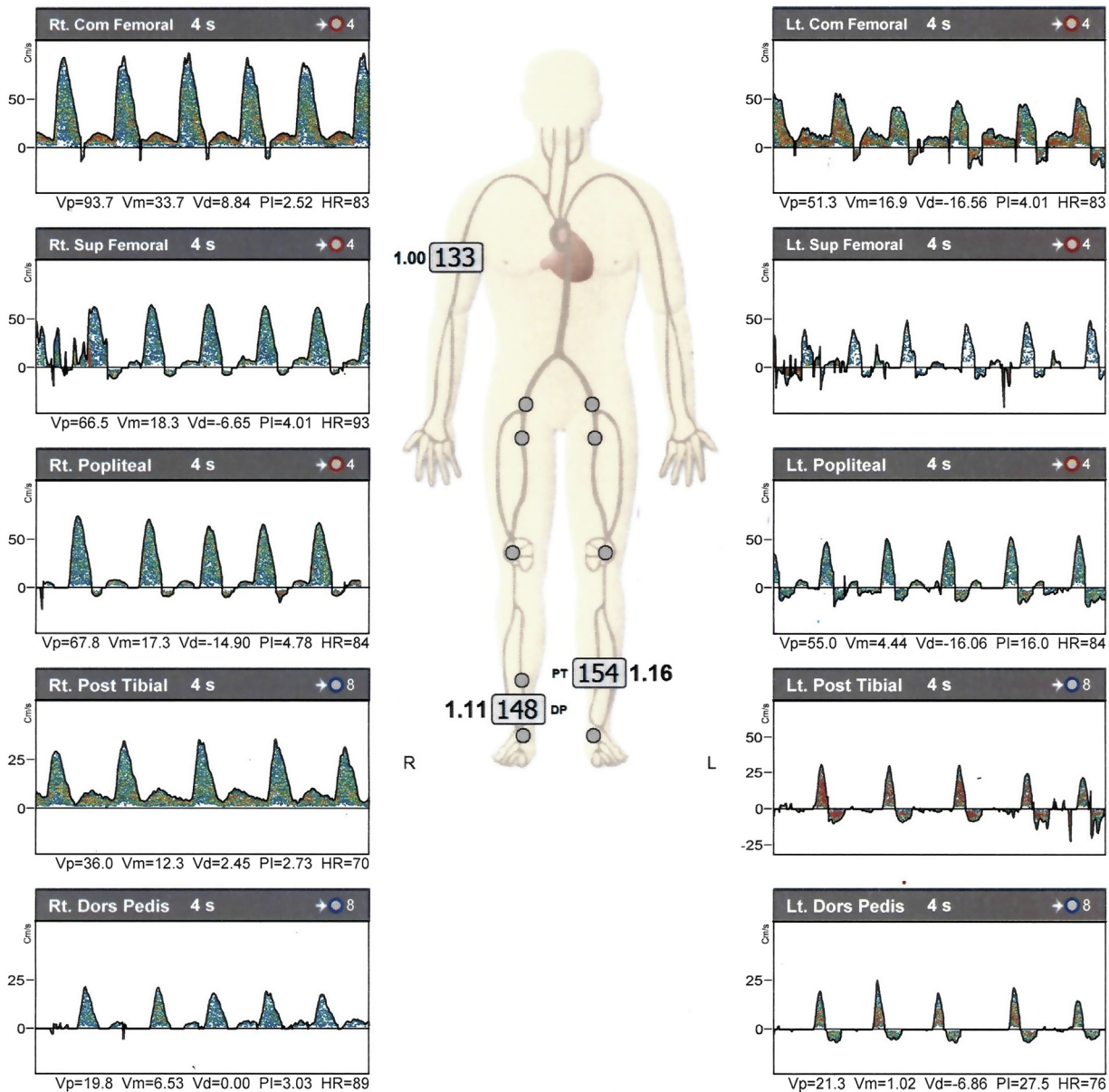
In this case report, the outcome of a novel approach to arterial reconstruction for blunt trauma of the child's external iliac artery is described. This 4-year-old girl was delivered to the emergency department with an open-book pelvic injury, open left femoral fracture, and hemorrhagic shock with an ischemic right leg.

Arterial reconstruction in a contaminated pelvis with blunt trauma to the external iliac artery and vein is a challenge for the vascular surgeon. It is known that ligation of limb arteries results in a 50% amputation rate; the rest of the cases will develop collateral circulation and will therefore suffer from limb length discrepancy.<sup>3,7</sup> The primary management strategy is therefore to resume vascular continuity whenever possible.<sup>1-6</sup>

Thus, there are several considerations for performing arterial reconstruction in a contaminated pelvis of a pediatric patient. The first is the type of vascular conduit to use: a homologous or a synthetic graft. Most vascular surgeons prefer to avoid synthetic grafts because of the high rate of infection and patency.<sup>1-4</sup> Milas et al<sup>2</sup> reported a reconstruction of the left common iliac injury with PTFE graft that resulted in occlusion 2 weeks after surgery. The use of an autogenous graft, such as the reverse saphenous vein graft, is preferred because it is appropriate in size and more resistant to infection.<sup>1,3</sup> In this case, the saphenous vein was not used because of a disparity in size between the graft and vessel.<sup>2</sup> The vein is too small, therefore causing harvesting difficulty, especially in infants.<sup>1</sup> Also, vein graft dilation has been reported using an autogenous graft.<sup>3,5</sup> The use of contralateral femoral vein was not feasible in this case because of open fracture of the left femur. In addition, the hypogastric artery graft is easily accessible<sup>1,2</sup> and can be used for larger caliber arteries, such as an autogenous graft.<sup>1,3</sup> In this case, the proximal internal iliac artery remained in place while the distal end was translocated, making this autogenous graft unique. Another possibility is the use of an endovascular stent graft, such as a bridge procedure, in children with

<b>Patient name:</b>	 מרכז רפואי אסף-הרופא מכון כלי דם	<b>Exam Date/Time:</b> 25/07/2018 10:48
<b>Patient ID:</b>		<b>Examiner:</b>
<b>Gender:</b> Female   <b>DOB:</b> 08/12/2002		<b>Ref Physician:</b>

Segmental Blood Pressures and Doppler



**Fig 2.** Normal biphasic Doppler waveforms of right tibial arteries with 1.1 pressure index 12 years after operation.

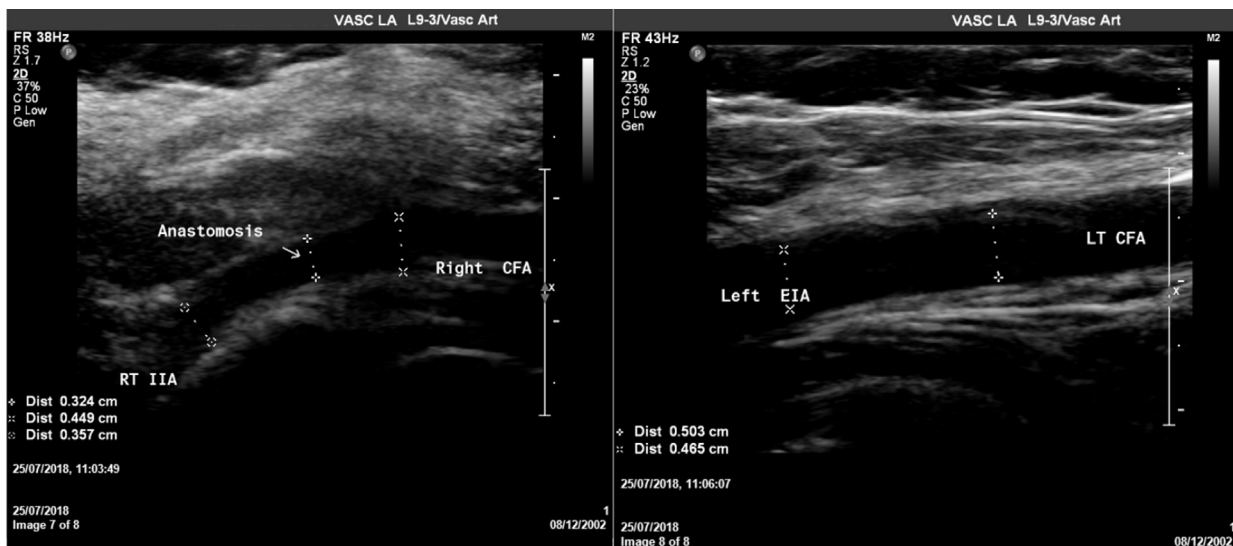
multiple trauma.<sup>5</sup> However, there are no clear statistics of graft migration and stenosis.

The second consideration is the discrepancy between the injured small arteries of 3 mm in infants and the commonly available 6-mm PTFE graft. Klinkner et al<sup>4</sup> reported a case of successful axillofemoral PTFE bypass for blunt external iliac injury and fecal contamination after a 6-month follow-up. Stylianos et al<sup>8</sup> performed an extra-anatomic PTFE femorofemoral bypass because of fecal

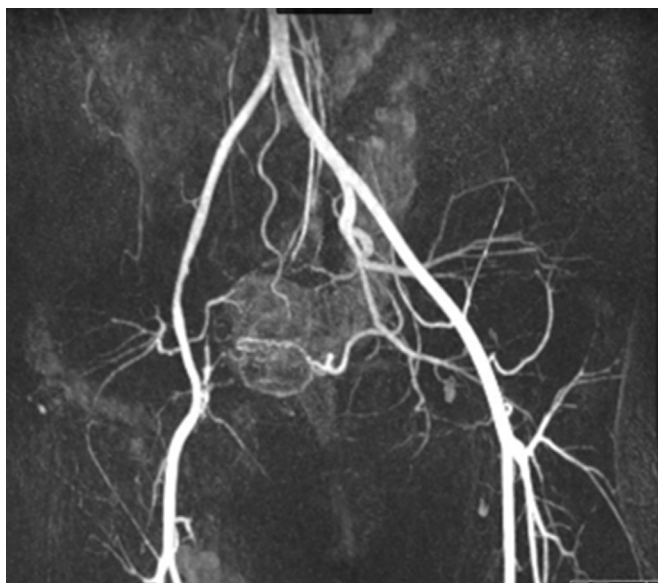
abdominal contamination that resulted in thrombosis 2 weeks later.

The third consideration is that the young patient is still growing, and therefore the synthetic graft will have to be replaced in the future.<sup>2-5</sup>

We used the spatulation technique with continuous Prolene suture for the anastomosis between the translocated right internal iliac and distal external iliac arteries. By use of an autologous graft in a contaminated



**Fig 3.** The 12-year postoperative right internal iliac artery (IIA) translocation with anastomosis to the distal external iliac artery (EIA). CFA, Common femoral artery.



**Fig 4.** Magnetic resonance angiography image of the pelvis and right proximal thigh. The translocated right internal iliac artery is of normal length. Mild stenosis is noted at the right external iliac anastomosis. The left internal iliac artery fully developed to supply the right-sided pelvic organs.

environment, leaving the proximal internal iliac origin, the natural growth of the translocated artery is facilitated. Furthermore, spatulation increased the diameter of the distal internal and external iliac arteries, rendering them fit for the performance of an end-to-end anastomosis. Preferably, use of interrupted stitches for the external iliac anastomosis would have enabled the diameter of the anastomosis to dilate as the child grew and prevented the stenosis documented 12 years later.

A 12-year follow-up duplex ultrasound examination showed no change in the diameter of the anastomosis. The translocated right internal iliac artery grew with the patient; thus, there was no need to replace the graft. Today, the patient is 16 years old; she is 162 cm tall, and her left leg is 2 cm shorter than her right leg as a consequence of the fracture of the left pelvis and femur. The diameter of the right thigh is 11 cm greater than the left thigh, and the diameter of the right calf is 2 cm more than the left one. These are the result of ligation of the left external iliac vein during the operation. The patient has undergone multiple orthopedic procedures, including muscle and tendon translocation and right ankle ankyloses because of femoral nerve injury. The patient walks independently with a limp.

## CONCLUSIONS

A new method of translocation of the internal iliac artery for external iliac artery blunt injury of a young child is described. This kind of arterial reconstruction in a contaminated environment protects against infection and enables the graft to develop with the growing patient, therefore obviating the need for future replacement.

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