

# Minimal Access Kidney Transplant: A Novel Technique To Reduce Surgical Tissue Trauma

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## Abstract

**Objectives:** Minimally invasive surgery and minimal access surgery has replaced conventional surgical procedures during the last 15 years with benefits including a decrease in postoperative pain, time spent convalescing, early return to normal activities, and pleasing cosmetic results. Many centers perform kidney transplant through an oblique or J-shaped approach deep into the iliac fossa. Both approaches have possible disadvantages regarding the extent of tissue trauma. Therefore, we introduced a new minimal access kidney transplant technique in our kidney transplant program in 2008 and report the outcomes of the first 10 patients transplanted with this technique.

**Materials and Methods:** Between November 2008 to May 2009, ten kidney recipients were subjected to the minimal access kidney transplant technique. These patients represent a consecutive series of kidney transplants performed by the senior surgeon or under the supervision of the senior surgeon of transplant surgery.

**Results:** The mean ( $\pm$  SD) age of the recipients was  $47 \pm 14.7$  years (range, 28-67 y), the body mass index was  $25 \pm 2.02$  (range, 23-30), the time of procedure was  $126.2 \pm 27.5$  minutes (range, 90-165 min) with a mean ( $\pm$  SD) anastomoses time

of  $27.7 \pm 8.4$  minutes (range, 19-45 min). Follow-up for all recipients was at least 18 months. There was no reintervention necessary, no wound infections, no primary nonfunction or a delayed graft function, no need for dialysis, no acute rejection episodes, no graft loss, no wound dehiscence, no incisional hernia, or lymphocele. Furthermore, no urologic complications or vascular complications were observed.

**Conclusions:** Our reported technique was used on heart-beating donor kidneys as well as on living-donor organs and is safe with less comorbidity. This minimal access kidney transplant technique might be an alternative procedure for avoiding some of the disadvantages of conventional approaches used for kidney transplant.

**Key words:** Renal, Transplantation, Minimal incision, MAKT, Surgical method

## Introduction

Minimally invasive surgery and minimal access surgery have replaced many conventional surgical procedures during the last 15 years with benefits for the patients ranging from a decrease in postoperative pain, time spent convalescing, early return to normal activities, and pleasing cosmetic results.<sup>1</sup> Minimal access surgery is not as common in transplant as it is for other surgical disciplines. Regarding kidney transplant, many centers usually perform kidney transplant through an oblique or J-shaped approach deep into the iliac fossa. The oblique incision is performed parallel to the inguinal ligament, extending near the midline, just above the pubis, and laterally to the anterior superior spine. The abdominal muscles, sometimes including the rectus muscle, are divided in the direction of the incision. In recent years, the J-shaped incision has become

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increasing popular for kidney transplant. This pararectus incision is prolonged toward the midline above the pubic symphysis. The ipsilateral rectus muscle is divided, and the incision is usually extended upward toward the subcostal margin.

Both approaches have possible disadvantages regarding the extent of tissue trauma because a significant amount of abdominal muscles must be divided. Beside other factors, the trauma of these approaches may contribute to the prevalence of incisional hernia and may lead to limited cosmetic results.<sup>2</sup> The potential advantages of reducing incision/trauma are of greater benefit in immunosuppressed patients, with significantly impaired wound healing. Because of this, minimally invasive techniques for kidney transplant are being used in other centers,<sup>3, 4</sup> as in our center. Since 2008, we have used a minimal access kidney transplant technique (MAKT) as standard protocol at our center that no longer requires division of muscular tissue. We describe this MAKT technique as a single-center experience.

### Materials and Methods

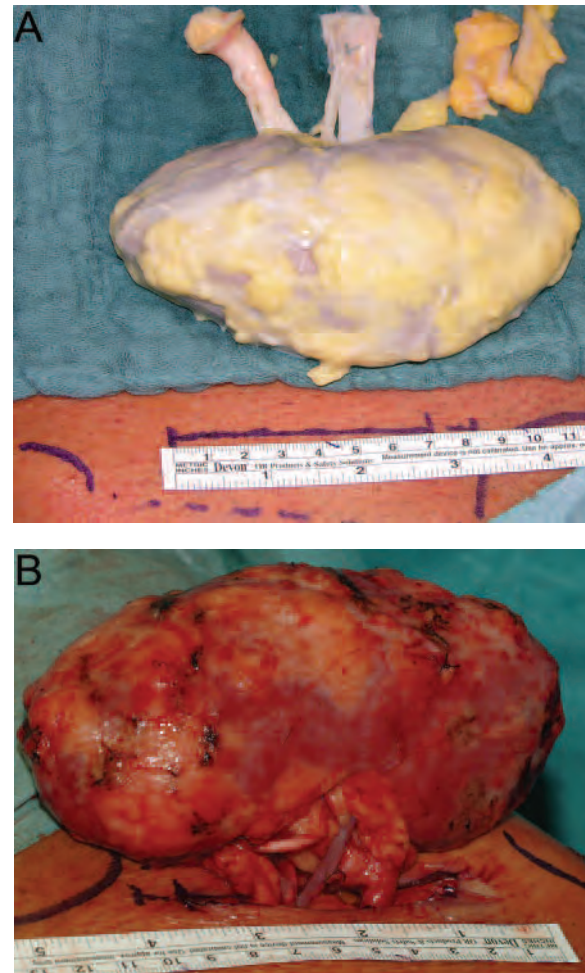
Between November 2008 and May 2009, ten kidney recipients were subjected to the MAKT. The MAKT patients represent a consecutive series of kidney transplants performed by the senior surgeon or under the supervision of the senior surgeon of transplant surgery.

#### Surgical technique: minimal access kidney transplant technique without division of muscular tissue

Before transplant, we perform back table preparation of the kidney. We dissect the renal arteries and veins, and all branches are thoroughly secured by ligatures. We ensure ligation of the dissected lymphatic vessels. We place a 7- to 9-cm transverse incision 1 finger's breadth above the inguinal ligament, with the medial end 2 to 3 cm from the midline (Figure 1A and 1B). After splitting the external fascia, we carefully spread apart the internal oblique muscle and split the transverse fascia (Figure 2). We expose the iliac vessels in a minimalistic fashion without dissecting the lymphatic vessels. Before revascularization, we fit the extraperitoneal space to the size of the transplanted kidney under the transverse fascia by bluntly pushing aside the preperitoneal fatty tissue

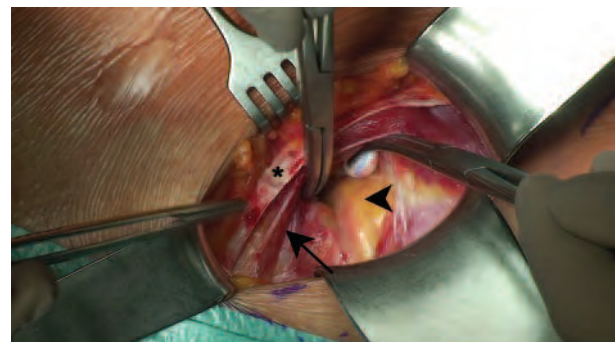
so as to sufficiently control any bleeding (Figure 3). Then, we place the prepared kidney extracorporeally in a surgical towel soaked in ice water to ensure

**Figure 1.** Skin Incision of the MAKT Technique



(A) Skin incision (7 cm) in the right lower abdomen, 2-3 cm above the inguinal ligament. As a comparison the size of the donor kidney above. Kidney with 2 arteries in 1 patch as well as 2 veins in 1 patch. (B) Extracorporeal position of the kidney directly after revascularization.

**Figure 2.** Atraumatic Splitting of the Internal Oblique Muscle and Transverse Abdominal Muscle

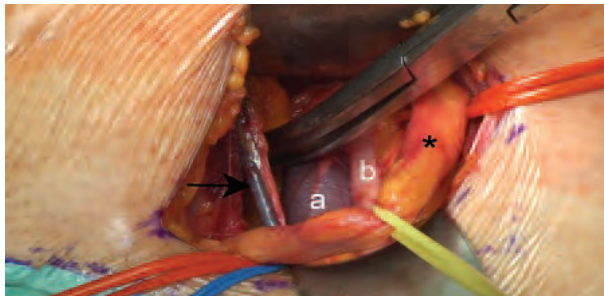


\*External oblique aponeurosis; arrow, internal oblique muscle; arrowhead, preperitoneal fat.

sufficient cooling while we perform the 2 anastomoses.

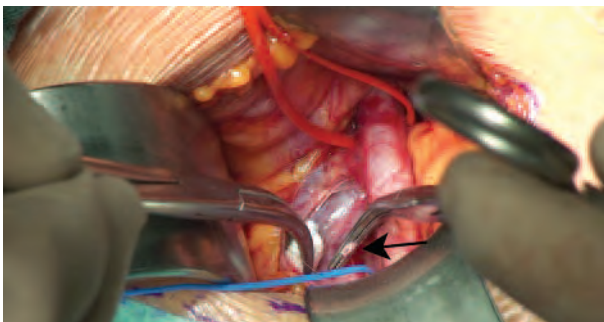
In brief, we pass vessel loops around the external iliac vein and artery without dissecting the lymphatic vessels. Before clamping the external iliac vein and artery, we ligate the venous tributaries of the iliac vein (Figure 4). Then, we anastomose the renal vein to the external iliac vein (end-to-side). Afterward, we anastomose the renal artery about 2 cm proximal to the external iliac artery (end-to-side) (Figure 5). We use continuous, nonresorbable monofilament 5-0 sutures for both vascular anastomoses. We place the kidney extracorporeally during the anastomoses, allowing us to suture the back wall of the vascular anastomoses from the outside. We implant the ureter in an extravesical manner in a modified Lich-Gregoir technique with minimal bladder dissection.<sup>5</sup> Modification consists of ending the paraureteral myotomy with an inverted Y, which permits easier detrusor muscle reapproximation. We insert a double J stent in the ureter. To place the kidney in the created extraperitoneal space, we require complete muscle relaxation. We carefully tilt the kidney in the direction of the vessel anastomoses and gently slide it into the created cavity (Figure 6A and 6B).

Figure 3. Preparation of the Extraperitoneal Cavity



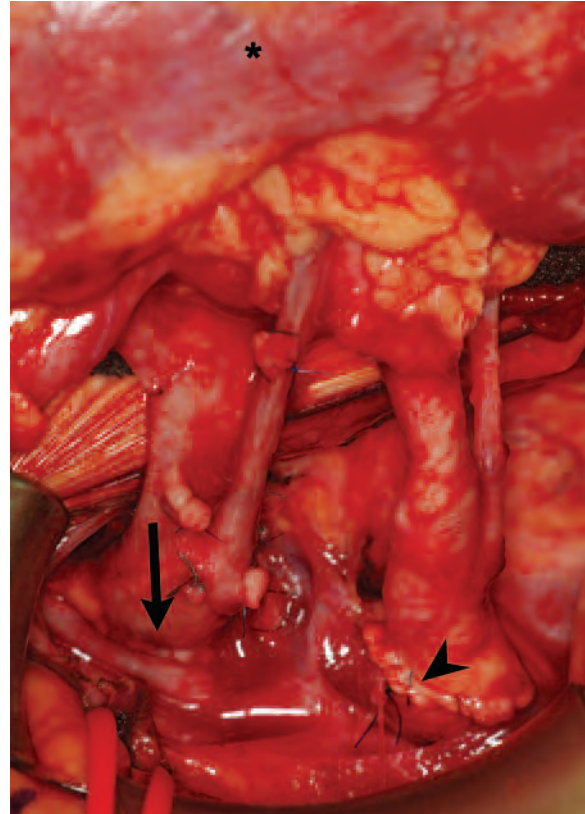
The preperitoneal fatty tissue is bluntly divided  
\*spermatic cord; arrow, epigastric vessels; (A) external iliac vein; (B) external iliac artery.

Figure 4. Preparation of the External Iliac Vessels



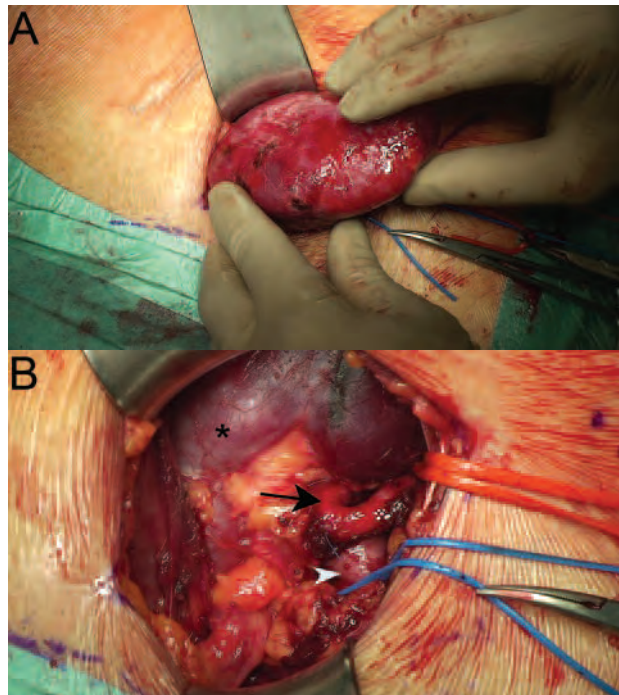
Vessel loops are passed around the external iliac vein and artery. Ligation of venous tributaries (arrow) of the backside of the iliac vein.

Figure 5. Both Vascular Anastomoses After Revascularization With the Kidney Situated Extracorporeally

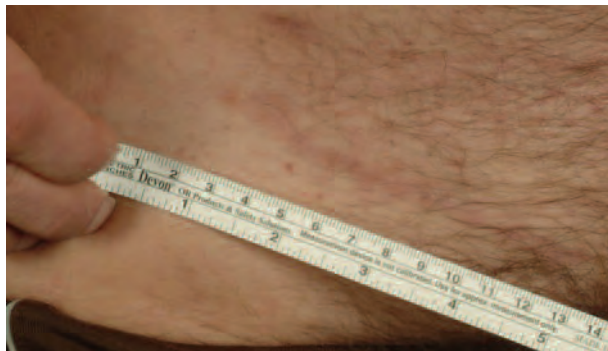


\*Kidney; arrow, venous anastomosis; arrowhead, arterial anastomosis.

Figure 6. Positioning of the Kidney



(A) Positioning of the revascularized kidney in the previously created cavity.  
(B) Final position of the kidney just before closure.  
\*kidney; arrow, artery; arrowhead, vein.

**Figure 7.** Result 6 Months After Transplant

Same patient as in Figure 1A.

### Immunosuppression

In case of grafts from elderly donors (> 65 y), an induction treatment (low-dose thymoglobulin) is administered intraoperatively and on day 4. Our standard immunosuppressive regimen, given to all recipients of the present cohort, consists of tacrolimus, mycophenolic acid, and corticosteroids.

### Results

The mean ( $\pm$  SD) age of the recipients was  $47 \pm 14.7$  years (range, 28-67 y) with a mean ( $\pm$  SD) body mass index (BMI) of  $25 \pm 2.02$  (range, 23-30). The mean ( $\pm$  SD) time of the procedure was  $126.2 \pm 27.5$  minutes (range, 90-165 min) with a mean ( $\pm$  SD) anastomotic time of  $27.7 \pm 8.4$  minutes (range, 19-45 min). The mean ( $\pm$  SD) cold ischemia time was  $14.4 \pm 6.4$  hours (range, 1.8-24 h). The follow-up for all recipients was at least 18 months.

There was no reintervention necessary and no wound infections occurred. Regarding graft function, there was neither primary nonfunction nor delayed graft function, and there was no need for dialysis. None of the patients showed acute rejection episodes or a graft loss. Serum creatinine levels were measured daily. Table 1 shows the serum creatinine levels on the day of admission, on postoperative days 3 and 7, on the day of discharge, as well as on follow-ups. Regarding hospital stay, the mean ( $\pm$  SD) time was  $18.5 \pm 5.8$  days (range, 4-29 d). During follow-up, there was no wound dehiscence, incisional hernia, or lymphocele. Furthermore, no urologic complications (eg, urinary leakage or stenosis) or vascular complications (eg, renal artery thrombosis or renal vein thrombosis) were seen. However, 2 patients showed nonsurgical-related complications. One patient had a cardiac arrest due to a myocardial

**Table 1.** Data on Progression of Serum Creatinine Levels at Various Time Points (SD, Standard Deviation)

	Serum Creatinine (Mean $\pm$ SD [ $\mu$ mol/L])
Day of admission	$725.7 \pm 191.37$ (range, 1194-490)
Postoperative day 3	$418.7 \pm 187.17$ (range, 706-130)
Postoperative day 7	$242.3 \pm 155.39$ (range, 619-108)
Day of discharge	$150.8 \pm 32.99$ (range, 201-90)
6 Months follow-up	$139.1 \pm 23.74$ (range, 175-95)
12 Months follow-up	$131.7 \pm 28.08$ (range, 169-101)
18 Months follow-up	$127.0 \pm 23.67$ (range, 170-102)
Last follow-up	$121.4 \pm 21.90$ (range, 145-89)

infarction that occurred 14 days after transplant, and the patient was admitted to the intensive care unit after successful cardiopulmonary resuscitation. The cardiac arrest and its treatment had no observed effect on renal function. Another patient showed acute calcineurin inhibitor toxicity.

### Discussion

Kidney recipients have an increased risk of wound complications, possibly due to immunosuppressive drugs, in particular steroids, mycophenolate acid, and proliferation signal inhibitors.<sup>6-8</sup> These drugs might have a negative effect on tissue healing that may lead to wound dehiscences, seroma, superficial and deep wound infections, and lymphocele. Additionally, there are surgical and/or technical factors (including the type of incision) that may have an effect on posttransplant surgical complications.

Regarding incisional hernia, studies have shown that a midline incision as well as the oblique incision seems to be more beneficial for the final clinical outcome compared with the J-shaped incisions.<sup>2, 9</sup> The oblique incision, however, requires division of all lateral abdominal muscles, sometimes including the rectus muscle. When exposure is poor, the oblique approach must be prolonged upward to the 12th rib, frustrating the cosmetic result. By reducing the incisional length (Figure 1A and 1B), the extent of dissection, and thereby tissue trauma, wound complications can be reduced with our MAK technique. Additionally, the minimal skin incision showed better cosmetic results independent of the BMI in our cohort (Figure 7). Some centers define a BMI < 30 kg/m<sup>2</sup> as a prerequisite for placing a patient on the waiting list for renal transplant, because analyses showed that BMI has a negative effect on patient and graft survival.<sup>10, 11</sup> Despite some limitations in space in obese patients owing to the small incision, there is no drawback in performing

the anastomoses in overweight patients up to a BMI of 30. The MAKT approach in morbidly obese patients (BMI > 30) and the need for an extension of the incision in these patients must be ruled out.

Applying this modified surgical technique may help avoid surgical risk factors such as bleeding. This technique ensures good control for possible hilar or capsular bleedings after revascularization owing to the extracorporeal placement of the graft during performance of the anastomoses. Limitations in surgery, like restricted access to the iliac vessels, might bear the risk of vascular complications. However, within our analysis of a small number of patients that underwent this novel approach, no vascular complications occurred. Using this technique, the external iliac vessels are anastomosed in an end-to-side fashion, because a significant reduction of arterial stenosis is achieved by performing end-to-side anastomoses of the renal graft artery to the external iliac artery instead of the internal artery.<sup>12</sup> Furthermore, anastomoses of the internal artery is suggested as being involved in the occurrence of male sexual dysfunction.<sup>13</sup> Despite the small incision in our approach, there is still good access to the external iliac vessels. The venous anastomosis is performed directly above the inguinal ligament. This allows room to maneuver when placing the arterial anastomosis, which might be difficult when dealing with calcifications or in living-donor transplant, where the graft vessels are sometimes very short. Another advantage of extracorporeal graft placement during performance of the anastomoses is the possibility of efficiently cooling the graft, which may lessen ischemic damage.

Intravesical graft ureter implantation was done using the modified Lich-Gregoir procedure to avoid vesicoureteral reflux.<sup>14</sup> Furthermore, a double-J stent was used because ureteral stenting provides a decrease in ureteroneocystostomy anastomotic complications after renal transplant.<sup>15</sup>

We want to stress that our data rely not only on a single surgeon's experience. This technique can be safely performed by younger surgeons with less experience under the guidance of a senior transplant surgeon, as in our center (which explains the variations in operating time). Regarding hospital stay after renal transplant, there are major differences reported in different countries. In Germany, the average hospital stay for renal transplant is 18.4

days.<sup>16</sup> In our cohort, 2 patients had a prolonged hospital stay due to nonsurgical complications (1 acute myocardial infarction and 1 calcineurin inhibitor toxicity), which could explain the mean hospital stay of 18.5 days. Eighteen months after renal transplant was done with the MAKT, our patients needed no hospital consultations for renal failure or rejections.

There are some limitations to our data. Follow-up is relatively short, and the analysis is on a small population, therefore, further studies are required to confirm the advantages of this technique. Considering the fact that the described MAKT technique is an initial series, the preliminary results seems to be promising. With a length from 7 to 9 cm, the incision is as short as possible and therefore, surgical trauma and risk of surgical complications are reduced. Our reported technique used on heart-beating donor kidneys as well as on living-donor organs is safe with the potential of less comorbidity. The MAKT technique may avoid some of the disadvantages of conventional approaches for kidney transplant.

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