



Incidental Ureteral Complication in Single-Center Consecutive Oblique Lateral Interbody Fusion Cases

Kang Hoon LEE¹, Dong Wuk SON^{1,2}, Bu Kwang OH¹, Su Hun LEE¹, Jun Seok LEE¹, Young Ha KIM¹, Soon Ki SUNG^{1,2}, Sang Weon LEE^{1,2}, Geun Sung SONG^{1,2}

¹Pusan National University Yangsan Hospital, Department of Neurosurgery, Yangsan, Korea

²Pusan National University, School of Medicine, Department of Neurosurgery, Yangsan, Korea

Corresponding author: Dong Wuk SON ✉ md6576@naver.com

ABSTRACT

Oblique lateral interbody fusion (OLIF) has recently gained widespread use as a minimally invasive surgical procedure for degenerative lumbar disease. OLIF has several advantages but can also lead to several possible complications. For example, although less common, access through the retroperitoneal cavity can cause ureteral injury. Here, we report two cases of ureteral complications that occurred during consecutive OLIF procedures. One involved a 77-year-old female patient who had a double-J catheter inserted due to ureteral injury during surgery, and the other involved a 69-year-old male patient suspected of having a ureteral stricture due to retractor compression. To prevent ureteral complications in OLIF, it is necessary to accurately identify the anatomy of the ureter through preoperative imaging and to pay special attention during surgery.

KEYWORDS: Lumbar vertebrae, Spinal fusion, Ureter, Stricture

ABBREVIATIONS: OLIF: Oblique lateral interbody fusion, CT: Computed tomography

INTRODUCTION

Oblique lateral interbody fusion (OLIF) is gaining popularity as a minimally invasive surgical technique for various degenerative lumbar diseases, including spondylolisthesis and kyphoscoliosis (12). It is safer and more effective than traditional spinal fusion surgery (5). In OLIF, the anterior spinal column is approached through the retroperitoneal cavity, allowing the operator to access the intervertebral disc space with relative ease, while minimizing bleeding and muscle damage (13). Moreover, the anterior-psoas approach is less likely to cause injury to the great vessels or lumbar plexus because it does not require access to the prevertebral space that can accompany the great vessels or plexus (2). However, various complications can occur during OLIF, including endplate fracture, cage subsidence, psoas muscle paresis, retroperitoneal hematoma, sympathetic

chain injury, and infection. Due to the anteriorly located OLIF corridor, the possibility of inadvertent injury to major vessels or the ureter is high (1). Few reports of ureteral injury are found in the literature, and they have only focused on the incidence rate (8,9). We recently encountered two cases of intraoperative ureteral complications during consecutive OLIF. In this case report, we share the course of complications and review the related ureteral anatomy with precautions taken during OLIF.

CASE REPORT

The local institutional review board (IRB) approved this case report study (05-2022-182). In the process of IRB approval, an exemption document of patient consent has been submitted.

Case 1

Ureteral injury occurred in a revision case of a 77-year-old

Kang Hoon LEE : 0000-0002-7624-172X
Dong Wuk SON : 0000-0002-9154-1923
Bu Kwang OH : 0000-0002-6410-121X

Su Hun LEE : 0000-0001-8952-5556
Jun Seok LEE : 0000-0003-2488-6953
Young Ha KIM : 0000-0003-0477-3169

Soon Ki SUNG : 0000-0001-7138-9621
Sang Weon LEE : 0000-0002-3199-7072
Geun Sung SONG : 0000-0001-8029-9011

woman with a history of lumbar spine surgery. The patient had a history of L3–5 fusion surgery. Imaging examination revealed that the patient had L3–4 nonunion and bilateral L3 screw loosening, which caused severe radiating back and leg pain. To resolve these symptoms, we decided to proceed with OLIF L3–4. No complications occurred after retroperitoneal access until discectomy. However, during the process of pulling out the trial, tissues such as muscle bundles were found to be crushed. We asked a urologist to evaluate ureter injury. To confirm ureteral injury, indocyanine green was injected intravenously; subsequently, purple urine leakage was observed from the injury site. A double-J catheter was inserted into the ureter injury site, and a urologist performed primary closure. After the operation, the patient was sufficiently hydrated; however, acute pyelonephritis occurred twice. The double-J catheter was replaced two months after surgery and removed four months later. After catheter removal, retrograde

pyelography revealed a mild stenosis of the left proximal ureteral anastomosis. However, the dye passed completely without any resistance (Figure 1).

Case 2

A 69-year-old man was diagnosed with lumbar spinal stenosis two years prior to presentation. The patient underwent OLIF at the L2–3 and L3–4 levels and pedicle screw instrumentation at L1–4 to relieve persistent radiating pain in the left thigh and sciatica. The L3–4 level procedure was performed first and proceeded smoothly thereafter. In the L2–3 process, the pin was fixed in the region where the retroperitoneal fat partially covered the psoas muscle. After the self-retaining retractor was mounted, OLIF was performed without any complications and the cage was inserted. Before removing the self-retractor, we checked the pathway of the ureter and confirmed that it was close to the pinning site. To prevent injury during pin

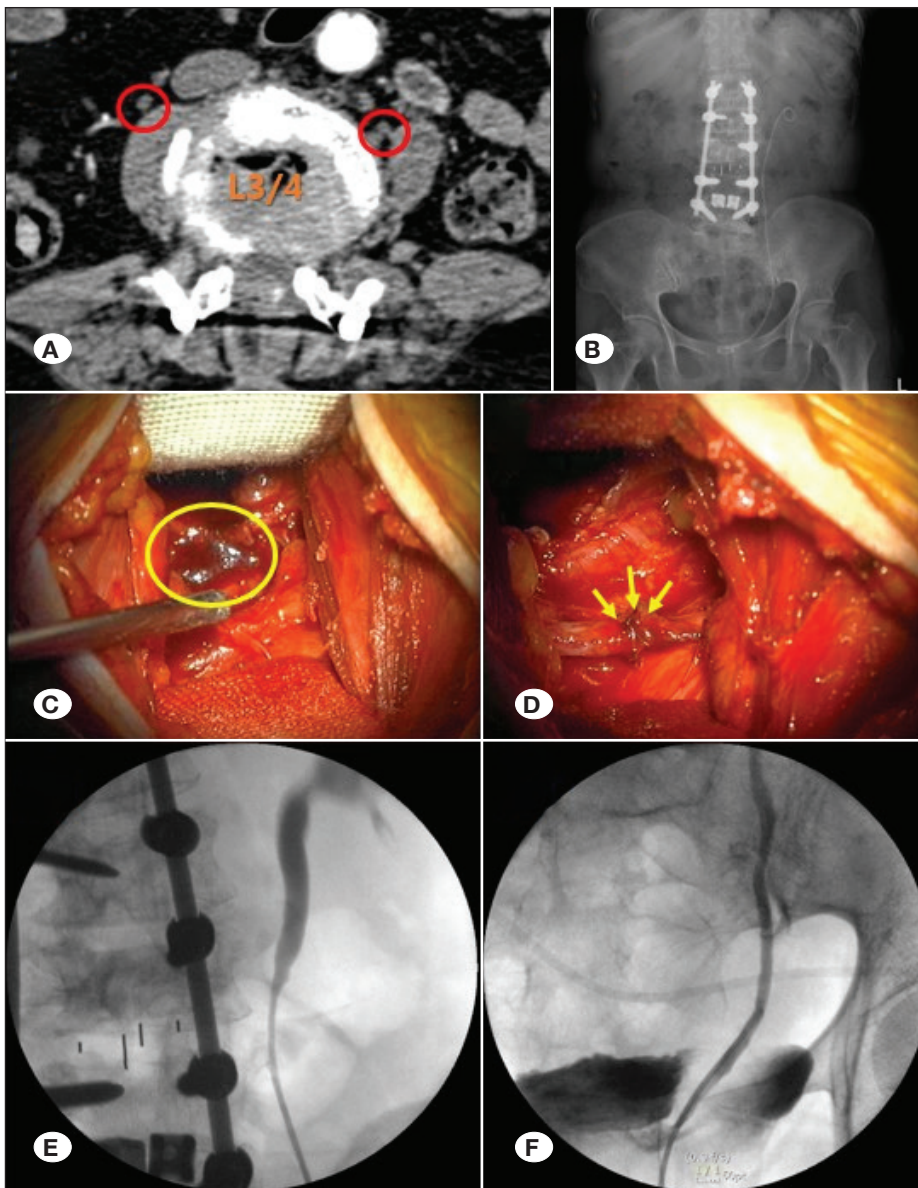


Figure 1: **A)** Preoperative computed tomography: the ureter at the L3/4 area is marked with red circles. The right ureter is located above the psoas muscle, whereas the left ureter is located at the medial border of the psoas muscle. **B)** Immediate postoperative image. **C)** Indocyanine leakage was found at the site of injury of the ureter (yellow circle). **D)** A double-J catheter was inserted, and primary closure was performed at the injury site (yellow arrows). **E, F)** Four-month postoperative retrograde pyelography: Mild stenosis at the suture site; however, the contrast passage was uneventful.

removal, the pin was removed by gentle medial retraction after checking the pathway of the ureter, which was confirmed in the upper and lower parts of the pin. Fortunately, there was no penetration of the ureter, but the surrounding soft tissue was kinked considerably. Before pin fixation, no procedure was definitively identified as being responsible for damage to the ureter; it was therefore thought that ureter stricture occurred due to the retractor, and we decided to check for ureter injury. Indigo carmine was administered intravenously after consultation with a urologist to evaluate ureter injury. Fortunately, no urine leakage was observed and the patient showed no postoperative urological symptoms. On postoperative day seven, intravenous pyelography was performed for further evaluation of the ureter status, revealing some strictures but normal patency (Figure 2).

DISCUSSION

We encountered two cases of ureteral complications during OLIF surgery. Few cases of ureteral complications during minimally invasive OLIF have been reported; however, they are rare and have a low incidence rate (8,9). Anatomically, the ureter is located anterolateral to the psoas muscle in the retroperitoneal space, adjacent to the disc space and great vessels, and is surrounded by fat tissue (10,15).

In Case 1, the ureteral pathway was atypical and showed variation. When we reviewed the preoperative computed tomography (CT) scan again, we found a difference in the paths of the bilateral ureters. Typically, the ureter is located on the psoas muscle and is easily identifiable. Therefore, the ureter

was retracted medially during the retroperitoneal approach. In our case, however, the ureter was not retracted properly to the medial side because the ureter was located between the psoas muscle and the vertebral body, resulting in ureteral injury. If ureteral injury is discovered postoperatively, urine leakage can lead to retroperitoneal infection, which can be dangerous as it can lead to sepsis or cage-associated discitis (9). Acute renal insufficiency and chronic renal failure can also occur as sequelae of ureteral injury (7). Fortunately, we suspected ureteral injury intraoperatively, and the complications were minimized because the patient was promptly diagnosed and treated.

The condition in Case 2 may have been related to the anatomical location of the ureter. The ureter originates in the kidney and is located in the retroperitoneal space above the psoas muscle, closest to the psoas medial border at the L2–3 level (3,11). Therefore, because the retractor is mounted on the medial side of the psoas muscle, the L2–3 level is the most vulnerable to ureteral injury. If the pathway of the ureter is grossly confirmed during the retroperitoneal approach, the risk of injury is low. However, it is more dangerous to inspect the retroperitoneal fat internally when the ureter has not been identified. Therefore, it was critical to retract the retroperitoneal fat sufficiently medially at the site where the retractor was mounted.

It is important for surgeons to be aware of the possibility of intraoperative ureteral complications. Intravenous dye injection may be helpful if ureteral injury is suspected intraoperatively; however, the site of injury may still be unknown (14). Even if

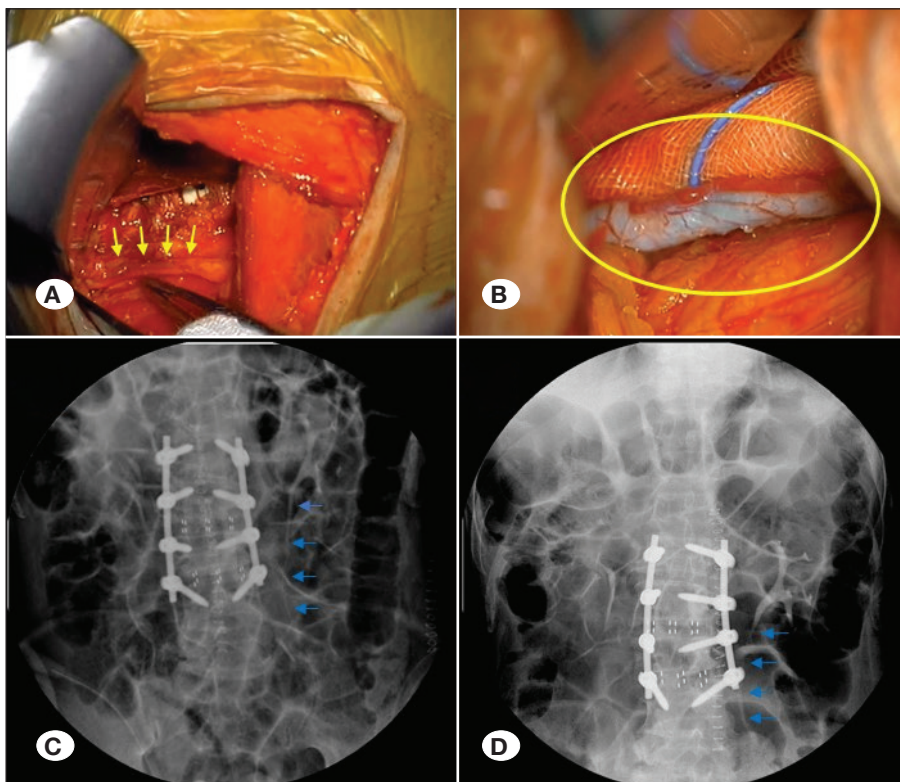


Figure 2: **A)** Suspicion of ureteral stricture was observed (yellow arrow). **B)** No leakage was observed after intravenous indigo carmine injection (yellow circle). **C)** Intravenous pyelography on postoperative day 3. **D)** Intravenous pyelography on postoperative day 7: Passage was good with no remarkable findings (blue arrows).

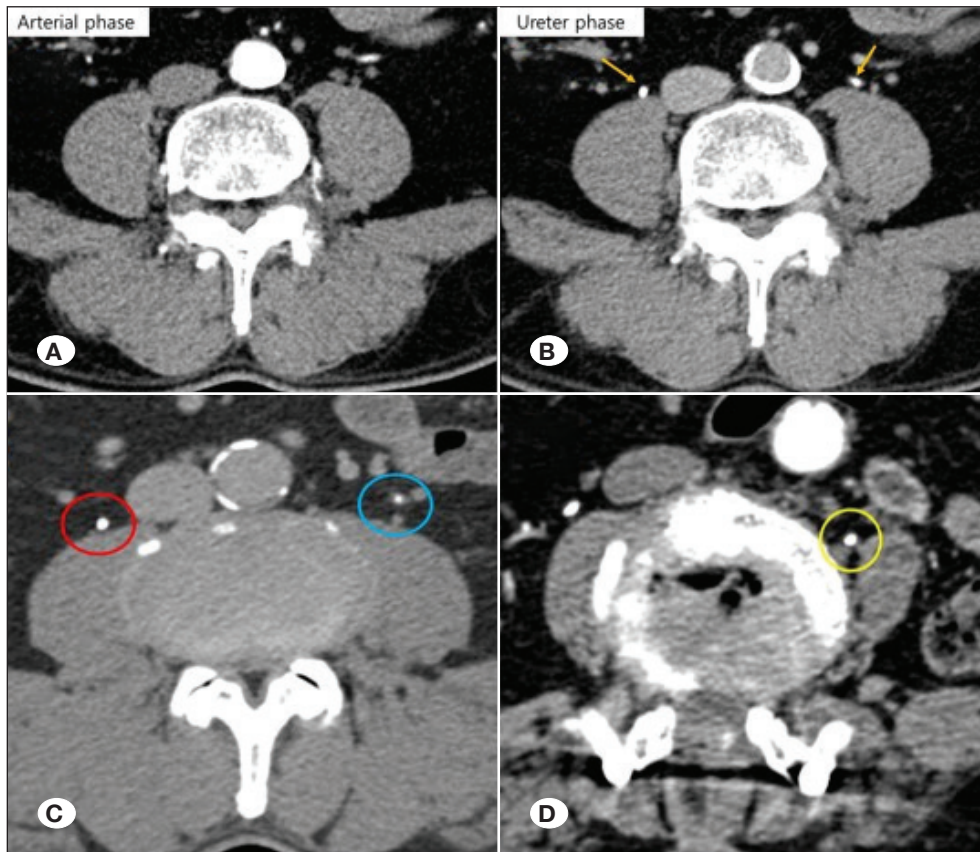


Figure 3: Dual-phase contrast-enhanced computed tomography. **A)** In the arterial phase, the position of the ureter could not be accurately assessed. However, **(B)** in the ureter phase, the ureter was contrast-enhanced and was thus correctly assessed. Location of Ureter. **C)** Located on the psoas (red circle) in retroperitoneal fat (blue circle). **C)** Located beside the medial border of the psoas muscle (yellow circle).

no ureteral injury is detected intraoperatively, the possibility of ureteral injury should be suspected if hematuria occurs intraoperatively or if there are any non-specific postoperative symptoms such as abdominal pain, flank pain, fever, and vomiting (4,9). While it is important to recognize ureteral injury promptly and treat it appropriately, prevention is far more important. Therefore, surgeons must take special care to avoid ureteral injury during surgery. To prevent ureteral complications, anatomical orientation of the ureter must be accurately determined. Ureteral imaging can assist in accurately determining the direction of the ureter, which varies among patients (6). Therefore, at our hospital, we prevent ureteral complications by simultaneously conducting dual-phase contrast-enhanced CT, which can confirm the direction of the ureter during preoperative spinal CT (Figure 3). Preoperative dual-phase contrast-enhanced CT is recommended for patients with a history of retroperitoneal surgery or if upper lumbar OLIF is considered. It is essential to preoperatively analyze the anatomical position of the ureter to prevent ureteral complications.

CONCLUSION

Although few cases have been reported, and the incidence rate is low, ureteral injury during OLIF is a serious complication. If the ureteral pathway is not identified during surgery, special attention is required. In such cases, it is necessary to ensure that the retroperitoneal fat is not located in the space where

the surgical instrument is moved. Additionally, identifying the anatomical location of the ureter preoperatively using image work-up will reduce ureteral complications.

AUTHORSHIP CONTRIBUTION

Study conception and design: KHL, BKO

Data collection: KHL, SHL

Analysis and interpretation of results: KHL, DWS

Draft manuscript preparation: YHK, JSL

Critical revision of the article: DWS, GSS

Other (study supervision, fundings, materials, etc...): SKS, SWL

All authors (KHL, DWS, BKO, SHL, JSL, YHK, SKS, SWL, GSS) reviewed the results and approved the final version of the manuscript.

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