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Case Report

Tibial Neuropathy after Revision Total Knee Prosthesis: A Case Report

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We describe a 74-year-old woman with right knee osteoarthritis experiencing right tibial neuropathy because of complications of total knee arthroplasty revision. Weakness in the right toe flexors and paresthesia over the sole of the right foot were observed after operation. A nerve conduction study and electromyographic examination indicated right tibial neuropathy. Radiography indicated a prosthesis fragment in the right popliteal fossa, and its location was different before and after surgery. Prosthesis fragment dislodgement was also confirmed through ultrasonography, and the nearby tibial nerve may have been entrapped because of the dislocation process and surrounding tissue fibrosis. Ultrasonography confirmed the prosthesis fragment did not contact the right tibial nerve directly. After considering her medical condition, we chose conservative treatment including therapeutic exercise, electrical stimulation and ultrasound-guided 5% glucose tibial nerve hydrodissection, and the patient's symptoms much recovered 6 months later. The causes of tibial neuropathy in our case may be different from those reported previously. Ultrasonography played a valuable role in the examination and treatment of the injured nerve. (Tw J Phys Med Rehabil 2021; 49(1): 105 - 111)

Key Words: tibial neuropathy, total knee arthroplasty, nerve conduction study, ultrasonography, electromyography

INTRODUCTION

Total knee arthroplasty (TKA) is one of the most clinically successful and commonly performed orthopedic procedures. Nerve complications related to TKA are uncommon.¹,²,³ Unlike the peroneal nerve, the tibial nerve is rather rarely affected due to its deep location in the popliteal fossa and the leg. We presented the first case of tibial neuropathy because of complications of TKA revision. We used ultrasonography and electromyography to check the condition of the injured nerve, observe surrounding fibrotic tissue, and locate the prosthesis fragment. Ultrasonography helped us make a clinical decision due to the unique situation and lack of previous literature.
A 74-year-old woman, 144 cm height, 71 kg weight, BMI: 41, with a history of type II diabetes and chronic kidney disease was admitted for right TKA revision. She had received right unicompartmental knee arthroplasty (UKA) 12 years prior. She felt right lateral knee pain without paresthesia or muscle weakness 1 month prior to admission. Physical examination revealed swelling and contracture of the right knee without motor or sensory deficit. Knee X-ray revealed a prosthesis fragment dislocation in the right popliteal fossa (Figure 1A).

Twenty days after revision, the patient felt hypoaesthesia and paresis over sole of her right foot. She could not stand on the tiptoe with her right leg, and her right toes could not flex one month after revision. Right toe flexors and ankle plantar flexors scored 0/5 in manual muscle testing. The deep tendon reflex of the right ankle presented but was depressed.

A follow-up knee X-ray revealed that a fragment of the previous prosthesis in the right popliteal fossa had changed position (Figure 1B). The right tibial nerve may have been damaged during dislodgement of the prosthesis fragment or compressed by the fibrotic tissue at the site of the prosthesis fragment. Ultrasonography of the right popliteal fossa confirmed the dislodgement of the prosthesis fragment, and the nearby tibial nerve may have been entrapped because of the dislocation process and surrounding tissue fibrosis (Figure 2A). The loss of normal architecture and hyperechoic pattern of the tissue surrounding the right tibial nerve indicates scar accumulation and muscle fibrosis. The right tibial nerve, which is superficial and lateral to the right popliteal artery, lost its honeycomb appearance compared to the normal side (Figure 2B). Ultrasonography also confirmed that the prosthesis fragment did not contact the right tibial nerve, which was reviewed by the other experts with more than 10 years’ experience for the musculoskeletal ultrasound. Considering the high risk of surgery due to underlying disease (diabetes with pool control and chronic kidney disease), the risk of perioperative nerve injury, and the challenge in finding the fragment, we chose a conservative treatment after discussing with her orthopaedic doctor. 29 days after revision, the patient received physiotherapy including electrical muscle stimulation and therapeutic exercise. Additionally, she received ultrasound-guided perineural injection at the right tibial nerve with 5% glucose (D5W). A follow-up ultrasound examination 130 days after revision found that the hyperechoic prosthesis fragment with comet-tail fact had moved to a more superficial location posterior to the right tibial nerve at the popliteal fossa (Figure 2C), which was compatible with findings of the repeated X-ray film (Figure 1C).

<table>
<thead>
<tr>
<th>Onset of injury (days after revision TKA)</th>
<th>Muscle</th>
<th>Spontaneous activity</th>
<th>EMG</th>
<th>NCS</th>
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<tr>
<td></td>
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<td>Fibrillation Positive sharp wave Polyphasic motor unit potential</td>
<td>Recruitment</td>
<td>Sensory Motor</td>
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<td></td>
<td>R. FDL.</td>
<td>2+</td>
<td>3+</td>
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</tr>
<tr>
<td>43</td>
<td>R. TP.</td>
<td>2+</td>
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<td></td>
<td>R. Soleus</td>
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<td>R. Medial gastrocnemius</td>
<td>2+</td>
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<td>Reduced</td>
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<tr>
<td>258</td>
<td>R. FDL.</td>
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<td>R. TP.</td>
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Abbreviations: NCS, nerve conduction study; EMG, electromyography; TKA, total knee arthroplasty; MUAP, motor unit action potential; R, right; FDL, flexor digitorum longus; TP, tibialis posterior.
Figure 1. X-ray image of the prosthesis fragment at the right popliteal fossa before surgery (A). The location of the prosthesis fragment (white arrow) changed after surgery (B) and changed again 130 days after surgery (C).

Figure 2. Ultrasound image (transverse scan) of the right popliteal fossa showing the hyperechoic prosthesis fragment close to the right tibial nerve. The loss of normal architecture and hyperechoic pattern of the tissue surrounding the right tibial nerve indicates scar accumulation and muscle fibrosis (A). The right tibial nerve lost its honeycomb appearance compared to the normal side (B). Hyperechoic prosthesis fragment with comet-tail artifact changed position 130 days after revision (C). White arrow: prosthesis fragment; white plus: the range of the prosthesis fragment; circle: tibial nerve; white double arrow: scar tissue; open arrow: flow in popliteal artery; POP: popliteal fossa; RT: right; LT: left.
Needle electromyography (EMG) 43 days after revision demonstrated prominent active denervation in the right flexor digitorum longus, tibialis posterior, soleus, and medial head of the gastrocnemius muscles (Table 1). EMG 258 days after revision showed mild denervation and reinnervation in the same muscles. Sensory NCS found no response on stimulation of the right plantar nerve, and motor NCS also found no response on stimulation of the right plantar nerve and right tibial nerve at the knee level. The final physical examination 258 days after revision also revealed improved muscle strength, sensation, and reflexes in the right lower limb.

**DISCUSSION**

The tibial nerve is the larger terminal branch of the sciatic nerve, which arises from the L4 to S3 roots and passes through the popliteal fossa to reach below the arch of the soleus.\(^4,5\) The tibial nerve injury following TKA is uncommon.\(^2,3,6\) Speelziek et al. reported 54 cases of neuropathy after primary total knee arthroplasty. Among them, only 2 cases of tibial neuropathy were reported, compared with 37 cases of peroneal neuropathy.\(^2\) In previous literature, intraoperative mechanical forces such as traction and compression are the most likely etiology of tibial neuropathy after TKA.\(^3\) Female gender was also identified as a risk factor for nerve injury following TKA.\(^3\)

In the present case, however, the tibial nerve was most likely injured by the movement of prosthesis fragment or by the surrounding fibrotic tissue caused by prosthesis fragment instead of direct traction or compression force.

Our patient’s symptoms indicated the classical pattern of tibial nerve neuropathy. A previous prosthetic fragment was found near the tibial nerve, and its location changed after surgery, which might imply that the tibial nerve was damaged during prosthesis movement and was also possibly entrapped by the fibrotic tissue at the site of the prosthesis fragment.\(^7,8\) Nerve recovery was variable.\(^9,12\) Concerning treatment, the imaging findings and the patient’s symptoms indicated tibial nerve hydrodissection, physical therapy, and thorough protection.

Ultrasound examination is performed only after taking patient’s history and conducting clinical evaluation. Ultrasound can be used as favorable evidence for tibial neuropathy. In our patient, the echogenicity and margin of the tibial nerve as well as the location of the prosthesis revealed that ultrasonography was helpful in obtaining a differential diagnosis and helped the physicians to make clinical decisions. Ultrasound is more sensitive than MRI and shows equivalent specificity in evaluating nerve pathologies.\(^13\) A previous study indicated that the nerve conditions can be visualized and defined by ultrasound, which is a valuable modality for aiding decision-making by clinicians before intervention.\(^14\)

The ultrasound-guided injection approach allows visualization of the surrounding structures and helps locate the tibial nerve, enabling the physician to perform perineural injection precisely without irritating the nerve. A previous study demonstrated that median nerve irritation was more likely to be observed in patients who received landmark-guided perineural injection than in those who received ultrasound-guided injection.\(^15\)

Although the true mechanism of how D5W affects peripheral neuropathy is still unclear, it is thought that D5W may exert anti-inflammatory effects by inhibiting the transient receptor potential vanilloid receptor-1, which is found in peripheral nerves.\(^16\) A previous study showed significant reduction in the cross-sectional area of the median nerve compared with the control group (perineural injection with normal saline).\(^17\) In addition, nerve hydrodissection may contribute to the improvement of neuropathy by detaching the soft tissue, thus allowing nerve impulses and vasculature to pass through and reversing ischemic damage.

The possible reason of fragment shifting may be due to the gravity effect. Since the patient lived a sedative lifestyle, she sat and lay (supine) in the most of her daily life. Gursoy et al. found loose bodies are commonly localized at the posterior compartment of the knee joint due to the gravity effect.\(^18\) Extra-articular loose body is extremely rare with few published reports in the literature. The reason why the fragment shifted may need further study. When we performed hydrodissection of the injured tibial nerve, the prosthesis fragment already shifted posteriorly to the tibial nerve.

In addition to clinical examination, we used NCS/EMG examination to follow up on the patient’s recovery and observe prosthetic fragment location through ultrasonography to ensure that the tibial nerve did not contact the prosthesis fragment. Repeated EMG
showed improved recruitment in the right flexor digitorum longus, tibialis posterior, soleus, and medial gastrocnemius muscles with a decrease in the amount of fibrillation potentials. Moreover, pain and paresthesia of the right lower leg and foot improved, and muscle power of the right toe flexors improved from 0 to 3 on postoperative day 258.

**CONCLUSION**

We present the first case of right tibial nerve palsy 20 days after TKA. Our patient received UKA previously. The prosthetic fragment dislodged and may have damaged her right tibial nerve after a TKA revision. Ultrasound examination found that the fragment had no direct contact with the tibial nerve. Therefore, the patient received conservative treatment including electrical stimulation, therapeutic exercise, and perineural injection with 5% glucose. EMG showed improvement in electrophysiological parameters, and the patient’s clinical symptoms had improved. Ultrasound played a valuable role in examining the location of the prosthesis fragment and helped physicians make clinical decisions.

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loose bodies determined on knee magnetic resonance imaging: joint compartments, recesses and bursae including arthroscopic blind spots. ActaRadiol. 2019;60:1286-93.
膝關節再置換後導致脛神經病變：個案報告

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本篇報告一位曾患右膝退化性關節炎之 74 歲女性，因膝關節再置換手術後造成右側脛神經病變之併發症。病人在術後被發現右腳趾屈肌無力及腳底感覺異常，安排神經傳導及肌電圖檢查後發現右側脛神經病變。X 光檢查發現在右側膕窩處的人工關節碎片位置與術前不同。安排超音波檢查後確認人工關節碎片移位，且旁邊的脛神經可能因碎片移位以及碎片附近組織纖維化而被夾擠。超音波檢查確定人工關節碎片並未直接接觸右側脛神經，因此我們選擇使用保守治療，包括運動治療、電刺激以及使用超音波導引下 5%葡萄糖水脛神經解套術，病患之症狀於 6 個月後大幅改善。本篇報告中造成脛神經病變的原因與過去文獻報導不同。超音波影像在受傷神經之評估檢查以及決定治療扮演了重要的關鍵角色。（台灣復健醫誌 2021；49(1)：105 - 111）

關鍵詞：脛神經病變(tibial neuropathy)，膝關節全人工置換(total knee arthroplasty)，神經傳導檢查(nerve conduction study)，超音波(ultrasonography)，肌電圖(electromyography)