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Ultrasound-Guided Injection of the Gluteobicipital Posterolateral Femoral Myofascial-Entheseal Complex: A Technical Report With Cadaveric Dye Assessment and Illustrative Dynamic Sonography

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Abstract

Pain in the posterior buttock and posterolateral thigh has many possible sources, including the spine, the sciatic nerve, the hip, and local muscles, tendons, and fascia. On the posterolateral femur, the distal insertion of the gluteus maximus and the origin of the short head of the biceps femoris converge with the iliotibial band and the lateral intermuscular septum. We refer to this region as the gluteobicipital posterolateral femoral myofascial-entheseal complex, an operational descriptive term. This technical report describes its sonographic anatomy and adjacent arteries, an illustrative dynamic examination using sonopalpation and sonographically guided digital palpation, and an ultrasound-guided in-plane injection technique. After the sciatic nerve is located, the needle is advanced from posteromedial to anterolateral into the lateral intermuscular septum, and the injectate is used to open the plane toward the gluteus maximus attachment on the posterolateral femoral cortex. To assess feasibility, a single experienced operator injected 10 mL of 1% methylene blue under ultrasound guidance into both lower limbs of three fresh-frozen cadavers (two male, one female; aged 70-78 years), followed by layer-by-layer dissection. In all six limbs, dye stained the lateral intermuscular septum, the distal gluteus maximus insertion, the origin of the short head of the biceps femoris, the vastus lateralis, and the long head of the biceps femoris. The sciatic nerve showed no visible staining from the subgluteal region to the popliteal fossa. In this single-operator cadaveric assessment, the injection spread regionally rather than to a single structure. These findings support cadaveric feasibility only. Clinical safety, the value of the dynamic examination, the optimal injectate, and clinical efficacy remain to be established.

Categories: Pain Management, Physical Medicine & Rehabilitation, Orthopedics
Keywords: cadaveric study, gluteus maximus, hydrodissection, iliotibial band, musculoskeletal ultrasound, sciatic nerve, short head of biceps femoris, sonographically guided digital palpation, sonopalpation, ultrasound-guided injection

Introduction

Pain in the posterior buttock and posterolateral thigh has a broad differential diagnosis. Spinal causes include lumbar disc herniation, which occasionally produces radicular symptoms at a level that does not match the herniation [1], lumbar spinal stenosis, and less common spinal cord or sacral lesions [2-4]. Neurological deficits, hyperreflexia, gait disturbance, constant or night pain, systemic symptoms, or failure of presumed musculoskeletal treatment should prompt spinal evaluation before pain is attributed to a peripheral source [2-4]. Extraspinal causes include sciatic nerve entrapment in the deep gluteal space [5-7], hip disorders, and disorders of local ligaments, muscles, tendons, and fascia [8].

On the posterolateral femur, the distal gluteus maximus inserts partly onto the gluteal tuberosity (a roughened ridge on the upper femoral shaft) and partly into the iliotibial band (the thickened lateral part of

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the deep fascia of the thigh) [9]. Slightly more distally, the short head of the biceps femoris arises from the lateral lip of the linea aspera (the longitudinal ridge along the back of the femur), the lateral supracondylar line, and the lateral intermuscular septum (the fascial partition between the anterior and posterior thigh compartments) [10,11]. In this report, we refer to this meeting point as the gluteobicipital posterolateral femoral myofascial-entheseal complex (GPFMEC), hereafter "the complex." This is an operational descriptor, not established anatomical nomenclature. The sciatic nerve lies medial to this region, deep to the long head of the biceps femoris, and is the main structure at risk during injection.

Muscle and tendon disorders, including enthesopathy, can generate pain independently of nerve entrapment [12-14]. Calcific tendinitis at the gluteus maximus femoral insertion, for example, has caused severe buttock and lateral upper-thigh pain with marked focal tenderness and was treated by ultrasound-guided injection of corticosteroid and local anesthetic around the tendon insertion [15]. In the authors' clinical experience, patients considered for evaluation of the complex typically report posterolateral thigh pain with focal tenderness over the posterolateral femur, sometimes with pain referred toward the lateral knee or mid-lateral calf. This description is based on clinical observation and has not been formally studied. The prevalence of pain arising from this region is unknown. A search of PubMed from inception to 20 October 2026 used a Boolean strategy combining terms for the gluteus maximus insertion, gluteal tuberosity, linea aspera, short head of the biceps femoris, lateral intermuscular septum, and iliotibial tract with terms for injection, ultrasound guidance, hydrodissection, and cadaveric dye studies, supplemented by phrase searches of Google Scholar (first 100 results each). It identified no technique specifically targeting the junction between the gluteus maximus insertion and the origin of the short head of the biceps femoris. The most closely related report described injection around the gluteus maximus insertion for calcific tendinitis [15]. Ultrasound-guided injection techniques in the deep gluteal region have mainly targeted the piriformis muscle and the sciatic nerve, including perineural hydrodissection [16-21]. The technique described here differs from injection around the gluteus maximus insertion in three ways. It targets the junction of both attachments rather than a single tendon insertion. It uses an in-plane, posteromedial-to-anterolateral path, after the sciatic nerve has been located, to open the plane along the lateral intermuscular septum. Its injectate is expected to spread regionally rather than reach one structure selectively. During ultrasound-guided injection in living patients, it is not possible to confirm which tissues the injectate ultimately reaches or whether it reaches the sciatic nerve. Cadaveric dye injection followed by dissection allows both to be assessed directly.

Aims and objectives

This technical report describes an ultrasound-guided injection technique for the complex and assesses its feasibility in cadavers. The primary objective was to describe the gross distribution of methylene blue after a 10 mL ultrasound-guided injection in six limbs from three fresh-frozen cadavers. Specifically, we recorded whether dye reached six predefined structures: the lateral intermuscular septum, the distal gluteus maximus insertion, the origin of the short head of the biceps femoris, the vastus lateralis, the long head of the biceps femoris, and the sciatic nerve. Secondary objectives were to describe the sonographic anatomy of the complex and its adjacent arteries, provide a step-by-step injection technique, and illustrate the dynamic examination maneuvers used clinically. In PICO terms, the population was three fresh-frozen cadavers (six lower limbs), the intervention was a single-operator ultrasound-guided injection of 10 mL of methylene blue, there was no comparator, and the outcomes were gross staining of the six predefined structures, including the sciatic nerve. The clinical ultrasound recordings illustrate the examination maneuvers only. Clinical outcomes, diagnostic accuracy, and comparisons of injectates or volumes were not assessed.

Technical Report

Cadaveric specimens and ethics

Three fresh-frozen cadavers (two male, one female; aged 70, 75, and 78 years; mean 74.3 years) were obtained from the Thammasat Medical Skill and Education Center, Thailand. Their use was authorized through the Innovation Academic Center (specimen identification no. 79-68). This was a convenience sample based on specimen availability for an exploratory anatomical feasibility study. Each cadaver was injected bilaterally, giving six injected limbs. The cadavers were the biological units. The six limbs are reported individually for description only and were not treated as independent samples for inference.

Cadavers were included if the gluteal and posterior thigh regions, including the posterolateral femur, were intact and suitable for ultrasound-guided injection and dissection. Cadavers were excluded for prior gluteal, hip, or femoral surgery, major regional deformity, extensive soft-tissue disruption, or gross pathology that would interfere with interpreting the injection pathway. Cause of death and comorbidities were not available from the donation program records. The interval from death to freezing was within 24 hours. Specimens were stored frozen at −20°C and had undergone one freeze-thaw cycle. According to institutional protocol, they were transferred to 2-4°C the day before the procedure and kept at 13-18°C for three hours before injection and dissection. No dissection of the target region had been performed before injection. The same three cadavers were also used, during the same session, in a separate ultrasound-guided injection study of the distal thoracolumbar fascia at the gluteal junction, which also used 10 mL of 1% methylene blue [22]. Because the same dye was used, staining was attributed to each injection by anatomical location. At dissection, the two stained fields were separated by unstained tissue in every cadaver, with no continuity

between the thoracolumbar-gluteal region and the posterolateral femoral region. No donor-identifiable information is disclosed.

Operator and assessor

All injections were performed under real-time ultrasound guidance by a single operator with 20 years of experience in musculoskeletal ultrasound-guided interventions. Before this study, the operator had performed more than 10,000 fascial or interfascial hydrodissection procedures and had also performed the procedure in routine clinical practice. The same operator performed all cadaveric injections. Dissections were performed by a separate anatomist with a PhD in anatomy. The anatomist knew that both sides of each cadaver had been injected and was therefore not blinded to the possibility of dye on either side or to the injection sequence. However, at the time of interpretation, the anatomist was blinded to the authors' expected spread pattern, the expected fascial and muscle involvement, and the expected absence of gross neural staining.

Equipment

The transducer is chosen according to target depth: a high-frequency linear transducer for slimmer patients and a curvilinear transducer for deeper targets or larger body habitus. In clinical practice, needle options are 25-gauge 2-inch, 22-gauge 2.75-inch, or 22-gauge 4-inch, depending on body habitus. All cadaveric injections were performed with a GE Venue Fit system and an L4-20t linear transducer (General Electric, Boston, MA, USA) operating at 3-20 MHz, using a 22-gauge 3.5-inch spinal needle. Imaging depth was approximately 3-4 cm so that the posterolateral femoral cortex and the sciatic nerve were in the same field of view. The focal zone was set at the level of the lateral intermuscular septum (approximately 3 cm). Depth, focus, and gain were adjusted in real time to tissue depth and body habitus, and no body mass index analysis was performed. Because cadavers have no blood flow, Doppler screening was not part of the cadaveric procedure. Vascular screening as used in clinical practice is described in the sonographic survey below. In clinical practice, 10-20 mL of 15% glucose containing 0.05% lidocaine (lignocaine) is used. This range reflects the authors' clinical experience of the volume needed to visibly open the plane along the lateral intermuscular septum across the length of the complex under real-time ultrasound, adjusted to body habitus and the observed spread, consistent with the general principle of hydrodissection [21]. It has not been formally optimized and was not evaluated in this study.

Sonographic survey

With the patient prone, the transducer is placed in the transverse plane over the posterolateral thigh. The region is scanned from just proximal to the gluteus maximus insertion, through the insertion, to just distal to the origin of the short head of the biceps femoris (Figure *1*, Video *1*). The sciatic nerve is identified first, deep to the long head of the biceps femoris and medial to the target. The adductor magnus lies deep (anterior) to the nerve. The posterolateral femoral cortex is then centered on the image. The distal gluteus maximus fibers, iliotibial band, lateral intermuscular septum, short head of the biceps femoris, and vastus lateralis are identified around it.

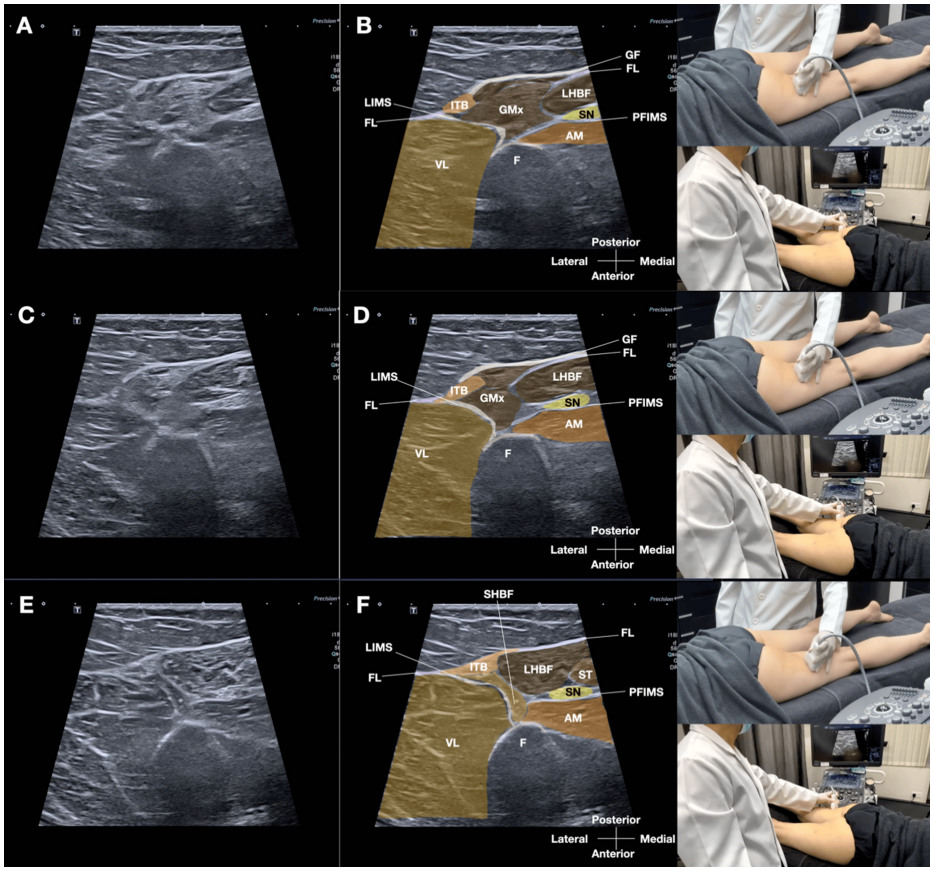
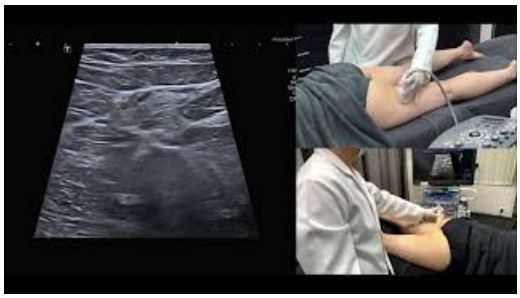


FIGURE 1: Sequential sonographic evaluation of the GPFMEC

(A, B) Proximal to the gluteus maximus insertion; (C, D) at the gluteus maximus insertion; (E, F) distal to the origin of the short head of the biceps femoris. A, C, and E are unannotated images. B, D, and F are the corresponding annotated images, with insets showing patient position and transducer placement. Living subject. Depth: 6 cm.

F: femur, FL: fascia lata, GF: gluteal fascia, GMx: gluteus maximus, GPFMEC: gluteobicipital posterolateral femoral myofascial-entheseal complex, ITB: iliotibial band, LHBF: long head of biceps femoris, LIMS: lateral intermuscular septum, PFIMS: posterior femoral intermuscular septum, SHBF: short head of biceps femoris, SN: sciatic nerve, ST: semitendinosus, VL: vastus lateralis

Credit: Annotations created in Keynote (Apple Inc., Cupertino, CA, USA) by Prof. King Hei Stanley Lam. Image courtesy of Prof. King Hei Stanley Lam.



VIDEO 1: Sequential ultrasound scanning technique for identification of the GPFMEC

Transverse scanning from proximal to the gluteus maximus insertion to distal to the origin of the short head of the biceps femoris, with the still images of Figure 1 inserted.

F: femur, FL: fascia lata, GF: gluteal fascia, GMx: gluteus maximus, GPFMEC: gluteobicipital posterolateral femoral myofascial-entheseal complex, ITB: iliotibial band, LHBF: long head of biceps femoris, LIMS: lateral intermuscular septum, PFIMS: posterior femoral intermuscular septum, SHBF: short head of biceps femoris, SN: sciatic nerve, ST: semitendinosus, VL: vastus lateralis

Credit: Video courtesy of Prof. King Hei Stanley Lam.

View video here: https://youtu.be/1TtroOQtHS4

Color or power Doppler is used before puncture to screen for adjacent vessels, particularly when the examination extends more proximally toward the deep gluteal region (Figure 2, Video 2). The medial circumflex femoral artery may be seen proximal to the gluteus maximus insertion. At the level of the insertion, the transverse branch of the lateral circumflex femoral artery and the descending branch of the medial circumflex femoral artery may be seen. At the origin of the short head of the biceps femoris, a perforating branch of the profunda femoris artery passes through the adductor magnus near the linea aspera before reaching the posterior compartment.

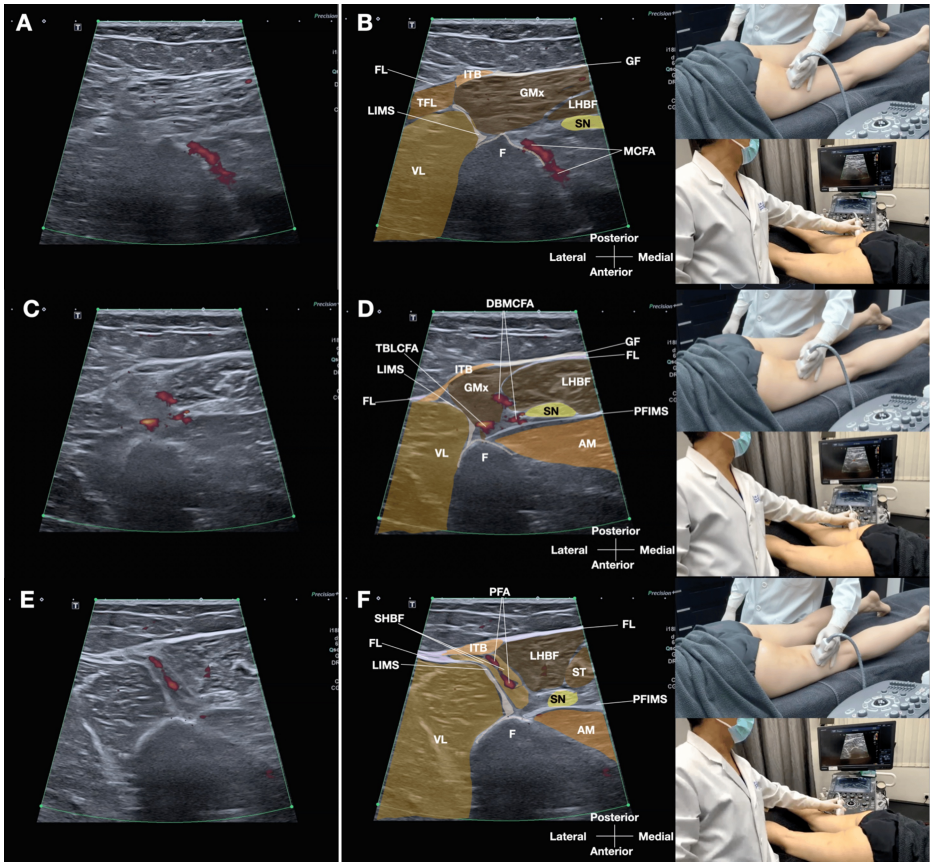


FIGURE 2: Sequential power Doppler sonographic assessment of the arterial structures related to the GPFMEC

(A, B) Medial circumflex femoral artery proximal to the gluteus maximus insertion; (C, D) transverse branch of the lateral circumflex femoral artery and descending branch of the medial circumflex femoral artery at the gluteus maximus insertion; (E, F) perforating branch of the profunda femoris artery passing through the adductor magnus at the origin of the short head of the biceps femoris. A, C, and E are unannotated images, and B, D, and F are annotated. Living subject. Depth: 6 cm.

AM: adductor magnus, DBMCFA: descending branch of medial circumflex femoral artery, F: femur, FL: fascia lata, GF: gluteal fascia, GMx: gluteus maximus, GPFMEC: gluteobicipital posterolateral femoral myofascial-entheseal complex, ITB: iliotibial band, LHBF: long head of biceps femoris, LIMS: lateral intermuscular septum, MCFA: medial circumflex femoral artery, PFA: perforating branch of the profunda femoris artery, PFIMS: posterior femoral intermuscular septum, SHBF: short head of biceps femoris, SN: sciatic nerve, ST: semitendinosus, TBLCFA: transverse branch of lateral circumflex femoral artery, VL: vastus lateralis

Credit: Annotations created in Keynote (Apple Inc., Cupertino, CA, USA) by Prof. King Hei Stanley Lam. Image courtesy of Prof. King Hei Stanley Lam.



VIDEO 2: Sequential power Doppler ultrasound scanning of the arterial structures related to the GPFMEC

Stepwise power Doppler identification of the medial circumflex femoral artery, the transverse branch of the lateral circumflex femoral artery, the descending branch of the medial circumflex femoral artery, and a perforating branch of the profunda femoris artery. The still images of Figure 2 are inserted.

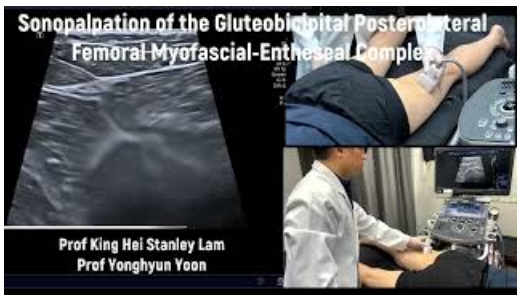
AM: adductor magnus, DBMCFA: descending branch of medial circumflex femoral artery, F: femur, FL: fascia lata, GF: gluteal fascia, GMx: gluteus maximus, GPFMEC: gluteobicipital posterolateral femoral myofascial-entheseal complex, ITB: iliotibial band, LHBF: long head of biceps femoris, LIMS: lateral intermuscular septum, MCFA: medial circumflex femoral artery, PFA: perforating branch of the profunda femoris artery, PFIMS: posterior femoral intermuscular septum, SHBF: short head of biceps femoris, SN: sciatic nerve, ST: semitendinosus, TBLCFA: transverse branch of lateral circumflex femoral artery, VL: vastus lateralis

Credit: Video courtesy of Prof. King Hei Stanley Lam.

View video here: https://youtu.be/-HsrroqCd64

Dynamic examination

Sonopalpation is performed with graded manual compression of the complex using the transducer. Sonographically guided digital palpation is performed by fingertip pressure next to the transducer under real-time imaging (Videos *3*-*6*). The soft-tissue thickness between the transducer and the posterolateral femoral cortex under compression is compared with the contralateral side, together with tenderness, reproduction of familiar pain, and any distal referral. Compression was performed manually, and the compression force, frequency, and transducer angle were not controlled or measured. Findings were assessed qualitatively through side-to-side comparison by a single unblinded examiner and were recorded descriptively in the clinical notes. No grading scale was used, and no second-assessor review was performed. A greater reduction in thickness on the symptomatic side is reported as an observation only. It may reflect differences in applied force, transducer angle, subcutaneous thickness, or guarding, and it does not establish altered tissue stiffness.



VIDEO 3: Dynamic sonopalpation of the GPFMEC on the symptomatic side

Rhythmic vertical compression with the transducer toward the posterolateral femoral cortex. The soft tissue between the subcutaneous layer and the cortex shows a greater reduction in thickness under compression than on the contralateral side (Video 4) (pink arrow). This is an illustrative observation, not a diagnostic criterion, and does not establish altered tissue stiffness. Compression force was not standardized.

GPFMEC: gluteobicipital posterolateral femoral myofascial-entheseal complex

Credit: Video courtesy of Prof. King Hei Stanley Lam.

View video here: https://youtu.be/M0mTDgQnCSo



VIDEO 4: Dynamic sonopalpation of the GPFMEC on the asymptomatic contralateral side

The same compression maneuver shows less reduction in the layered soft-tissue thickness above the femoral cortex (white arrow). Compression force was not standardized.

GPFMEC: gluteobicipital posterolateral femoral myofascial-entheseal complex

Credit: Video courtesy of Prof. King Hei Stanley Lam.

View video here: https://youtu.be/2OMWHdCMMCc



VIDEO 5: Sonographically guided digital palpation of the GPFMEC on the symptomatic side

Layered fingertip palpation under real-time ultrasound, from the skin and subcutaneous tissue through the complex toward the femoral cortex. In this patient, palpation over the gluteus maximus insertion reproduced the familiar pain (pink arrow), and the fascial plane glided sideways less than on the contralateral side. These are illustrative observations, not diagnostic criteria. Compression force was not standardized.

GPFMEC: gluteobicipital posterolateral femoral myofascial-entheseal complex

Credit: Video courtesy of Prof. King Hei Stanley Lam.

View video here: https://youtu.be/BDDc5AbqNPs



VIDEO 6: Sonographically guided digital palpation of the GPFMEC on the asymptomatic contralateral side

The same layered palpation shows sideways gliding of the fascial plane without tenderness over the complex (white arrow). Compression force was not standardized.

GPFMEC: gluteobicipital posterolateral femoral myofascial-entheseal complex

Credit: Video courtesy of Prof. King Hei Stanley Lam.

View video here: https://youtu.be/j6eeYVYXJj4

Illustrative observations are summarized in Table 1. These maneuvers are exploratory and have not been validated.

Maneuver	Illustrative observation, symptomatic side	Illustrative observation, contralateral side	Proposed use (exploratory)
Sonopalpation	Greater reduction in soft-tissue thickness between transducer and posterolateral femoral cortex under manual compression	Less reduction in thickness under similar compression	May indicate a segment to examine in more detail
Sonographically guided digital palpation	Tenderness at the complex	No or less tenderness	May help localize the region of maximal tenderness
Sonographically guided digital palpation	Reproduction of familiar pain	Not reproduced	May suggest local involvement; does not exclude a spinal or neural source
Sonographically guided digital palpation	Pain referred toward the lateral knee or mid-lateral calf in some patients	Not observed	Descriptive observation; significance unknown

TABLE 1: Illustrative dynamic sonographic observations at the GPFMEC (descriptive, not validated)

Observations from sonopalpation and sonographically guided digital palpation of the symptomatic and contralateral sides, given to illustrate the examination. Compression force was not standardized, and findings were judged qualitatively by a single unblinded examiner. These observations are not diagnostic criteria, and their reliability and diagnostic accuracy have not been evaluated.

GPFMEC: gluteobicipital posterolateral femoral myofascial-entheseal complex

Credit: Table courtesy of Prof. King Hei Stanley Lam.

The clinical ultrasound recordings in Videos 3-6 were obtained during routine practice and are shown only to illustrate the examination maneuvers. The Chi Mei Medical Center Institutional Review Board approved their use (serial no. 11411-003, approved 26 November 2025) with a waiver of informed consent for research use, and all recordings were de-identified. Written informed consent for publication was obtained from the patient shown in Videos 3-6.

Step-by-step injection technique

Step 1: Positioning. Place the patient prone, with full access to the buttock and posterolateral thigh.

Step 2: Equipment selection. Choose a linear or curvilinear transducer and a needle length according to target depth and body habitus.

Step 3: Sciatic nerve mapping. Locate the sciatic nerve along the scanned segment before choosing the skin entry point or needle path.

Step 4: Target identification. Center the posterolateral femoral cortex and identify the overlying distal gluteus maximus insertional tissues, the lateral intermuscular septum, and the adjacent short head of the biceps femoris.

Step 5: Vascular screening and dynamic confirmation. Screen for vessels along the intended path with power Doppler. In clinical practice, use sonopalpation and sonographically guided digital palpation to localize the segment of interest.

Step 6: Needle entry and trajectory. After skin preparation, insert the needle in-plane from posteromedial to anterolateral toward the posterolateral femoral cortex, which serves as the depth endpoint. Keep the needle

shaft and tip visible throughout, and keep the path lateral to the mapped sciatic nerve.

Step 7: Hydrodissection with tip confirmation. Inject small aliquots to open the fascial plane ahead of the tip. Confirm tip position by continuous visualization of anechoic fluid separating the fascial layers ahead of the tip, together with low resistance to injection. Advance the needle only within the anechoic space created. If fluid spreads into muscle tissue, no fluid is visualized, or resistance increases, pause the injection and reposition the needle.

Step 8: Incremental injection. Continue injection incrementally along the lateral intermuscular septum toward the gluteus maximus attachment on the femoral cortex (Figure *3*, Video *7*).

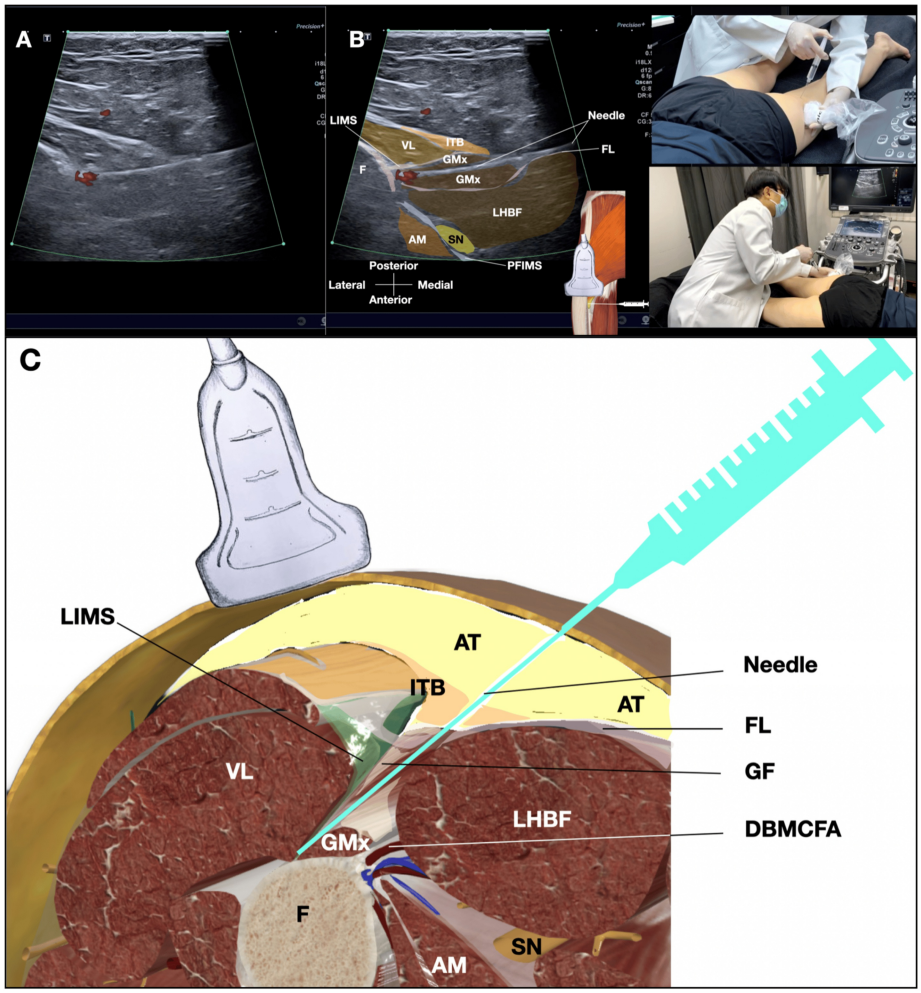


FIGURE 3: Ultrasound-guided hydrodissection-assisted injection of the GPFMEC at the level of the gluteus maximus insertion

(A) Unannotated image. (B) Annotated image showing the needle advancing from posteromedial to anterolateral, into the lateral intermuscular septum, toward the posterolateral femoral cortex. The sciatic nerve lies deep to the needle path, separated from it by the main bulk of the long head of the biceps femoris. (C) Schematic illustration showing the sciatic nerve relative to the needle path. The image shows the relationship in this example only and does not define a universal safe corridor. Living subject. Depth: 6 cm.

AM: adductor magnus, AT: adipose tissue, DBMCFA: descending branch of medial circumflex femoral artery, F: femur, FL: fascia lata, GF: gluteal fascia, GPFMEC: gluteobicipital posterolateral femoral myofascial-entheseal complex, ITB: iliotibial band, LHBF: long head of biceps femoris, LIMS: lateral intermuscular septum, PFIMS: posterior femoral intermuscular septum, SN: sciatic nerve, VL: vastus lateralis

Credit: Annotations created in Keynote (Apple Inc., Cupertino, CA, USA) by Prof. King Hei Stanley Lam. Image courtesy of Prof. King Hei Stanley Lam.



VIDEO 7: Ultrasound-guided hydrodissection-assisted injection of the GPFMEC

Posteromedial-to-anterolateral in-plane needle advancement at the gluteus maximus insertion level. The injectate progressively opens the lateral intermuscular septum and the plane along the posterolateral femoral cortex ahead of the needle tip, and the tip is advanced only within the fluid-opened space.

GPFMEC: gluteobicipital posterolateral femoral myofascial-entheseal complex

Credit: Video courtesy of Prof. King Hei Stanley Lam.

View video here: https://youtu.be/1NrpO7N0pRw

Step 9: Endpoint. The endpoint is visible spread of the injectate along the plane of the complex at the intended levels.

Step 10: Stopping criteria. Stop immediately if the patient reports paresthesia or radiating pain, if the needle tip is not visible, if injectate approaches the sciatic nerve, or if resistance is high.

Cadaveric dye assessment

Using the technique above, each limb received 10 mL of undiluted 1% methylene blue solution at a single site at the level of the gluteus maximus insertion, injected over 3-5 minutes. Before injecting, the operator confirmed on ultrasound that the needle tip was within the lateral intermuscular septum. The dye was then used to hydrodissect toward the gluteus maximus attachment on the femoral cortex. Dissection began 15-45 minutes after injection, on the same day, and proceeded layer by layer. Before dissection, six structures were specified for assessment: the lateral intermuscular septum, the distal gluteus maximus insertion, the origin of the short head of the biceps femoris, the vastus lateralis, the long head of the biceps femoris, and the sciatic nerve. The anatomist recorded staining of each as present or absent by gross visual inspection. The sciatic nerve was exposed from its exit beneath the inferior border of the piriformis to the popliteal fossa, covering its full course in the thigh and the entire injection region. Its epineurial surface and the surrounding perineural fat were inspected, including the tibial and common fibular nerves at the popliteal fossa. The craniocaudal extent of staining was not measured. No quantitative grading or histological examination was performed.

Results

Three cadavers (two male, one female; aged 70-78 years) were injected bilaterally, giving six limbs. All six limbs received 10 mL of undiluted 1% methylene blue over three to five minutes and were dissected 15-45 minutes after injection. No needle repositioning was required in any limb.

Gross dissection showed staining of the lateral intermuscular septum, the distal gluteus maximus insertion, and the origin of the short head of the biceps femoris in both limbs of all three cadavers (3/3 cadavers; 6/6 limbs). Staining also extended into the vastus lateralis and the long head of the biceps femoris in all six limbs (Figure *4*, Table *2*). The two limbs from each cadaver share specimen-level characteristics, so they are reported separately but are not independent observations.

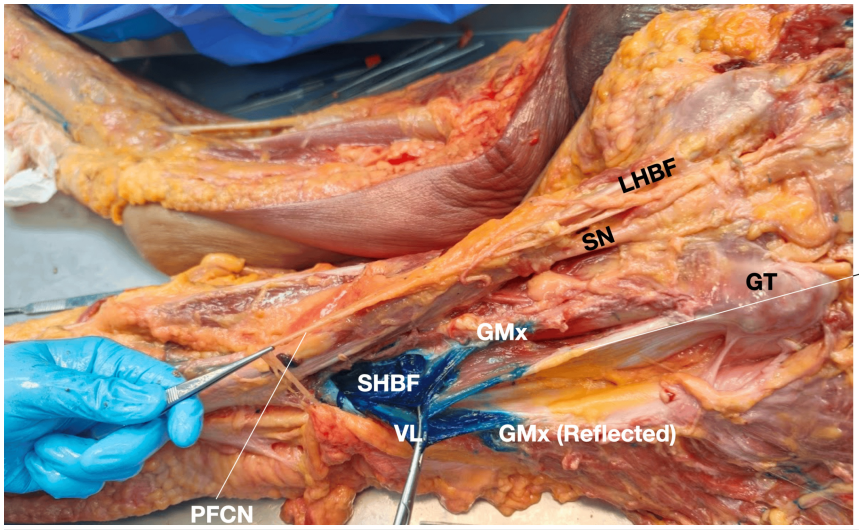


FIGURE 4: Gross dissection after a 10 mL ultrasound-guided methylene blue injection of the GPFMEC (representative cadaveric specimen)

Gross staining of the lateral intermuscular septum, the distal gluteus maximus insertion, the origin of the short head of the biceps femoris, the vastus lateralis, and the long head of the biceps femoris. The sciatic nerve is unstained. This pattern was seen in all six limbs.

GMx: gluteus maximus, GPFMEC: gluteobicipital posterolateral femoral myofascial-entheseal complex, GT: greater trochanter, LHBF: long head of biceps femoris, PFCN: posterior femoral cutaneous nerve, SHBF: short head of biceps femoris, SN: sciatic nerve, VL: vastus lateralis

Credit: Image courtesy of Prof. King Hei Stanley Lam

Cadaver	Sex	Age (years)	Side	LIMS	Distal GMx insertion	SHBF origin	VL	LHBF	Sciatic nerve*	Needle repositioning
1	M	70	Left	Yes	Yes	Yes	Yes	Yes	No	No
1	M	70	Right	Yes	Yes	Yes	Yes	Yes	No	No
2	F	75	Left	Yes	Yes	Yes	Yes	Yes	No	No
2	F	75	Right	Yes	Yes	Yes	Yes	Yes	No	No
3	M	78	Left	Yes	Yes	Yes	Yes	Yes	No	No
3	M	78	Right	Yes	Yes	Yes	Yes	Yes	No	No
Total				6/6	6/6	6/6	6/6	6/6	0/6	0/6

TABLE 2: Gross methylene blue distribution after a 10 mL ultrasound-guided injection of the GPFMEC by cadaver and limb

*Inspected from beneath the piriformis to the popliteal fossa, including the tibial and common fibular nerves.

Six limbs from three fresh-frozen cadavers, injected bilaterally with 10 mL of undiluted 1% methylene blue over 3-5 minutes. Injections used a GE Venue Fit system with an L4-20t linear transducer and a 22-gauge 3.5-inch spinal needle, and dissection began 15-45 minutes after injection. All six structures were specified before dissection. "Yes" indicates visible staining on gross inspection during layer-by-layer dissection, and "No" indicates no visible staining. Limbs from the same cadaver are not independent observations. Gross inspection does not exclude microscopic spread.

GPFMEC: gluteobicipital posterolateral femoral myofascial-entheseal complex, LIMS: lateral intermuscular septum, GMx: gluteus maximus, SHBF: short head of the biceps femoris, VL: vastus lateralis, LHBF: long head of the biceps femoris, M: male, F: female

Credit: Table courtesy of Prof. King Hei Stanley Lam.

Along its full exposed course, from beneath the piriformis to the popliteal fossa, the epineurial surface of the sciatic nerve and the surrounding perineural fat showed no visible staining in any limb (0/3 cadavers; 0/6

limbs). The tibial and common fibular nerves at the popliteal fossa were also unstained. The stained structure nearest to the nerve was the long head of the biceps femoris, which lies superficial to the nerve in the posterior thigh.

Spread to the vastus lateralis and the long head of the biceps femoris, beyond the intended junction, was the main deviation from the intended target and occurred in every limb. The staining pattern was the same in the male and female cadavers, although three cadavers are too few to assess differences between the sexes. In every cadaver, the stained field of this study was separated from that of the separate thoracolumbar fascia study by unstained tissue.

Discussion

This report describes the sonographic anatomy of the posterolateral femoral convergence zone between the gluteus maximus insertion and the origin of the short head of the biceps femoris, as well as an ultrasound-guided injection technique. In six cadaveric limbs from three cadavers, a 10 mL injection stained the lateral intermuscular septum, both target attachments, the vastus lateralis, and the long head of the biceps femoris, without visible sciatic nerve staining. The schematic in Figure *3C* summarizes the relationship between the needle path, the target plane, and the sciatic nerve.

The staining pattern shows that the injection is regional rather than structure-selective. Figure *5* summarizes the anatomy of the complex in cross-section and long axis. The lateral intermuscular septum runs from the region of the distal gluteus maximus insertion along the lateral lip of the linea aspera to the origin of the short head of the biceps femoris, between the vastus lateralis anteriorly and the posterior compartment. Spread to the vastus lateralis was not intended but occurred in every limb, probably via the lateral intermuscular septum, which is anatomically associated with both the short head of the biceps femoris and the vastus lateralis [10]. Staining of the long head of the biceps femoris suggests that the injectate also spread into the posterior compartment. The exact routes were not determined, and the clinical significance of this spread is unknown. The technique should therefore be understood as a regional interfascial injection of the complex, not as a selective injection of one enthesis.

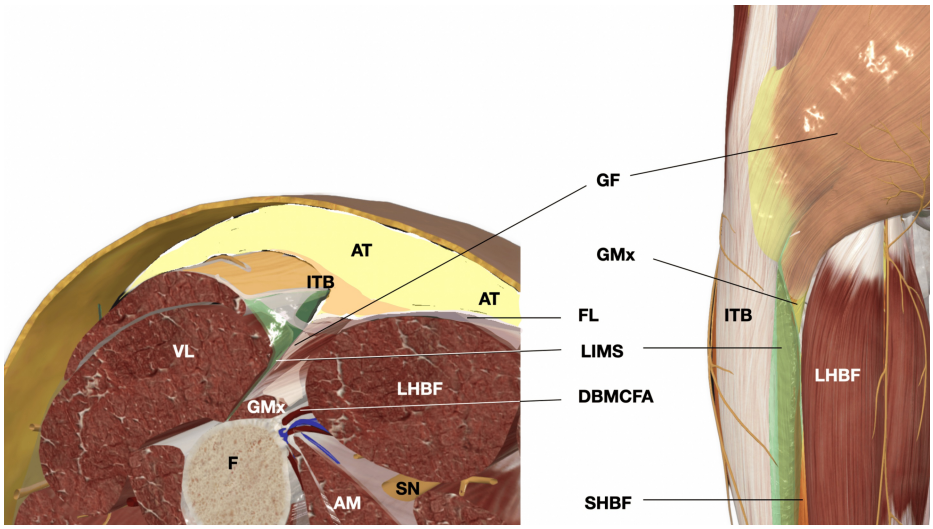


FIGURE 5: Schematic illustration of the GPFMEC

Left: cross-sectional (transverse) view at the level of the gluteus maximus insertion and the origin of the short head of the biceps femoris. Right: long-axis view of the posterolateral femur from proximal (top) to distal (bottom). The distal gluteus maximus inserts on the gluteal tuberosity and into the iliotibial band. Its attachment continues distally into the origin of the short head of the biceps femoris along the lateral lip of the linea aspera and the lateral intermuscular septum. The lateral intermuscular septum (shaded green) separates the vastus lateralis anteriorly from the posterior compartment. The sciatic nerve lies medial to the complex, deep to the long head of the biceps femoris. Not to scale.

AM: adductor magnus, AT: adipose tissue, DBMCFA: descending branch of medial circumflex femoral artery, F: femur, FL: fascia lata, GF: gluteal fascia, GMx: gluteus maximus, GPFMEC: gluteobicipital posterolateral femoral myofascial-entheseal complex, ITB: iliotibial band, LHBF: long head of the biceps femoris, LIMS: lateral intermuscular septum, SHBF: short head of the biceps femoris, SN: sciatic nerve, VL: vastus lateralis

Credit: Schematic drawing created in Keynote (Apple Inc., Cupertino, CA, USA) by Prof. King Hei Stanley Lam.

The technique combines bony-landmark guidance with hydrodissection. The posterolateral femoral cortex gives a clear depth endpoint. Advancing the needle only within the fluid space it creates follows the

hydrodissection principle described for perineural injection [21], in which fluid, rather than the needle tip, separates the tissue planes. Lam et al. mainly discussed dextrose solutions, saline, and local anesthetic for nerve hydrodissection [21]. The 15% glucose solution used in our clinical practice has not been compared with other injectates for this target.

Safety depends mainly on protecting the sciatic nerve. Unlike ultrasound-guided piriformis and perisciatic injections, which are directed toward or around the nerve [16-20], this technique is directed away from it. The nerve is mapped first, the needle path stays lateral to it, and the femoral cortex limits needle depth. Doppler screening is advised because circumflex and perforating arteries lie close to the complex (Figure *2*). However, the long head of the biceps femoris, which lies directly superficial to the sciatic nerve in the posterior thigh, was stained in every limb. Injectate can therefore reach adjacent muscle even when the nerve itself remains unstained, and this proximity is another reason for careful nerve mapping and real-time monitoring of spread. The absence of visible nerve staining in six limbs is reassuring but limited. It reflects gross inspection of a 10 mL volume in cadaveric tissue and does not exclude microscopic spread, needle injury, or complications in living patients or at larger volumes.

Dynamic sonopalpation and sonographically guided digital palpation are described because they form part of the authors' clinical examination of this region. Enthesopathy and muscle and tendon disorders may generate pain independently of nerve entrapment [12-14], and dynamic ultrasound may add information that static imaging does not [14]. However, reproduction of familiar pain during these maneuvers does not exclude a spinal source, and spinal evaluation remains necessary when clinical features suggest it [1-4]. Dynamic sonopalpation and sonographically guided digital palpation are proposed as exploratory aids to target selection. Their reliability and diagnostic accuracy have not been established and should be evaluated in prospective studies against a suitable reference standard.

Limitations

The study has several limitations. It included a convenience sample of three cadavers (two male, one female; aged 70-78 years), and the six injected limbs are descriptive units, not independent observations. Assessment was gross rather than histological. Sciatic nerve staining was assessed by inspection of the epineurial surface and perineural fat only, and intraneural dye cannot be excluded. Three cadavers are too few to assess differences by sex, age, or body habitus. Differences in subcutaneous fat thickness, muscle bulk, and femoral dimensions may affect target depth, equipment choice, and injectate spread. Cause of death and comorbidities were unavailable, body mass index was not recorded, and all three cadavers were aged 70-78 years and may not represent the tissue properties of younger patients. Cadaveric tissue differs from living tissue in compliance and perfusion, and the single freeze-thaw cycle, the thawing protocol, and the variable interval between injection and dissection (15-45 minutes) may have influenced dye distribution. Spread over longer periods, or with tissue movement in living patients, was not assessed. The same cadavers received a separate 10 mL methylene blue injection at the thoracolumbar-gluteal junction during the same session. Although the two stained fields were separated by unstained tissue, use of the same dye means that a contribution from the other injection cannot be completely excluded. All injections were performed by a single highly experienced operator, which may limit the applicability of the findings to less experienced clinicians, and reproducibility between operators was not evaluated. The anatomist was not blinded to the side or injection sequence, although the anatomist was blinded to the expected spread pattern, fascial and muscle involvement, and neural findings. Several variables were not measured: compression force and transducer angle during sonopalpation, reliability of the dynamic findings, injection pressure, craniocaudal extent of dye spread, distances between the target, the needle path, and the sciatic nerve, and microscopic dye presence. The reduction in tissue thickness under uncontrolled compression does not establish reduced compliance or increased stiffness, and force-controlled or elastographic methods would be needed to assess this. Doppler vessel screening could not be assessed in cadavers because there is no blood flow. Only 10 mL of methylene blue was tested, so the findings cannot be extrapolated to 20 mL clinical injections, to the clinical injectate, or to living patients. The viscosity and diffusion of undiluted 1% methylene blue may differ from those of 15% glucose with lidocaine, and the dye may stain beyond the area the fluid itself reached. Injectates and volumes were not compared, and no conclusions about clinical efficacy can be drawn.

Conclusions

In six fresh-frozen cadaveric limbs from three cadavers, a single experienced operator performed an ultrasound-guided, in-plane injection of the junction between the distal gluteus maximus insertion and the origin of the short head of the biceps femoris. The needle was advanced along a posteromedial-to-anterolateral path into the lateral intermuscular septum toward the posterolateral femoral cortex. After a 10 mL methylene blue injection, the lateral intermuscular septum, the gluteus maximus insertion, the short head origin, the vastus lateralis, and the long head of the biceps femoris were stained in both limbs of all three cadavers, and the sciatic nerve showed no visible staining from the subgluteal region to the popliteal fossa. This shows regional rather than structure-selective spread under the tested conditions.

These findings describe cadaveric feasibility only. Reproducibility between operators, the dynamic examination maneuvers, the clinical injectate, and volumes above 10 mL were not evaluated. The absence of

visible nerve staining does not exclude microscopic spread or establish safety in living patients. No conclusions about clinical safety, diagnostic validity, the optimal injectate, or clinical efficacy can be drawn, and prospective studies are needed.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

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Acquisition, analysis, or interpretation of data: King Hei Stanley Lam, Yonghyun Yoon, Daniel Chiung-Jui Su, Wai Wah Mark Lai, Teinny Suryadi, Anwar Suhaimi

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Supervision: King Hei Stanley Lam

Disclosures

Human subjects: Informed consent for treatment and open access publication was obtained or waived by all participants in this study. Institutional Review Board of Chi Mei Medical Center issued approval 11411-003. The Institutional Review Board approved the use of de-identified clinical ultrasound recordings on November 26, 2025, with a waiver of informed consent for research use. Written informed consent for publication was obtained from the patient shown in Videos 3-6. The images in Figures 1-3 and Videos 1, 2, and 7 were obtained from a patient covered by the same approval who gave written informed consent for publication. Three fresh-frozen donated cadavers were provided by the Thammasat Medical Skill and Education Center, Thailand, with use authorized through the Innovation Academic Center (specimen identification no. 79-68). All procedures complied with institutional requirements for the use of donated human tissue, and no donor-identifiable information is disclosed. **Animal subjects:** All authors have confirmed that this study did not involve animal subjects or tissue. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

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