Introduction: Selection of the optimal anastomosis site is essential for obtaining good results from distal bypass. Herein, a unique, precise technique that uses pre-operative duplex scanning for selecting this site is presented.

Technical summary: Before distal bypass surgery, duplex scanning is performed to assess patency and flow. Use of the venous preset mode and controlling the slant function allows visualisation of colour Doppler flow inside the arteries, thus enabling selection of the best segment for anastomosis.

Conclusion: Use of duplex scanning in the appropriate mode consistently enables selection of the best anastomosis site for distal bypass, even when there is heavy calcification.

INTRODUCTION
Distal bypass is considered a very effective means of salvaging critically ischaemic legs in patients with peripheral arterial disease. An important factor affecting long-term patency is the quality of the distal anastomosis. In patients with critical limb ischaemia (CLI), especially those with end stage renal disease, calcium deposits may be so thick that vascular surgeons are forced to abandon attempts to create a distal bypass. The authors routinely perform pre-operative duplex ultrasound scanning (DUS) in such patients and have found it very effective for selecting the best anastomotic sites. The efficacy of DUS has previously been reported. However, the precise technical aspects of this detection and assessment methodology have not been described in published reports.

SURGICAL TECHNIQUE
The patient is placed in a prone position. Prior to performing DUS, angiography is performed to roughly identify the region of the optimal distal anastomosis site, that is, the best quality tibial portion of an artery with enough runoff vessels. A linear probe is then used to assess the vessel wall characteristics and the vessel’s diameter, thus enabling identification of a precise anastomotic site in the crural or para-malleolar portion of the target vessel. The extent of calcification is easily estimated by the thickness and intensity of echo density (Fig. 1). Regions with thick calcium deposits with strong acoustic shadows are unsuitable for anastomosis. However, close examination with colour Doppler scanning may reveal weak flow elsewhere in the same artery. In the authors’ experience, colour Doppler signals of a certain length (almost 5 mm) generally indicate that calcium deposits in the arterial wall are thin enough to cut and to allow placement of stitches in the arterial wall, and thus denote a feasible anastomosis site (Fig. 2). The important technical points vital to locating such sites are to use the venous, rather than arterial, preset mode and to...
adjust the slant function, which controls the Doppler insonation angle, to best visualise colour Doppler signals. An angle of 60° of Doppler insonation relative to the vessel axis provides the most accurate colour Doppler signal. Correct adjustment of this angle enables detection of very slow blood flow in the distal artery.

Between February 2013 and June 2016, 58 distal bypasses were performed, 28 (48%) of them in patients with end stage renal disease who were undergoing haemodialysis. Pre-operative DUS was performed and anastomosis to the portion selected by DUS completed in all patients. There were no operative deaths or bleeding complications. Early graft failure (within 1 month) occurred in one patient, who was later diagnosed as having antiphospholipid antibody syndrome. Two patients required secondary interventions to the distal anastomosis within 1 month. One of these patients developed a distal pseudoaneurysm that required surgical repair. The other had an arterial stenosis just distal to the anastomosis that was probably caused by clamping. This patient recovered after balloon angioplasty. Long-term results, which have previously been reported, support the efficacy of DUS. Mazzariol et al. reported 185 cases of pre-operative duplex scanning, including 58 having tibial bypasses, and concluded that duplex scanning was a safe alternative to angiography. A guideline developed in collaboration with the American College of Radiology and the Society of Radiologists in Ultrasound recommends peripheral arterial ultrasound examination for mapping of arteries before surgical interventions. The present unique technical methodology could help surgeons to create successful anastomoses consistently.

CONCLUSION
Pre-operative assessment with DUS and angiography is essential to achieving high quality anastomoses and optimising long-term results of distal bypasses.

CONFLICT OF INTEREST
None.

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