Torsion Does Not Affect Early Vein Graft Patency in the Rat Femoral Artery Model

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Abstract

Background
- Torsion of microvascular vein grafts (1 mm diameter) is a commonly cited reason for graft failure in the clinical setting.
- Interpersonal vein graft torsion is a common technical error made by the surgeons in microsurgery training courses.
- The objective of this study was to determine if torsion would lead to early vein graft failure in non-survival surgery rat models.

Methods
- 25 Sprague-Dawley rats were divided into 5 equal cohorts.
- Cohorts were labeled based on degree of vein graft torsion (0, 45, 90, 135, and 180 degrees) (Fig. 1).
- Torsion was created in the vein grafts at the distal arterial end by mismatching sutures placed between the proximal and distal end of the vein graft and the distal arterial end.
- Average vessel diameter was 1 mm.
- Vein graft patency was then verified via two methods, and 24 hours post-operation.

Results
- All vein grafts were patent 2 and 24 hours post-operation.
- Average blood flow rate measurements for 0, 45, 90, 135, and 180 degrees of torsion 2 hours post-operation: 0.37 ± 0.02, 0.38 ± 0.04, 0.34 ± 0.01, 0.33 ± 0.01, and 0.29 ± 0.02 (mL/min) respectively.
- Average blood flow rate measurements for 0, 45, 90, 135, and 180 degrees of torsion 24 hours post-operation: 0.94 ± 0.07, 1.03 ± 0.15, 1.26 ± 0.22, 1.45 ± 0.11, and 0.99 ± 0.15 (mL/min) respectively.

Conclusion
- Torsion of up to 180 degrees does not affect early vein graft patency in rat models.
- Suggestion to improve clinical reproducibility of practicing vein graft procedures in rat models.
- Microsurgery instructors should assess vein graft torsion prior to clamp release.

Introduction
- Vein grafts are used to bridge vessel gaps in situations where primary vessel repair would result in excessive tension across the anastomosis.1
- Microsurgery training courses incorporate interpositional vein graft procedures, using femoral or epigastric veins as grafts, in their curricula to provide surgeons with clinically relevant models to practice these procedures in a controlled environment.
- At the Microsurgery Training and Research Laboratory of the Columbia University Irving Medical Center, it was found that torsion of the vein graft is a common technical error made by surgeons.

Preparation
- 5 rats of Sprague-Dawley rats were divided into cohorts based on degree of vein graft torsion (0, 45, 90, 135, and 180 degrees).
- The mean weight of the rats was 614 ± 30 g (range, 580–630 g).
- The rats were anesthetized with a combination of ketamine (70 mg/kg) and xylazine (5 mg/kg), and anesthesia was maintained via an intraperitoneal ketamine injection.
- All surgeries were conducted using a surgical operating microscope (Zeiss OPMI Micro; Carl Zeiss, Inc., Germany) and 11-0 nylon (Surgical Operative Corporation; Reading, PA).

Vein grafting
- Intravenous heparin was used to prime the surgical field, and 1% lidocaine hydrochloride was used to infiltrate the surgical field.
- Torsion was created in the vein grafts at the distal arterial end by mismatching sutures placed between the proximal end of the vein graft and the distal arterial end.
- Average vessel diameter was 1 mm.
- Vein graft patency was then verified via two methods, and 24 hours post-operation.

Vein grafting
- All branches were ligated, cauterized, and transected.
- Single vascular clamps were applied to the femoral artery near the inguinal ligament (proximally) and the superficial epigastric branch (distally).
- A defect was created in the artery at the midpoint between the clamps, and the vessel ends were ligated with 5-0 prolene, countermailed, and dilated.

Results
- Vein graft patency
- Average blood flow rate measurements for 0, 45, 90, 135, and 180 degrees of torsion 2 hours post-operation: 0.37 ± 0.02, 0.38 ± 0.04, 0.34 ± 0.01, 0.33 ± 0.01, and 0.29 ± 0.02 (mL/min) respectively.
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Conclusion
- Torsion of up to 180 degrees does not affect early vein graft patency in rat models.
- Suggestion to improve clinical reproducibility of practicing vein graft procedures in rat models.
- Microsurgery instructors should assess vein graft torsion prior to clamp release.

Discussion & Conclusion
- Torsion of up to 180 degrees does not affect early vein graft patency in rat models.
- In human patients, it is common to minimize dissection to reduce tissue damage and the potential of scarring, yet for interpositional vein graft exercises in rat models, the entire femoral artery is dissected, which significantly mobilizes the artery.
- Torsion becomes widely distributed along the graft and artery and is quite difficult to appreciate visually.
- Torsion is a potential risk factor for vascular thrombosis in the clinical setting.
- To improve the clinical reproducibility of practicing vein graft procedures in rat models, we suggest that instructors of microsurgery training courses assess the success of a completed vein graft not only on patency but also on the basis of any torsion in the vein graft prior to clamp release.

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References