Minimizing the anastomosis time is essential in microsurgical procedures for tissue survival and functional restoration. Although the continuous suture technique (CST) requires less time than interrupted suture technique (IST) in vascular anastomosis, surgeons are hesitant to extensively apply it clinically. There are two main concerns. Theoretically, CST can narrow the anastomotic site, limit the systolic expansion, and leave a greater amount of suture material in contact with the bloodstream to lead to stasis and thrombosis. Experimental results have varied. In order to offer convincing evidence to surgeons for future clinical use, this study was designed to evaluate CST in the end-to-end anastomosis of different sized microvessels.

METHODS (approved by IACUC). 45 adult rabbits weighing 3-4 kg and 30 adult rats weighing 250-300 g were divided into 5 groups (n=15 for each). Group I: rabbit carotid artery (1.8-2.0 mm of the external diameter (ED)), Group II: rabbit femoral artery (1.4-1.6 mm), Group III: rat femoral artery (0.7-0.9 mm), Group IV: rabbit femoral vein (2.0-2.2 mm), Group V: rat femoral vein (1.0-1.2 mm). In each animal, the vessel on one side was repaired using CST, and the opposite vessel with IST. Vessel samples were harvested at 1, 2, and 4 weeks following anastomosis, 5 paired vessels from each group at each time point. One orthopedic surgeon performed all operations. Two sample T-pair test was applied to analyze anastomosis time, bleeding time, and blood loss. Chi-square test was used to determine differences in patency rate, thrombosis rate and aneurysm rate. Operative durations were compared using ANOVA. Statistical significance was set at p < 0.05.

RESULTS. Anastomosis time: The anastomosis time was significantly (p<0.01) reduced in each CST group when compared to the contralateral IST group. The percentage of the time-saving by CST was 47% in group II, 87% in group IV, and 100% in group V. In CST significantly (p<0.05 to <0.01) reduced both bleeding time and blood loss when compared to IST. The bleeding time in CST decreased between 32% and 42% in arteries (groups I, II, and III, respectively); 41 ± 8% and 29 ± 9% in veins (groups IV and V, respectively). The reduction in anastomosis time decreased (p<0.01) as the vessel ED decreased (Fig. 1).

Bleeding time and blood loss: CST significantly (p<0.01 compare to 1.5mm artery, **p<0.01 compare to 1.0mm artery) reduced both bleeding time and blood loss when compared to IST. The bleeding time in CST decreased between 32% and 42% in arteries (groups I, II, and III) and 30% and 50% in veins (groups IV and V). Similarly, the blood loss in CST was diminished by between 50% and 75% in arteries and 25% and 40% in veins.

Patency rate: The patency rate was 100% in both CST and IST groups immediately after anastomosis. At harvest, the patency rate in arteries was 100% in both CST and IST groups (Fig. 3). Patency rate was 100% in both CST and IST groups. However, when compared to IST, CST significantly reduced anastomosis time, bleeding time, and blood loss. The percentage of the anastomosis time saved by CST exceeded forty percent in both larger arteries and veins (average ED = 2.0 mm). As the vessel diameter decreased, this time-saving was significantly reduced to less than thirty percent in both arteries and veins (average ED = 1.0 mm).

There is still lots of controversy related to the efficacy of CST. Compared to the traditional IST, Moscona reported that CST reduce anastomosis time by 50% in 0.8-mm arteries, with a patency rate of 73.3%. In contrast, Adani showed that the CTS could create 100% patency in 1.1-mm arteries, but without much time-saving. Conflicting data in the literature may reflect differences in the methodology of CST itself, the surgeon's experience, the vessel size and the suture material. In the present study, we compared CST with IST in arteries and veins of the sizes commonly encountered in clinical microsurgery. One experienced orthopedic surgeon performed all vessel anastomoses under consistent working conditions and a paired anastomoses (CST and IST) were performed in each animal. Those steps are critical to maximize comparability and limit variability of the outcome. The results encourage application of the continuous suture technique to future microvascular operations.

Our finding that savings on operating time decreased as the vessel diameter decreased concurs with others who reported little advantage for repair of arteries with an ED of 0.5 to 0.6 mm by CST. In CST, four of the stitches are similar to those of IST, i.e. the first two stay-stitches and the final two stitches. Excepting these four stitches, the more stitches are needed, the more time CST can save. The time-saving is greater in larger vessels than in smaller vessels not only because the necessity of repeated tying, cutting, and needle-retrieving is greatly reduced, but also because the stitches can be placed more easily through the vessel wall. CST can save operating time and result in earlier reperfusion of the tissue, reducing trauma to the clamped vessel wall and diminishing surgeon’s fatigue. Furthermore, diminution of the bleeding time and blood loss also contributes to reduced operation time and prevention of thrombosis. Thus, we believe that CST can save operation time of the end-to-end anastomosis in arteries greater than 0.7 mm and veins greater than 1.0 mm in diameter.

In summary, our results indicate that CST can significantly reduce anastomosis time and obtain a similar patency rate, stenosis rate, and morphologic outcome to IST. CST is superior to IST for repairing arteries when the diameter is greater than 0.7 mm and for veins greater than 1.0 mm. The evidence from this study encourages the use of CST in future clinical microsurgery.

![Fig. 1. Effects of the vessel size on the time-saving by the CST](image)

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