Inexpensive Materials for Microsurgery in Middle- and Low-Income Countries

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Abstract

With the continuous incorporation of new technologies and advancements in surgical technique, microsurgical procedures around the world have generated a higher success rate and innovative procedures are now possible. In this setting, limitations regarding accessibility and acquisition of medical resources and equipment for these types of operations may be difficult in developing countries. We believe the dexterities of surgeons go beyond the surgical technique, meaning that we are able to use everyday materials to re-create affordable solutions that can be used during surgery in a safe way. This manuscript presents our experience with different surgical instruments and gadgets, developed out of necessity, to improve microsurgical interventions in developing countries.

Improvements in microsurgery have been expeditiously achieved with advancements in engineering and technology. In developing countries, regional reconstructive alternatives are considered before free tissue transfer to improve the postoperative care, equipment utilization, intraoperative time, and the cost of surgical interventions.[1] Nonetheless, the implementation of free tissue transfer is sometimes required as no other reconstructive approach suffices the needs of complex tissue defects. Accomplishing microsurgical reconstructions in emergent nations can be challenging as it is resource-demanding, requires more surgical equipment, added intraoperative time, and demands careful postoperative monitoring.[2] Therefore, the aim of this report was to provide a series of affordable and low-cost instruments and gadgets, developed out of necessity, to improve microsurgical interventions in developing countries (►**Video 1–5).**

Video 1

Construction of vessel loop. Online content including video sequences viewable at: https://www.thieme-connect.com/products/ejournals/html/10.1055/s-0042-1758640.

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Video 2

Construction of microsurgical background. Online content including video sequences viewable at: https://www.thieme-connect.com/products/ejournals/html/10.1055/s-0042-1758640.

Video 3

Construction of vessel loop. Online content including video sequences viewable at: https://www.thieme-connect.com/products/ejournals/html/10.1055/s-0042-1758640.

Video 4

Construction of microsurgical retractor. Online content including video sequences viewable at: https://www.thieme-connect.com/products/ejournals/html/10.1055/s-0042-1758640.

Video 5

Construction of CholoSuck. Online content including video sequences viewable at: https://www.thieme-connect.com/products/ejournals/html/10.1055/s-0042-1758640.

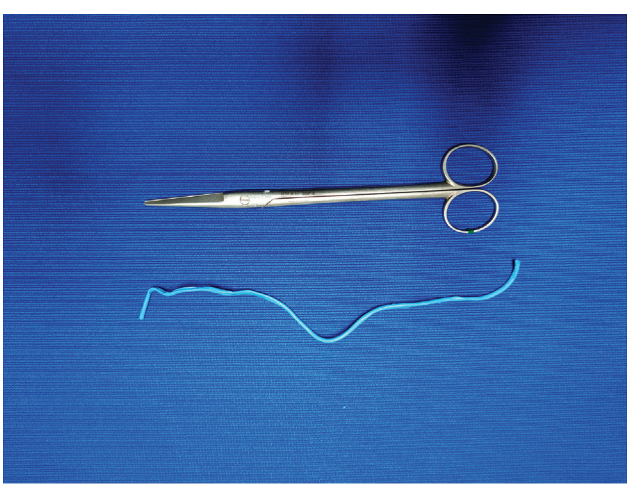

Fig. 1 Blue glove used for vessel loop.

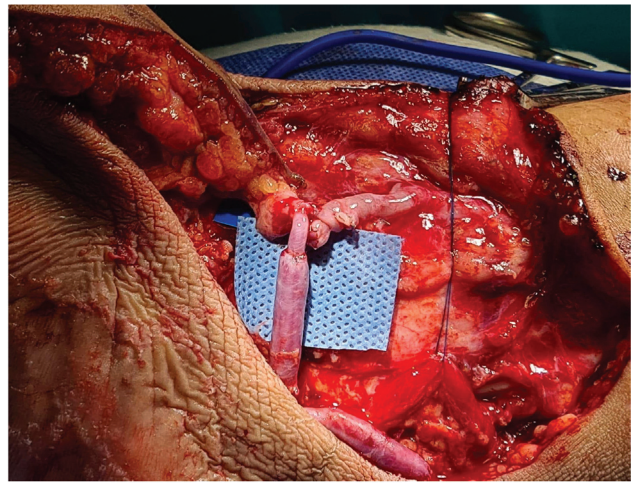

Fig. 2 Microsurgical background and gauze-based loop.

Vessel Loops from Latex Gloves

Vessel loops are disposable medical device made of an elastomer of polysiloxane (silicone rubber) available in multiple colors.[3] The most common use of a vessel loop is the identification of arterial and venous vessels, peripheral nerves, and tendons.[3] However, it can be used for atraumatic retraction, to deliver a nerve through a tunnel for nerve coaptation, to temporarily close fasciotomy wounds, or can be used as a finger tourniquet.[3] Recently, we have used the circumferential border of the proximal end of latex gloves as vessel loops, obtaining a low-cost accessible utensil that fulfills the aforementioned functions. Certainly, the latex from which gloves are made of provides a waterproof vessel with almost the same friction coefficient of silicone (►**Fig. 1**).[4]

Vessel Loop from Surgical Gauze Sponges

Surgical sponges of medium size usually contain a blue radiopaque strip that can be detected under X-rays, which make them useful for identification if it is mistakenly left within the surgical field after closure (►**Fig. 2**). This blue strip can be detached from the sponge and used as a low-cost vessel loop as an alternative to latex gloves and silicone loops. However, care must be taken when handling these gauze-based loops as the friction generated from the material can cause microtrauma to the vessel's wall and thin delicate hollow/tubular structures.

Visibility Background Material

Background sheets are beneficial as they prevent tissue and suture thread from sticking, and facilitate movement of the suture thread with less friction. Currently, we use two different accessible and cost-effective alternatives as visibility background materials during microsurgery. The first option is a small rectangular segment of a sterile surgical

Fig. 3 Abbocath No. 18 microsurgical retractor.

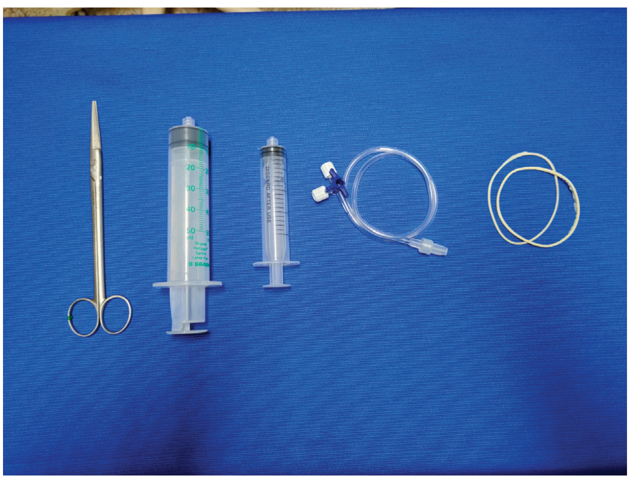

Fig. 4 Supplies for the CholoSuck.

glove crafted to a reasonable size after the excess powder is removed; the second option is a small rectangular piece from sterile drapes. The later has a suitable color and texture that avoids reflections from the theater's lights, its texture is firmer than the surgical glove, and the pattern on the surface simulates a grid to identify the size of structures (►**Fig. 2**).[5] In comparison to modern background sheets, the gloves and drapes are radiolucent that makes their identification with radiography not possible if they are left within the surgical field.

Abbocath No. 18 Retractor

In our hospital, we use a retractor model made with the needle of a peripheral venous catheter (Abbocath No. 18). The venous catheter is held with the nondominant hand. With the dominant hand, a hemostatic clamp is taken and directed toward the tip of the needle and secured. Afterward, the tip of the needle is firmly bent until it is molded into the desired shape and curvature (►**Fig. 3**). If

Fig. 5 CholoSuck generating negative pressure.

desired, the tip of the needle can be smoothened before bending.

CholoSuck

The use of closed suction drainage has proven to be safe to prevent fluid accumulation after reconstruction with free flaps. We have been pragmatic by creating the CholoSuck. This drain is crafted using a 100-cc syringe ($3.33/item), a 10-cc syringe ($0.34/item), a catheter, and surgical elastic bands (►**Fig. 4**). First, the tip of the 100-cc syringe is inserted in the catheter. Then, after pulling the plunger to generate negative pressure, a 1-cc syringe is inserted between the plunger's flange and the barrel's flange of the 100-cc syringe to maintain the position of the plunge, ultimately preserving the negative pressure. Finally, the 10-cc syringe is secured with the surgical elastic bands.

Another way to preserve the negative pressure is to perforate the plunge proximal to the barrel's flange, so a needle cap can be inserted to block the pullback of the plunger. With the implementation of this closed system with negative pressure, we have seen the same rate of seromas and hematomas following free tissue transfer while reducing the cost of postoperative care (►**Fig. 5**).

Currently, none of the microsurgeons that have used any of these innovative ideas has come across any related complications. This preliminary report demonstrates that this technology is reliable and beneficial, especially in developing countries. Further studies are required to identify if the implementation of these inexpensive tools significantly reduces the cost of hospitalization and postoperative care.

Author Contribution

Idea and conceptualization: P.C.; Research and investigation: P.C., J.M.E.; Data curation: P.C. and J.M.E.; Analysis: P.C., J.M.E.; Funding acquisition: P.C., J.M.E.; Methodology: P. C.; Project administration: P.C.; Software and simulation: P.C.; Supervision: P.C.; Verification: P.C. and O.J.M.; Original draft preparation: all authors; Revision and editing: all authors.

Patient Consent

Written patient consent was obtained.

Ethical Approval

This article was performed in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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Conflicts of Interest

P.C. is an editorial board member of the journal but was not involved in the peer reviewer selection, evaluation, or decision process of this article. No other potential conflicts of interest relevant to this article were reported.

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