

Video Article

Manufacturing Devices and Instruments for Easier Rat Liver Transplantation

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Abstract

Orthotopic rat liver transplantation is a popular model, which has been shown in a recent JoVE paper with the use of the "quick-linker" device. This technique allows for easier venous cuff-anastomoses after a reasonable learning curve. The device is composed of two handles, which are carved out from scalpel blades, one approximator, which is obtained by modifying Kocher's forceps, and cuffs designed from fine-bore polyethylene tubing. The whole process can be performed at a low-cost using common laboratory material. The present report provides a step-by-step protocol for the design of the required pieces and includes stencils.

Video Link

The video component of this article can be found at <https://www.jove.com/video/50380/>

Introduction

A technique of orthotopic rat liver transplantation has been shown in a recent Journal of Visualized Experiments paper¹. Portal vein and infrahepatic vena cava anastomoses were performed using the quick-linker assisted cuff technique. This technique was chosen among other revisions of the original Kamada's technique²⁻⁴, as it allows for easier and quicker anastomoses, results in a better hemodynamic, and can be implemented with a shorter learning curve^{1,5}.

The quick-linker technique requires the use of a handle, an approximator and cuffs, all of which can be designed from common laboratory material according to the technique described in the present report.

Protocol

1. Handle: Design and Shaping

1. Secure an Nr 10 carbon scalpel blade on a wooden board with a tape.
2. Tag the center of the ring under the microscope. It should be located 1.2 cm straight from the groove of the scalpel blade.
3. Drill a 2 mm hole with a spherical diamond bit, mounted on a high-speed drill.
4. Widen the hole with fusiform or conic diamond bits. The final diameter varies according to the rat weight as shown in **Table 1**.
5. Design the shape of the handle with a permanent marker. **Figures 1** and **2** can be used as stencils.
6. Convert the drill into a mini bench grinder and remove the part of the blade outside the shape.
7. Round off the piece with a low speed rotating brush.

2. Approximator: Design and Shaping

1. The approximator is obtained by modifying straight surgical Klemmer's or Kocher's forceps.
2. Cut off half of one branch under the microscope using the high-speed mini bench grinder.
3. Make symmetrical grooves on both sides to allow for the handle to slide in completely.
4. Cut a longitudinal slit in the long arm and check that the center of the long arm and a well-positioned handle are on a same axis.
5. Design a notch on the long arm facing the center of the handle.
6. Make the branch as thin as possible and round off the piece with the low speed rotating brush.

3. Cuffs: Design and Shaping

1. Cuff calipers vary according to the rat weight and strain. By contrast, their length should be kept around 4 mm.
2. Take fine-bore polyethylene tubing and round off one edge with an Nr 10 scalpel.
3. Design a groove 0.5 mm from the edge, and carefully cut out a slope going down to the groove.
4. Cut out one or two full-thickness nicks into the tubing. These will help manipulating the cuff during graft preparation and transplantation.
5. Cut the cuff at 4 mm from its edge.

Representative Results

Five kits, including five approximators and 11 handles have been manufactured. One handle broke during the final brushing. This problem was due to the fact that the ring of the handle was too narrow, and it has been solved by setting the narrowest part of the handle ring at 0.5 mm. No problems occurred during the shaping of the approximators.

| Rat weight (g) | Porta handle (inner dia) (mm) | Porta cuff (outer dia) (mm) | IVC handle (inner dia) (mm) | IVC cuff (outer dia) (mm) |
|----------------|-------------------------------|-----------------------------|-----------------------------|---------------------------|
| 120-180 | 2.2 | 1.7 | 2.6 | 2.08 |
| 180-270 | 2.6 | 2.08 | 3.4-3.7 | 3.0-3.25 |
| >270 | 2.9 | 2.42 | 4.2 | 3.7 |

Table 1.

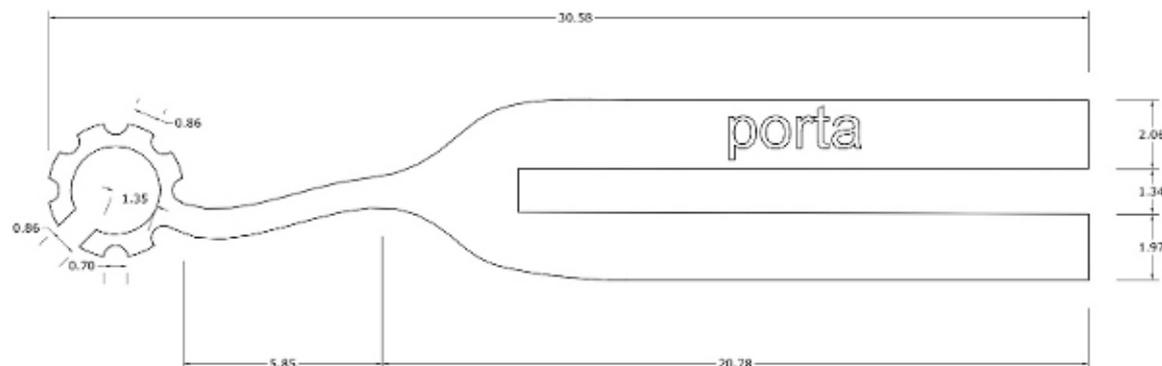


Figure 1. Porta handle stencil. If printed with a scale 1:1 can be used to guide the handle shaping. [Click here to view larger figure.](#)

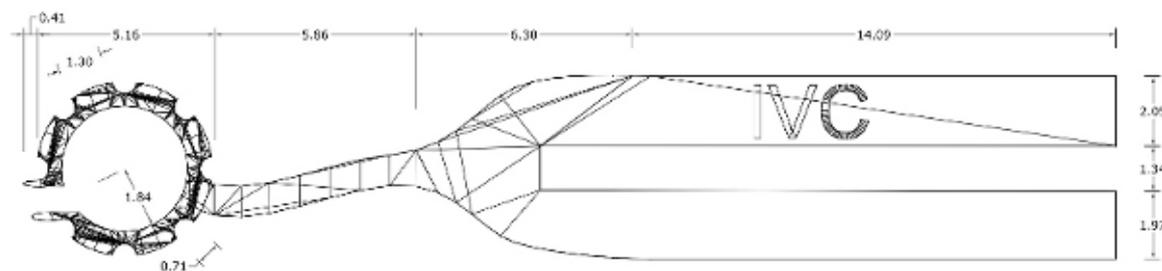


Figure 2. IVC handle stencil. If printed with a scale 1:1 can be used to guide the handle shaping. [Click here to view larger figure.](#)

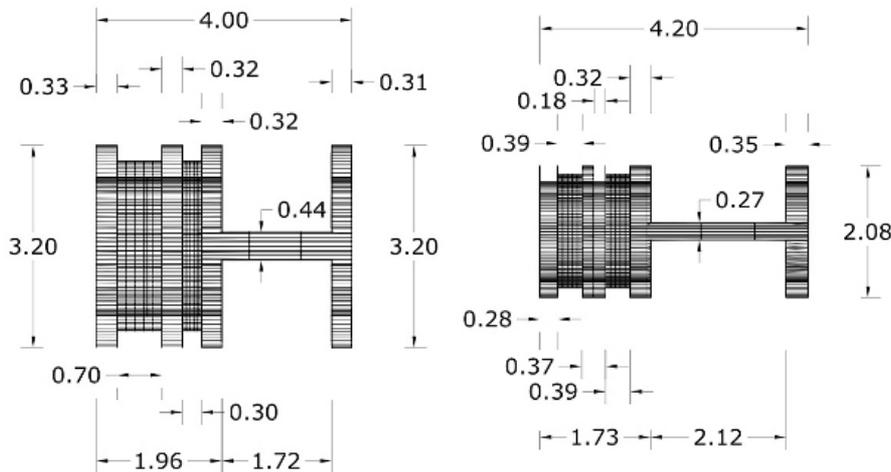


Figure 3. Porta and IVC cuffs lateral view. Graft's v.porta should be secured to the central groove, while recipient's vessel to the lateral one. This expedient allows for optimal intima-to-intima contact.

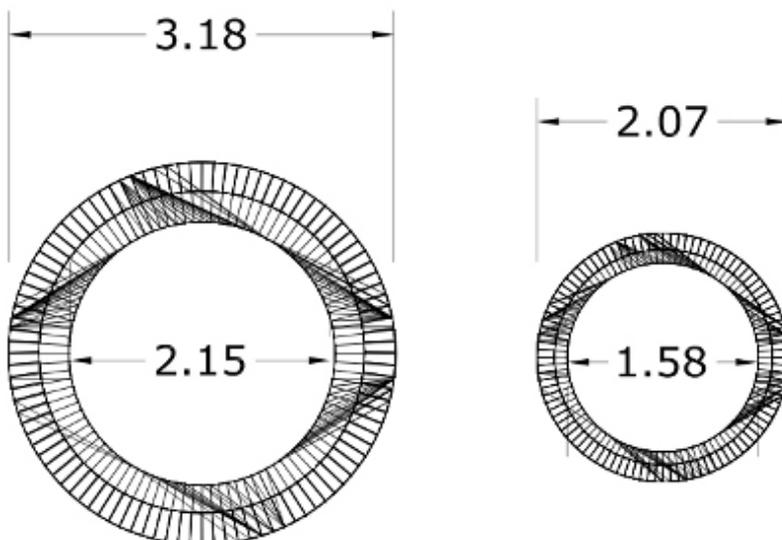


Figure 4. Porta and IVC cuffs front view. Calipers suitable for rats weighing 180-270 g are represented.

Discussion

The present report describes the design and building of the quick-linker system for easier rat liver transplantation.

Rat liver transplantation is a popular model with 125 to 180 related papers published yearly since the early 1990's (www.pubmed.com). It allows for a wide range of experiments including the exploration of immunological and graft preservation issues. The use of the "quick-linker" kit allows for easier and quicker anastomoses with guaranteed intima-to-intima contact. A detailed description and discussion of the technical steps of a rat liver transplantation have been described previously¹.

The quick-linker kit can be built at low price from common laboratory material. The main challenge encountered has been related the breakdown of one handle during the final brushing, and that problem has been solved by setting the narrowest part of the handle ring at 0.5 mm (**Figures 1 and 2** show appropriate sizes). Regarding the blade quality, only stainless steel should be considered. Although slightly less flexible compared to the average carbon steel blade, stainless steel blades do not develop rust, allowing a lifetime use of the handles.

Of note, the design of the current handles and cuffs is the result of a process, which has led to the proposed sizes, allowing for the most efficient anastomoses. Cuff diameters vary according to the rat weights (**Table 1**). Minimal variations can be tolerated in terms of length, with a usual length of about 4 mm (**Figures 3 and 4**).

Regarding the approximator, the selected Kocher's forcep should have handles at least 4 cm from the fulcrum. This allows for a safe closure of the rack outside the animal's abdomen.

Overall, the proposed device can allow easier vein anastomoses for the transplantation of liver and other types of grafts in rats.

Disclosures

The authors have nothing to disclose.

Acknowledgements

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References

1. Oldani, G., Lacotte, S., Morel, P., Mentha, G., & Toso, C. Orthotopic Liver Transplantation in Rats. *J. Vis. Exp.* (65), e4143, doi:10.3791/4143 (2012).
2. Hori, T., *et al.* Comprehensive and innovative techniques for liver transplantation in rats: A surgical guide. *World Journal of Gastroenterology*, WJG 16, 3120 (2010).
3. Kashfi, A., *et al.* A review of various techniques of orthotopic liver transplantation in the rat. *Transplantation Proceedings*. 37 (1), 185-188 (2005).
4. Kamada, N. & Calne, R.Y. Orthotopic liver transplantation in the rat. Technique using cuff for portal vein anastomosis and biliary drainage. *Transplantation*. 28, 47 (1979).
5. Oldani, G., *et al.* A novel technique for rat liver transplantation using Quick Linker system: a preliminary result. *Journal of Surgical Research*. 149, 303-309 (2008).