Megbelayin Affordable Trocar System (MATS): A Locally Fabricated Trocar-Cannula System for Vitreoretinal Use

Megbelayin EO

ABSTRACT

In attempts to meet human needs, necessities often form the basis of inventions. Amid scarcity of financial, material and skilled human resources, especially in underserved parts of the world, inventions and innovations are always apt. This article is a modest attempt to bridge a technology gap. It describes a less than ten dollars do-it-yourself needle trocar and cannula system for minimal invasive vitrectomy and sundry vitreoretinal procedures. The article utilized available literature and internet search for relevant information on subjects of Ophthalmic innovations. The Trocar System (Megbelayin Affordable Trocar System-MATS) is designed from a 23G hypodermic needle, 21G irrigating ophthalmic cannula, a bead, glue, iron files and sandpaper.

Keywords: Megbelayin, Affordable, Trocar, Fabricated, Vitreoretina

INTRODUCTION

Innovations continue to be the bedrock of modern societies. The focus of every innovative idea ought to be to cut costs, achieve the same or better results with minimal effort or improve on the existing quality of a product. Creating usable medical items from commonly available day-to-day materials is a viable panacea to the prohibitive cost of health services in developing countries.

Vitrectomy has evolved from a trocar-less 20G system in the 1970s to a 23G Trocar system that began in 2002.[1,2] A trocar-cannula system ensures better wound construction and management. The need to maximize the merits and minimize the demerits of earlier systems led to the introduction of 23G cannula in 2004 by Claus Eckardt.[3,4] This allows for trans-conjunctival (no peritomy) sutureless sclerotomies. It also enables rigid and efficient vitrectomy up to the vitreous base thereby saving surgical time.[5]

Unfortunately, this minute vitreoretinal item is expensive at an average price of 100 to 200 dollars (50 to 100 thousand naira) depending on the product. It is often recommended by the manufacturers to be used once and discarded. This write-up aims to report a re-usable cost-effective trocar system that competently serves its role of creating unhindered paths for intravitreal instrumentation at a cost of less than ten dollars ($10), about 5 thousand naira only.

Department of Ophthalmology, University of Uyo, Nigeria.

*Corresponding author: favouredolu@yahoo.com
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Cannula: A 21G Ophthalmic irrigating cannula is cut to 4mm, filed with iron files and smoothened with sand-paper. It is best cut with a machine cutter. The challenge is the occlusion of the lumen during the process of cutting as the heat generated melts the iron to cause luminal occlusion. To minimize this, before cutting with a machine cutter, the 21G cannula is "cannulated" with a 23G syringe or solid metal that could go in through the lumen of the 21G cannula. After cutting, the 23G syringe or solid metal is removed from the cut piece.

Bead: This can be obtained in an open market. It should be 3mm in diameter and 2mm in length or less so that it does not preclude a proper view of the surgical field.

Glue: Cement the bead to the upper 2mm of the cut cannula, exposing its remaining 2mm. Additional strength could be derived by creating a beveled portion of the cannula which is then bent over the bead to prevent bead removal during manipulations. The opposite end of the cannula is also beveled to aid intra-ocular penetration during sclerotomy construction.

Iron Files: Iron files of varying coarseness are used to reduce cannula diameter. This ensures that sclerotomy is not too large when the cannula is removed.

Sand-paper: To smoothen cannula outer body to avoid ragged sclerotomy.
Plier: Assists in gripping the cannula during cutting or filing. However, minimal force is needed to avoid luminal collapse of the cannula.
Lighter: The point the metallic part joins the green plastic part of a 21 G hypodermic is minimally heated by a flame from a lighter and a plier used to separate the stainless iron part from the green plastic part. The iron part serves as an introducer and the green plastic part serves as a component of a reducer. The introducer is passed through the reducer to help railroad 23G needle which serves as the needle-trocar. Railroading ensures the needle-trocar is not blunted as it passes through the reducer (see Figure 2).

The reducer, on the other hand, reduces the effective length of a 23G needle trocar from 25mm to 8mm. The tip of a 5ml syringe is severed and inserted into the green plastic part of a 21G needle (with an iron part removed by flame) to form a 17mm reducer (Figure 2). Without a reducer, 23G needle would be too long to serve as a trocar, with the likelihood of injuring the opposite retina during sclerotomy construction. When the reducer is placed on a 23G needle, which then serves as a trocar, the part of the needle in front of the reducer should be 8mm. This is the effective length with the potential to penetrate the globe during sclerotomy construction and it is unlikely to touch the opposite retina. Four millimeters of the 8mm is later covered by a MATS cannula before creating sclerotomy.

The final MATS parameters are tabulated below comparing it with commercially available prototypes like Alcon.

Table 1: MATS parameter juxtaposed with commercially available Alcon trocar-cannula

S/N	Parameter	MATS	Alcon
1	23G needle -trocar length	8mm (MATS reducer in situ)	8mm
2	Length of trocar not covered by cannula	4mm	4mm
3	Bead diameter	3mm	2mm
4	Bead length	2mm	2mm
5	Cannula lumen diameter	0.8mm	0.7mm
6	Outer cannu la diameter	1.1mm	1.0mm
7	Total cannula length (Bead inclusive)	4mm	4mm

MATS COMPONENTS

MATS has 4 main parts: a syringe, a 23G needle, the reducer and a cannula.
Syringe: Serves as a handle. Any size of the syringe with which the Surgeon is comfortable is suitable.
23G needle: Commercially available beveled disposable hypodermic 23G needle serves as a needle-trocar. It makes the first contact with the globe by penetrating the sclera through the pars plana. Then the MATS' cannula goes through the preformed sclera tunnel. The 23G needle trocar is gently removed from the cannula to avoid explanation of the latter.
Reducer: The metallic part of a 23G needle is 25mm of which not more than 8mm should be inserted during sclerotomy construction. To reduce the length of the needle that goes into the globe, a reducer of 17mm is fashioned as described above and preplaced on a 23G needle by a railroading technique illustrated in figure 2.
Cannula: For better ergonomics, MATS cannulae are beveled to aid scleral penetration.

MATS COUPLING

Coupling MATS can be done with ease. A 23G needle is mounted on a syringe, either 2ml or 5ml. The introducer is passed through the reducer which railroads the 23G needle through the reducer and ensures it does not become blunt (figure 2). Finally, the beaded cannula is then placed just in front of the reducer.

Megbelayin Affordable Trocar System (MATS) design

MATS is fashioned from locally sourced materials shown below in figure 1.

Figure 1: MATS materials from left to right: (21G-cannula, bead, super-glue, iron files, sand-paper, plier, lighter and needle cap).

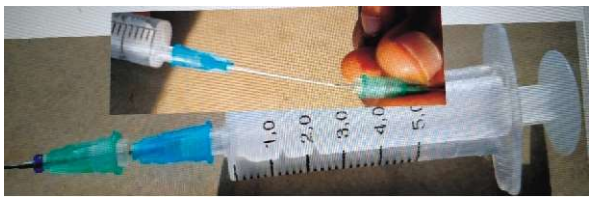

Figure 2: Top Image: rail-roading technique to minimize needle-trocar blunting. Bottom image: Fully loaded MATS consisting of a beaded cannula (deep blue), a green reducer, a sky-blue needle-trocar and a 5ml syringe.

MATS USE DURING SURGERY

Figure 3 shows MATS cannulae in a human eye and on an eye model.

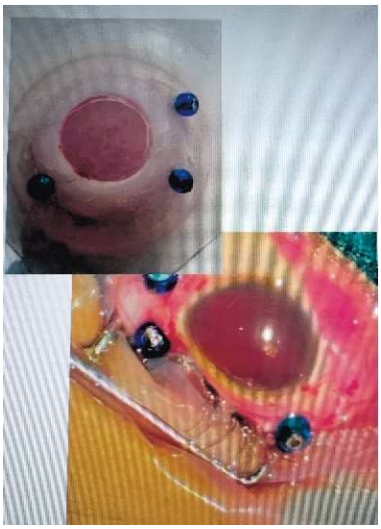

Figure 3: Top image: MATS cannula placed on an eye model. Bottom image: MATS cannula placed on a human eye.

Two-step insertion is advised with MATS. It could be through bare sclera or transconjunctival. The syringe, bearing MATS needle-trocar and cannula, is held tangentially to the sclera with the bevel parts of the needle and cannulae flat on the sclera. This is then advanced until the cannula tip is reached. The direction of insertion is now changed to about 90 degrees pointing to mid-vitreous and the trailing cannula is gently maneuvered until it is completely inserted into the preformed scleral tract created by the needle trocar. The bead serves as a stopper. A pair of Colibri forceps is used to hold the bead at any convenient position while the needle-trocar is gently removed. A pair of Colibri forceps is used to gently pull the conjunctiva in the opposite direction of intraocular penetration as a counterforce. Holding the conjunctiva also creates a sclero-conjunctival mismatch that serves as a physical barrier to microbial invasion when sclerotomy is sutureless.

Having been guided by a 23G needle-trocar, the cannula is left in situ to help ease the traffic of intraocular instrumentation. It is subsequently removed after the procedure. It is advised that the three sclerotomies be closed with 7/0 Vicryl to ensure a well-formed globe and reduce infection. However, with adequate size and proper filing, resultant sclerotomies may be minimal to warrant leaving them sutureless.

PEARLS TO MAXIMIZING MATS EFFICIENCY

Railroading 23G needle through the reducer minimizes blunting. Loading the MATS cannulae carefully under the microscope at the start of surgery minimizes needle prick. Sometimes, the reducer may not be firm on 23G needle, to avoid excessive mobility, the needle should be bent by about 10 degrees at its midpoint. Ethylene Oxide (ETO), or autoclave with MATS wrapped in several layers of gauze ensures re-usability.

CONCLUSION

MATS is a very cost-effective, reusable, technologically simple do-it-

yourself surgical tool that serves the primary purpose of easing intravitreal instrumentation during vitreoretinal procedures. It is versatile and its needle-trocar part could be used with the commercially available cannulae from Alcon and Midlabs, especially when their trocars have become blunted from repeated use.

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