CLINICAL TECHNIQUE

Viscodilation of Schlemm's Canal Combined with Goniectomy Using a 30 G Needle (Visco-Bent Ab Interno Needle Goniectomy)

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Abstract

Background and aim: Bent ab interno needle goniectomy (BANG) is a low-cost minimally invasive glaucoma surgery (MIGS) technique that has gained wide popularity in developing nations. However, the risk of injury to surrounding angle structures and especially the outer wall of Schlemm's canal (SC) is the main drawback of this technique. We describe a simple and easy-to-perform modification, "Visco-BANG," to improve the safety and efficacy of the BANG procedure.

Technique: A 30 gauge (G) needle attached to a syringe filled with cohesive viscoelastic is used. The needle is bent at the proximal junction of the bevel with bevel towards the operating surgeon. The needle is then inserted into the SC and viscoelastic injected to dilate the canal, creating a buffer between the inner and outer walls of SC, which is followed by cutting of a trabecular meshwork (TM) strip.

Conclusion: The current modification can prevent damage to adjoining angle structures, including the outer wall of SC, which is critical for aqueous outflow. It can potentially increase efficacy of the BANG procedure by incorporating viscodilation of the SC along with removal of the TM.

Clinical significance: Injury to surrounding structures causes a fibrotic response, which is the main cause of failure for the BANG procedure. Prevention of injury to adjoining structures and dilatation of the SC can potentially increase the long-term success rates of this procedure.

Keywords: Minimally invasive glaucoma surgery, Modification of bent ab interno needle goniectomy, Modification of goniectomy, Visco-bent ab interno needle goniectomy, Viscodilation of Schlemm's canal.

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Introduction

Minimally invasive glaucoma surgeries (MIGS) are ab interno procedures that reduce intraocular pressure (IOP) by cutting or stenting the trabecular meshwork (TM), which is the main site of resistance for aqueous humor outflow in glaucoma patients. Compared to the expensive instrument-based TM excisional procedures like Trabectome (NeoMedix, Tustin, California, United States), Kahook Dual Blade (New World Medical, Rancho Cucamonga, California, United States), or excimer laser trabeculostomy, bent ab interno needle goniectomy (BANG) is a low-cost procedure, which has gained popularity in developing countries and is being used in conjunction with cataract surgeries, with good IOP lowering efficacy.[1] BANG technique, initially described by Shute et al., involves bending the distal 1 mm of a sterile 25 gauge (G) 5/8 inch hypodermic needle towards the bevel using a needle holder.[1] The bent needle is used to excise the nasal 100° of TM, creating a cleft for drainage of aqueous directly into Schlemm's canal (SC).[1] Use of 26 G hypodermic needle instead of 25 G for BANG procedure has also been described in literature.[2] The main drawback of this technique is that there is a risk of injury to the outer wall of the SC, which can damage the outflow channels and also incite a fibrotic response, leading to closure of the cleft. Other disadvantages are damage to the surrounding tissues due to the sharp needle, bleeding during excision of TM, and reattachment of TM, causing early failure of surgery.[3] Additionally, dimensions of SC and TM in eyes with primary open-angle glaucoma (POAG) have been documented to be much smaller compared to normal controls.[4] The TM diameter and SC dimensions are significantly small when compared to the outer diameter of the 25–27 G hypodermic needles, which can increase the risk of damage to adjacent tissues.

Taking the above points into consideration, the author (Tanuj Dada) modified the BANG technique to make the procedure less traumatic to angle structures and overcome its current limitations.

Surgical Technique

A 30 G needle (12.5 mm in length) with an outer diameter of 312 µm is bent at the proximal end of the bevel using a needle holder, with the bevel towards the operating surgeon (bent toward the bevel) (Fig. 1A). The needle is attached to a syringe filled with

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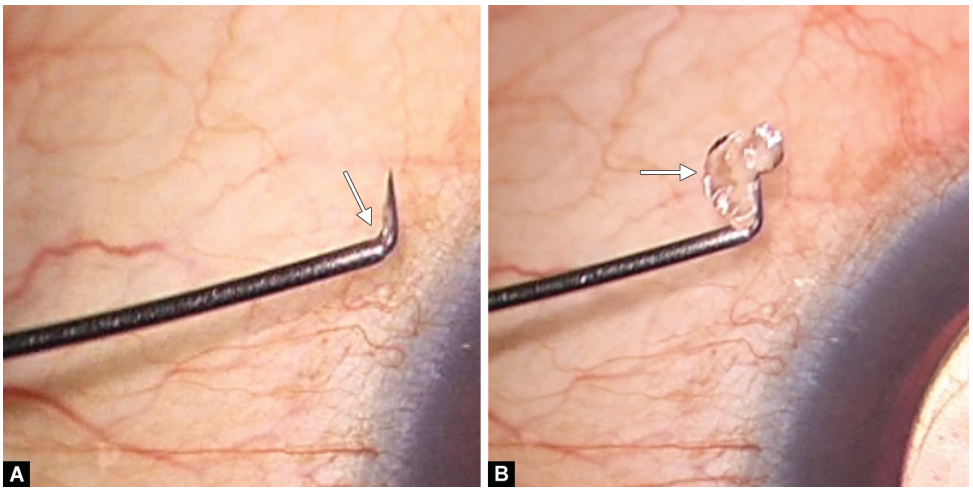
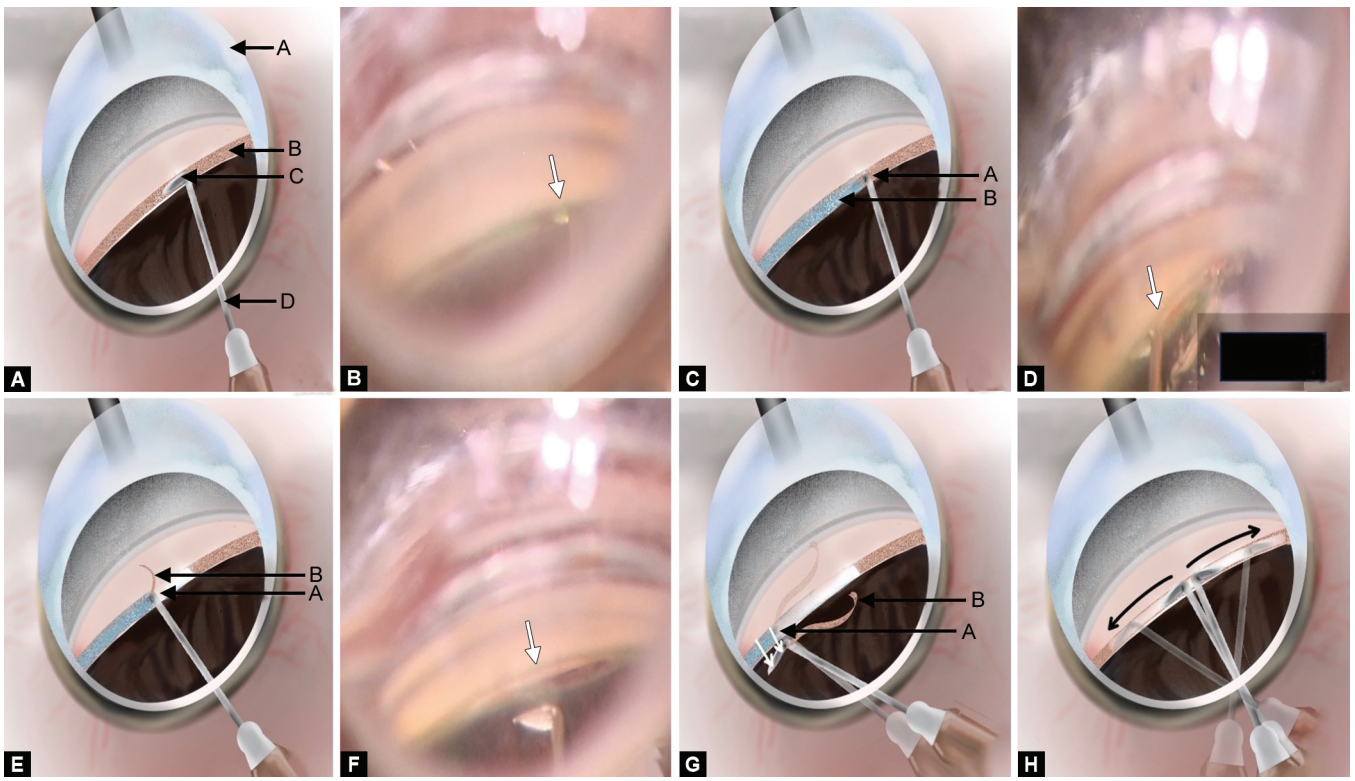
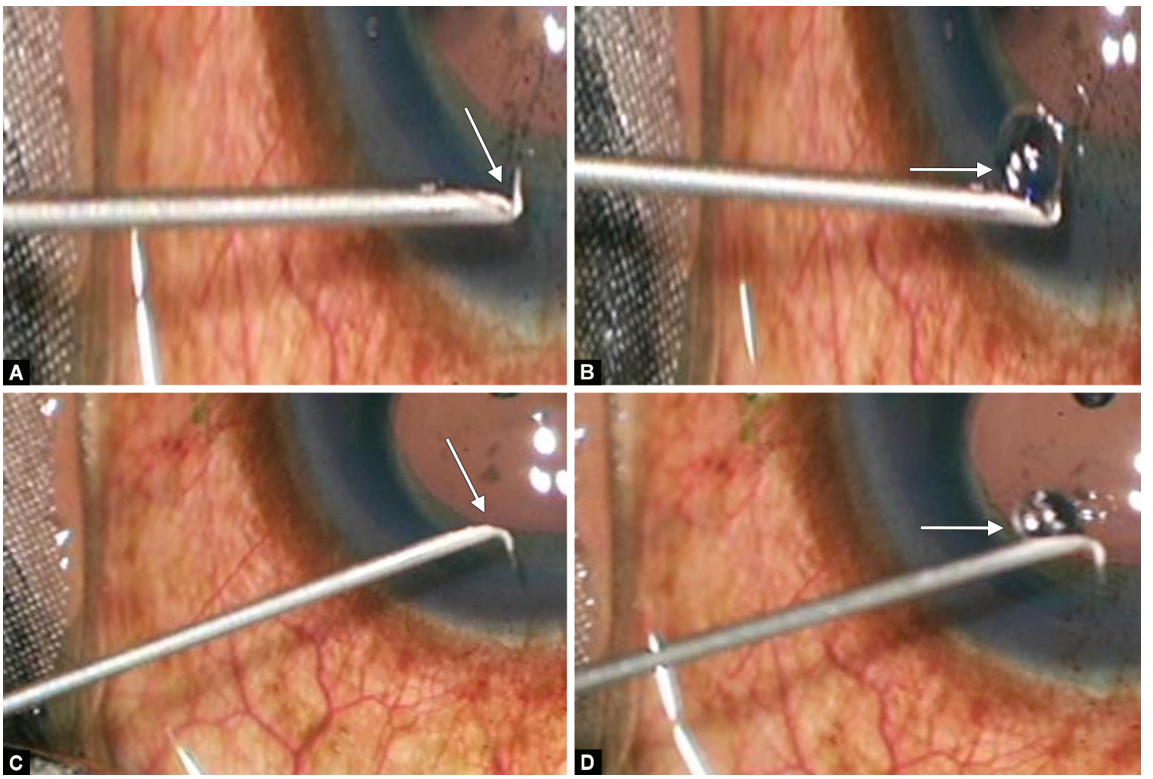
1% sodium hyaluronate (Fig. 1B). The microscope is tilted to about 30° towards the operating surgeon and the patient's head is tilted to the opposite side. The nasal angle is visualized with the help of Swan–Jacob goniolens, and the needle is advanced from the temporal clear corneal incision (Figs 2A and B). If there is shallowing of the anterior chamber or if any air bubbles obstruct the view, viscoelastic is injected from the 30 G needle to get a clear view of the TM. The bent needle is engaged into the nasal TM, and



Figs 1A and B: Modification in the method of bending a 30 G needle; (A) Arrow pointing at the proximal end of the bevel from where the needle is bent at a 90° angulation; (B) Arrow points to visco-cohesive agent coming through the bent needle. The proximal bend of the needle allows complete entry of viscoelastic into the Schlemm's canal



Figs 2A to H: Stepwise illustrations and clinical photos of the "Visco-BANG" technique; (A) Illustration of intraoperative gonioscopic view of nasal angle and 30 G needle bent at the proximal end of the bevel; Swan–Jacobs goniolens, A; TM, B; needle bent at the proximal junction of the bevel, C; 30 G needle, D; (B) Clinical picture of intraoperative gonioscopic view with arrow pointing to 30 G needle engaged in SC; (C) Illustration showing engagement of bent needle into SC along with viscodilation of SC; bent needle engaged in SC, A; dilated segment of SC, B; (D) Clinical picture showing excision of TM, arrow pointing at the goniectomy cleft created due to excision of TM; (E) Illustration showing excision of TM as the needle is moved 30° along the TM; outer wall of SC, A; shaved segment of TM, B; (F) Clinical picture with arrow pointing at the goniectomy cleft; (G) Illustration showing centripetal piercing movement of bent needle tip to cut the TM strip, arrow shows direction of centripetal piercing movement of needle tip, A; free floating strip of the TM, B; (H) Illustration showing "inside-out" movement of the bend needle to excise the TM in two short segments, black arrows represent the direction of movement of the bent needle



Figs 3A to D: Methods of bending the 30 G hypodermic needle for BANG procedure; (A) Arrow points to distal 1 mm bent of the needle toward the bevel (as commonly practiced); (B) Arrow points to viscoelastic coming out of the needle but due to the distal bend, incomplete entry of viscoelastic occurs in SC; (C) Arrow points to distal 1 mm bend of the needle away from the bevel (incorrect method); (D) Arrow points to viscoelastic coming out of the needle but due to the bend being away from the bevel, it is unable to enter the SC

1% sodium hyaluronate is injected into the SC to dilate the canal and create a wide separation between the inner and outer walls of the canal (Fig. 2C). This creates an appropriate buffer to prevent contact of the needle with the outer wall and facilitates stripping of the TM. Thirty degrees of the TM is excised, followed by centripetal piercing movement to cut the stripped TM (Figs 2D to G). Repetition of the above steps in the opposite direction is done to achieve a complete 60° excision of TM with extensive dilatation of the canal (Fig. 2H).

Discussion

The canal of Schlemm is a tubular structure with a meridional diameter of 233.0 ± 34.5 µm in healthy subjects, which decreases to 195.6 ± 31.3 µm in POAG patients.[4] In contrast, the outer diameter of 25 G needle is 515 µm, 26 G is 464 µm, 27 G is 413 µm, and 30 G is 312 µm, respectively. Thus, the 30 G needle seems to have the most appropriate dimensions to perform viscodilation and goniectomy with the least chance of damage to the outer wall of SC or other adjoining structures compared to the other needles.

Attaching the 30 G bent needle to a cohesive viscoelastic allows for its injection to reform the anterior chamber during the procedure without the use of a separate side port or syringe. Also, it helps to displace any bleeding obstructing the surgical field while performing the procedure. A deep anterior chamber during the procedure reduces the risk of injury to the crystalline lens when the procedure is performed in phakic eyes. Bending the 30 G needle at the proximal end of the bevel instead of the distal tip (as is usually done) allows for complete entry of the bent portion of the needle, the entire viscoelastic then enters the SC, leading to its dilatation. This helps protect the outer wall of the SC from injury, allows clear visualization of goniectomy cleft, and facilitates movement of the needle for smooth excision of the TM. Dilatation of SC and the collector channels with sodium hyaluronate may enhance the aqueous outflow, as seen in viscocanalostomy procedures.[5,6]

The needle should be bent at an angle of 90° as any angulation more than this can lead to the sharp end of the needle damaging the outer wall of the SC. Bending only the distal tip of the needle originally described, causes viscoelastic to be delivered outside the canal, and viscodilation is not possible (Figs 3A and B). Also, bending the needle away from the bevel causes inability to viscodilate the SC as viscoelastic is delivered outside the canal (Figs 3C and D). Cutting through the TM strip after excision makes the cut segment fall off and reduces risk of re-adhesion, which can prevent early failure.[3]

Conclusion

In conclusion, we describe a novel modification of BANG technique, "Visco-BANG," which uses a proximally bent 30 G needle a syringe filled with cohesive viscoelastic to potentially improve the safety and efficacy of the goniectomy procedure.

Clinical Significance

Minimally invasive glaucoma surgery (MIGS) procedures, which involve cutting of the TM, can damage adjacent angle structures, including the outer wall of the SC, and incite a fibrotic response, which can lead to failure of surgery. Prevention of injury to adjoining structures and adding a component of viscodilation of the SC in addition to the removal of the strip of TM can potentially enhance the safety and efficacy of the procedure.

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