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Ring graft technique for microvascular decompression

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Abstract:

Introduction: Various nerve compression syndromes, such as trigeminal neuralgia (TN), glossopharyngeal neuralgia (GN), and hemifacial spasm (HFS), are caused by compression of the concerned nerve by the adjacent vessel. Patients who do not respond to medical management are usually treated by "microvascular decompression (MVD) of the nerve." Teflon patch graft is the most commonly used material for MVD. This graft has been used in various shapes like a patch, in the shredded form, or as a sling. This is done to prevent recurrence because of graft failure. We used a teflon ring graft to perform a successful MVD in 10 patients.

Material and Methods: Out of 10 cases, 6 cases were of TN, 2 of HFS, 1 of GN, and 1 case was of cochleovestibular nerve compression syndrome (CNCS). After MVD, every patient underwent a follow up assessment for 5 years.

Results: There was no major postoperative complication, except in the patient with CNCS who suffered from a temporary episode of facial palsy. All cases were symptom free at a follow-up duration of equal to or more than 5 years.

Conclusion: Ring teflon graft may be used as an alternative as well as a safe method to perform MVD and has a good success rate.

Key Words:

Microvascular decompression, neuralgia, teflon

Key Message:

The use of the novel technique of teflon ring graft around the affected cranial nerve during microvascular decompression provides a long-lasting improvement in symptoms.

Compression of the cranial nerve from adjacent vessels, mostly an artery, presents as a nerve compression syndrome, e.g., trigeminal neuralgia (TN), glossopharyngeal neuralgia (GN), and cochleovestibular nerve compression syndrome (CNCS).[1-3] TN is the most common among all these neuralgias.[4] Initially, patients are managed by medical treatment, and those who do not respond (resistant cases) are treated by surgery. Microvascular decompression (MVD) of the concerned nerve has become the treatment of choice in resistant cases.[1,2,5-7]

In 1932, Dr. Walter Dandy proposed the theory of vascular compression of the trigeminal nerve as a possible cause of neuralgia. Dr Janneta initially introduced MVD and popularized the technique.[8] He placed a muscle patch between the nerve and artery. Since then, various graft materials have been used for MVD such as a muscle patch, teflon, cotton, gelfoam, thread, tape, titanium plate, and glue, as summarized in Table 1.[9-13] Teflon is, world-wide, the most commonly used graft material.[11] Neurosurgeons have tried various shapes of teflon to achieve maximum success. The two most commonly used shapes are a teflon patch and sling. These slings or patch grafts can, however, slip due to various reasons and may cause a recurrence of symptoms. In this study, we are reporting a series of 10 patients in whom we used the novel technique of a ring-shaped teflon graft for MVD.

Materials and Methods

Ten patients underwent MVD over a period of 3 years. The clinical and demographic details are summarized in Table 2. All these cases had a classical history of neurovascular compression syndrome. We considered MVD only in patients who (1) had received medical treatment in full doses for at least 6 months and there was less than 50% relief in symptoms, (2) had given informed consent, (3) had a recurrence of symptoms after undergoing a previous

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surgery (MVD/radiofrequency ablation/percutaneous rhizotomy). The diagnosis was confirmed based on the clinical symptomatology and radiological correlation on magnetic resonance imaging (MRI) of the brain with hyper-T2 (constructive interference in study state; CISS, Siemens®, Erlangen, Germany), fluid-attenuated inversion recovery (FLAIR), contrast T1 sequences, and time of flight (TOF) sequences.

The severity of pain symptom was analyzed using the visual analog scale (VAS) score (0–10). The score 0 was considered when there was no pain and 10 was considered when patient had the worst possible kind of pain that he/she had ever experienced.

The neurovascular conflict was classified into four categories, as mentioned by Haider *et al*.[14]

1. Simple contact: The conflict is caused by an arterial loop,which most of the times is the superior cerebellar artery (SCA), and a there is a single point of contact with the nerve.
2. Multiple contacts: The conflict includes different points of contact by several arterial loops, most of the time related to the SCA, around the nerve.
3. Nutcracker type of contact: The conflict includes one or more offending vessels above and below, with the nerve entangled between them.
4. Vein contact: The most common offending vein is the Dandy vein or an inconstant and aberrant petrous vein.

Table 1: Pros and cons of various grafts used in MVD

Type of graft	Pros	Cons
Muscle patch	Autologous	Graft shrinkage
	Inert	
	Easy harvesting	
Teflon patch	Inert	Teflon granuloma
	Long term studies have proven efficacy	Graft migration
Sling technique	Moves vessel away from nerve	Technical difficulty
	Inert graft	No large-scale study
Titanium plate	Inert	Metallic
	No adhesions	Nonmodifiable
		No large-scale study
Vascular tape	Mobilizes vessel away	Difficult technique
	No graft-nerve direct contact	No large-scale study

We set the criteria for the outcome of MVD as:

1. Complete success: 100% relief in symptoms (VAS score 0) after 5-years of follow-up
2. Partial success: More than 50% relief in symptoms (VAS score reduced to half or lesser) after 5 years of follow-up
3. Failure: Less than 50% relief in symptoms after 5 years of follow-up
4. Recurrence: The patient had some recovery initially followed by worsening of symptoms.

Technique

Each patient was operated under general anesthesia after obtaining an informed consent. MVD was done using the standard technique. A suboccipital retromastoid craniotomy was performed. The impending vessel and the nerve complex were identified. The vessel was dissected under a microscope. The ring-shaped teflon graft was harvested from the vascular tube graft [Figure 1and b], which is commonly used by vascular surgeons to repair vessels. A 1-2-mm length of the ring graft was cut out from the tube graft of 6 mm diameter. The ring was further split to open it [Figure 1b]. The split ring graft was then carefully placed around the nerve at the site of compression, as shown and explained in a case of TN [Figure 2a-d] and HFS [Figure 3a-c]. The size of the ring was selected based upon the space available for the graft. Only one ring was used in all ten cases. The technique has been explained by a diagram to simplify it [Figure 4a and b].

Illustrative case

A male patient, aged 42 years, had a history of attacks of severe, lancinating facial pain over the left lower cheek and below the angle of mouth for the last 5 years. There was precipitation of the episode of pain on washing the face, touching the involved area, chewing, or exposure to cold breeze. There was a history of left molar tooth extraction to relieve pain. He was taking carbamazepine 300 mg thrice a day and gabapentin 300 mg twice a day for the last 3 years;there was, however, no relief in the severity of pain for the last 3 months. On examination, he had no neurological deficits.

Radiology

Constructive interference in steady-state (CISS) sequence of MRI brain showed the loop of left SCA compressing and pushing the trigeminal nerve.

Table 2: Demographic and clinical profile of all patients

Age/sex	Symptoms	VAS (10)	Δ	Complications	Day 1	Follow-up VAS (10) (months)					
						3	12	24	36	48	60
24y/M	Pain V2,3	7	Right TN	Nil	0	0	3	1	0	0	0
34y/F	Pain V2,3	8	Right TN	Nil	0	0	2	1	0	0	0
42y/M	Pain V3	8	Left TN	Nil	0	0	2	1	0	0	0
51y/F	Pain V3	7	Right TN	Nil	0	0	3	2	0	0	0
40y/F	Vertigo, vomiting	-	Right CNCS	Right facial palsy x1 month	Nil	0	0	0	0	0	0
57y/M	Ear-ache radiating to throat	8	Left GN	Nil	0	0	0	0	0	0	0
43y/F	Facial spasm	-	Rt HFS	Nil	Nil	0	0	0	0	0	0
38y/M	Pain V2,3	9	Lt TN	Nil	0	0	0	0	0	0	0
47y/F	Facial spasm	-	Lt HFS	Nil	Nil	0	0	0	0	0	0
28y/M	Pain V1-3	8	Lt TN	Nil	0	0	0	0	0	0	0

Δ=Diagnosis; rt=Right; lt=Left; GN=Glossopharyngeal neuralgia; TN=Trigeminal neuralgia; VAS=Visual analogue scale; CNCS=Cochleovestibular nerve compression syndrome

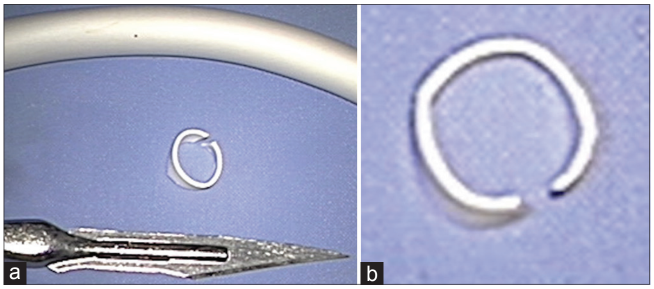

Figure 1: (a) Teflon tube graft for vascular surgery and ring graft with an open end. (b) Ring teflon graft of 6 mm diameter

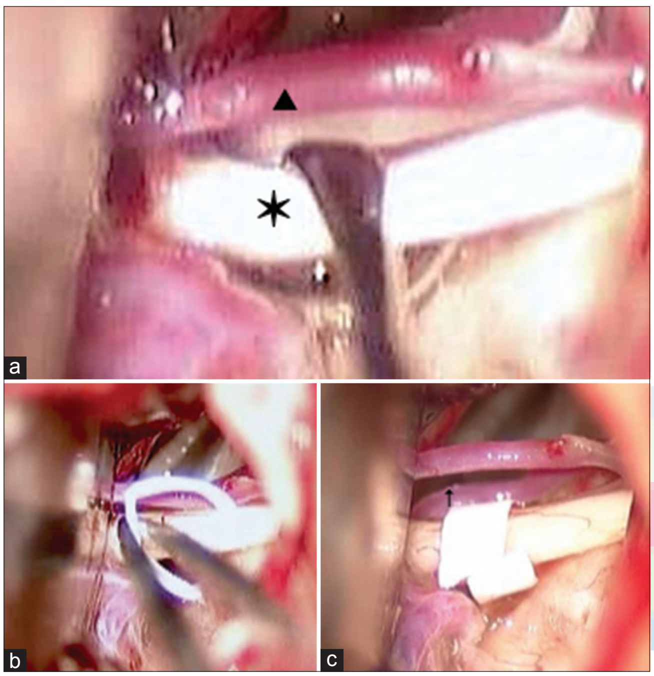

Figure 3: (a) 7-8th nerve complex, dissector retracting 8th nerve (*). Trigeminal nerve is compressed (arrow) at REZ by AICA loop (up arrow head). (b) Ring graft placement around 7-8th nerve. (c) Ring teflon graft placed around 7-8th nerve complex, separating it from AICA (upward directed arrow)

Operative technique

The patient underwent MVD of the trigeminal nerve. Surgery was done under general anesthesia in a sitting position. A left retromastoid suboccipital, retromastoid craniotomy was undertaken. The cerebellum was retracted. The trigeminal nerve along with aberrant SCA loop was visualized. The SCA loop was present above the trigmeinal nerve and a vein was present below it [Figure 2a]. Both were pressing and stretching the nerve near its origin. An arachnoidal dissection was done to mobilize the arterial loop and vein. A ring-shaped teflon graft (6 mm diameter and 3 mm wide) was placed around the trigeminal nerve [Figure 2b-d] to separate it from the SCA loop and vein.

The patient experienced a significant relief from the repeated attacks of pain in the immediate post-operative period (VAS 1/10). There was no neurological deficit and he was discharged after 7 days. At the follow-up visit after 1 month, the patient had no pain episodes. On a serial follow-up, there was no recurrence of pain and the patient remained pain -free at the 5-year follow-up.

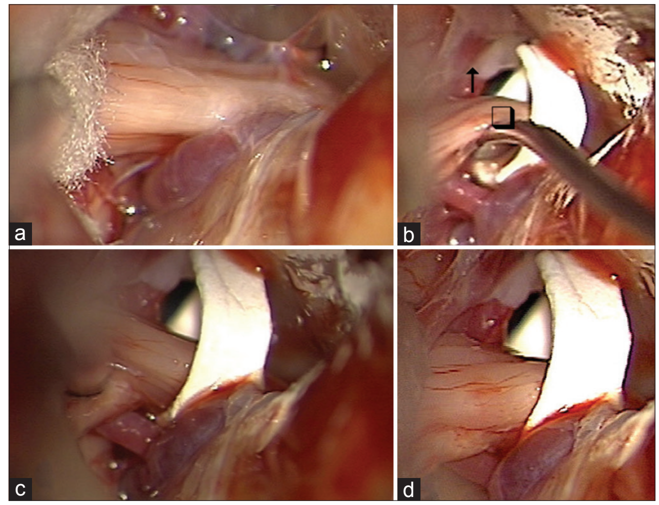

Figure 2: (a) Trigeminal is compressed by SCA loop superiorly and vein inferiorly. (b) Ring teflon graft placement around TN lifted by the dissector at contact site (square), separating it superiorly from the SCA loop (superior arrow) and inferiorly from vein. (c and d) Ring graft around TN after final adjustment

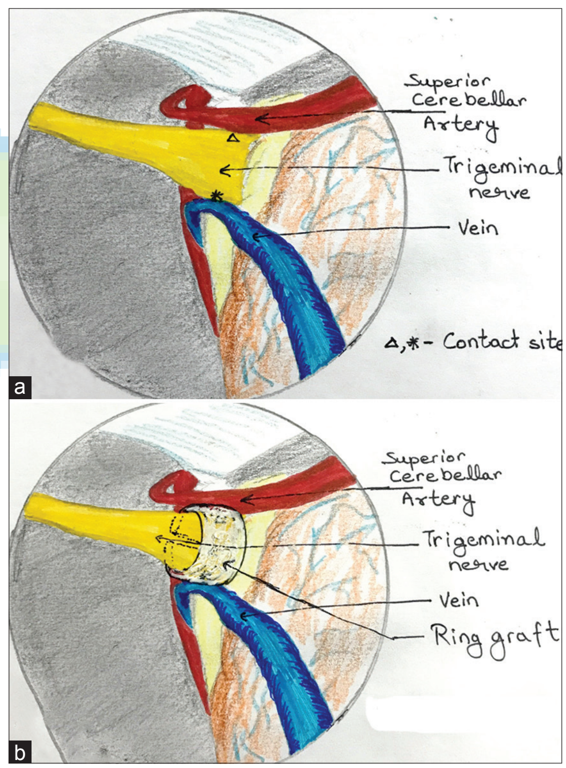

Figure 4: (a) Schematic diagrams showing the intraoperative view of V^{th} nerve compressed by an artery and a vein; (b) application of ring graft around the nerve and circumferential protection of the nerve from artery and vein

Results

In this study, there were ten cases of nerve compression syndrome [Table 1] treated by MVD. Six patients had TN, 2 HFS, 1 GN, and 1 CVNCS. The compressing vessels included six SCAs, three AICAs, and one PICA. Four patients had type 1 conflict, 4 had type 2 conflict, and 2 had type 3 conflict. No patient had type 4 conflict.

All patients had complete resolution of symptoms (type 1, 100% relief) after 5 years of follow-up. The patient of CVNCS developed a House and Barackmann grade II facial palsy in the postoperative period. She was taught facial muscle exercise, following which the palsy completely resolved in 4 months. No other complications were reported in the remaining patients.

Discussion

The offending vessel causes pressure on the root entry zone of the nerve and precipitates neuralgia. It is initially treated by medicines such as carbamazepine, gabapentin, and amitriptyline. These medicines give relief for some time, but long-term results are poor due to worsening of symptoms and side-effects of drugs, e.g., hyponatremia and leucopenia.[4,15] In about 50% of patients, some sort of surgical treatment is needed.[16] There are various surgical options for alleviating nerve compression syndromes, including MVD, rhizotomy and nerve blocks.[17]

MVD is the most popular and effective surgical treatment. The efficacy of MVD is around 65–80%.,[1,2,5,16,17] MVD is the most popular and effective surgical treatment. The efficacy of MVD is around 65–80%., as reported by various studies.[1,2,5,16,17] MVD may fail due to slippage of the graft, development of adhesions between the vessel and the nerve, the development of a graft granuloma, or the graft placing pressure on the nerve.[18-24] Continuous research and efforts are ongoing to increase the efficacy of MVD. A polytetrafluoroethylene or a teflon graft is usually the material of choice for MVD because it is inert, well-tolerated in the nervous system, resistant to resorption, and has a lower complication rate than other materials.[11] However, recent studies have shown that it is not that inert and can form a granuloma.[14,18-22] Teflon graft is generally used by making a sling around the offending vessel or nerve. The sling can, however, slip due to pulsations of the brain, cerebrospinal fluid (CSF) flow, and a poor sling memory. This results in a recurrence of symptoms. According to Cohen-Gadol, an unshredded teflon graft can get dislodged easily and hence a shredded graft should be used.[23] We also suspect that failure of MVD may occur due to the teflon patch migration as a result of CSF and arterial pulsations. According to Hana *et al*., failure in the surgical managment of HFS can also occur due to change of body postures and due to activities that may cause an indirect mild compression as a result of the decompression material coming in contact with the nerve, or the CSF pulsations causing displacement of the graft.[24] This results in recurrence of symptoms.

To prevent the graft slippage, some surgeons use the anchoring/wrapping of graft around the artery using stitch or glue, which again does not ensure its non-migration.[10,11,17] Our technique of using a ring-shaped graft has the advantage of lesser chance of slippage and the single graft protecting the nerve circumferentially. This also takes care of compressions due to multiple vessels (the nutcracker contact or multiple contact). While utilizing a teflon patch graft, a delayed recurrence may occur due to compression by a new vessel at a different surface of the neve. However, the ring graft may also prevent this late recurrence by preventing contact of the REZ with the new vessel (vein or artery) due to the circumferential cover provided to the nerve surface. Due to these advantages of our technique, there was no recurrence of symptoms seen in any of the reported cases.

There are a few limitations of our study. There were only 10 cases recruited in the study. There are a few reports of the formation of a teflon granuloma that causes a recurrence of symptoms.[18-22] In our ring graft technique also, the teflon ring graft is placed around the nerve. It might cause granuloma formation or compression of the nerve. Further long-term follow-up studies with large numbers of patients are needed to predict its success or failure.

Conclusion

MVD using a ring teflon graft is an alternate and safe method for the management of various types of neuralgia. A large-scale study is needed to statistically confirm its efficacy over the regular teflon patch graft for MVD.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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