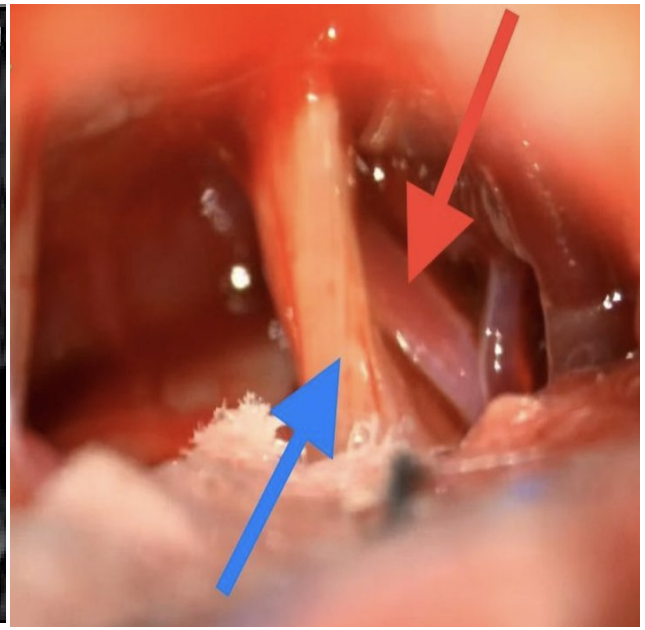
TITLE : :“Detection of neurovascular conflict in trigeminal neuralgia by fusion of 3D FIESTA and MRA”.



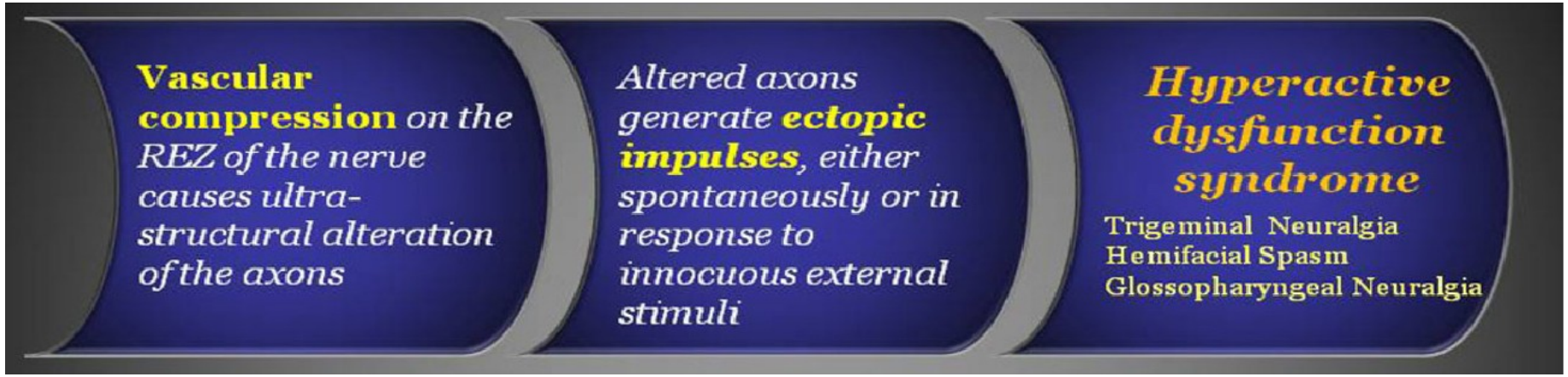
Dr. RAMYA

Asst.Professor

ABS244

Trigeminal neuralgia : recurrent unilateral electric shock-like pain, abrupt in onset and termination, limited to the distribution of one or more divisions of the trigeminal nerve. TN affects elderly adults.

The neurovascular conflict theory:



PURPOSE OF THE STUDY:

.Evaluate the efficacy of fused 3D-FIESTA (fast imaging employing steady-state acquisition) and 3D-TOF-MRA (MR angiography) sequences for detecting neurovascular compression (NVC) in patients presenting with trigeminal neuralgia (TN).

-allowing radiologists and neurosurgeons to use the post-processed, reconstructed 3D image

-to observe anatomical details more clearly from different angles, depict the complex anatomical relationships between neural and vascular structures.

- provide information about severity of the neurovascular conflict.

- **3D FIESTA:**
- Very high resolution T2W MRI.
- Excellent contrast between CSF, trigeminal nerve and adjacent blood vessels; however, it is difficult to distinguish between arteries and veins.
- **3D TOF MRA:**
- Selectively demonstrates fast-flowing blood.
- visualization of arteries.
- veins are insufficiently visualized.
- **Fusion imaging is a relatively novel technique, uses combination of two high-resolution 3D MRI techniques i.e., 3D FIESTA with 3D TOF MRA**
- **provides an excellent contrast between structures in complex posterior fossa**
- **accurately visualize the fine anatomical structures at the REZ of the trigeminal nerve and detect neurovascular conflict (NVC).**

Material and methods

Patients and study protocol:
- Prospective observational study.
- 50 patients, with clinical suspicion of classic trigeminal neuralgia .

Exclusion criteria:
Patients with
- implanted devices (pacemakers, cochlear implants, aneurysmal clips, metallic prostheses)
- Cerebello pontine (CP) angle tumors
- Meningitis

IMAGE ACQUISITION:

GE SIGNA EXPLORER 1.5 (1.5T MRI) scanner.

-3D FIESTA and 3D TOF MRA sequences.

-centered on the pons, axial T1, T2, FLAIR and GRE sequences

	3D FIESTA	3D TOF MRA
TE	2.1 ms	2.3 ms
TR	5.5 ms	38 ms
Flip Angle	60	20
Matrix	360 x 360	320 x 224
FOV	18 mm	22
Slice thickness	0.6 mm	0.8 mm
Acquisition time	4 min 10 sec	4 min 22 sec

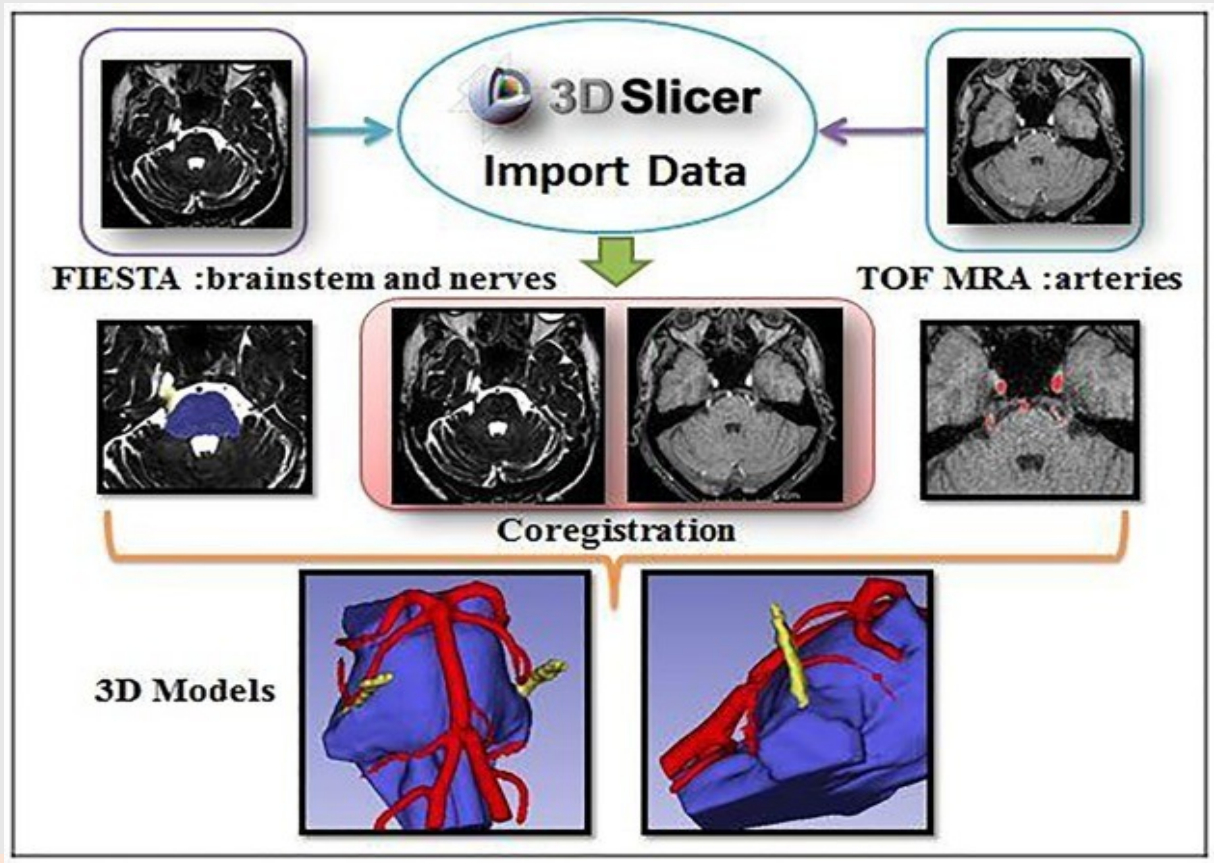


IMAGE ANALYSIS:

- Workstation with GE Ready view software version 4.7 for post-processing and analysis.
- 3D FIESTA + 3D TOF MRA single 3D volume rendering (VR) module.
- **Arteries- Red color**
- **Veins- Black (not given color)**
- **Trigeminal nerve- iso intense relative to the brain stem.**
- We can objectively distinguish and identify the type of blood vessels (arteries or veins) from trigeminal nerve.

Material and methods:

Data analysis

NVC of the trigeminal nerve was evaluated in TN patients on the side of the pain, as well as on the contralateral side.

: PRESENCE/ ABSENCE OF NVC,

: TYPE OF VESSELS INVOLVED ,

: LOCATION OF COMPRESSION ALONG THE NERVE ,

: SITE OF COMPRESSION AROUND THE CIRCUMFERENCE OF THE NERVE,

: SEVERITY AND GRADING OF COMPRESSION

15 PATIENTS RECEIVED SURGICAL TREATMENT.

Patients with grade I compression received medical treatment.

Patients with grade II and III NVC had MVD surgery.

Statistical analysis:

All the statistical analyses were performed using SPSS Statistics software version 23.

X^2 (Chi- square) statistical method:

- NVC grade comparison between symptomatic and asymptomatic sides.

- $p < 0.05$ was regarded as statistically significant for all statistical tests.

→Cohen's kappa(K):

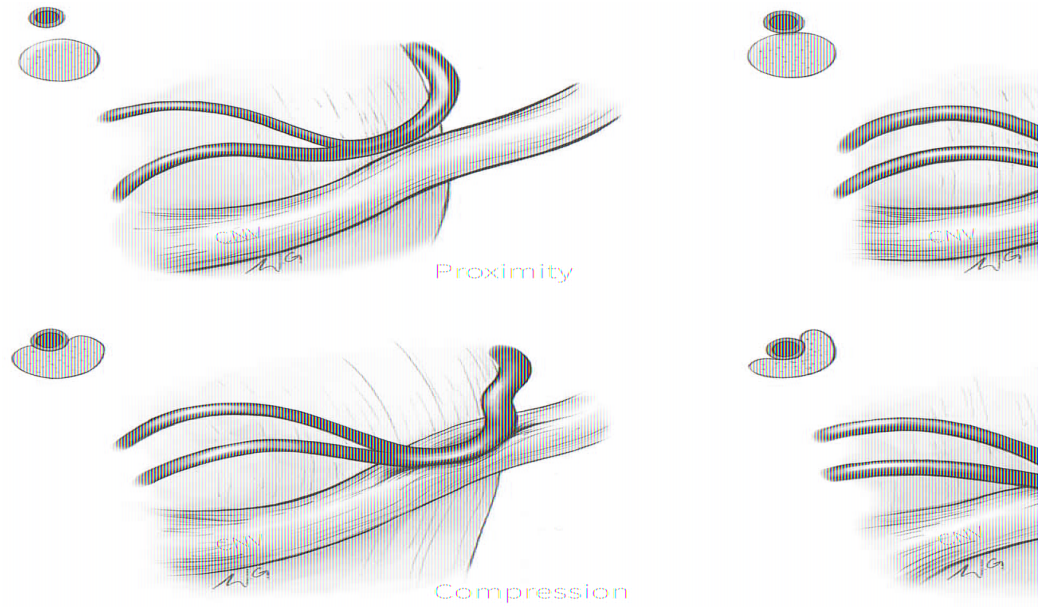
- Concordance of NVC assessed by MRI and surgery was assessed by

- K>>0.8 indicates a perfect diagnostic approach

0.6<< K <<0.8 is defined as good .

MR can support the clinical diagnosis of neurovascular conflict when the following signs are present:

- The conflict is at the root entry zone.
- The vessel crosses the nerve in a perpendicular way.
- The vessel is an artery (most of the times).
- The vessel displaces the nerve, causing bending, deformation, angulation and thinning of the nerve.



Neurovascular conflict (NVC) can be classified into three grades on MRI:

- Grade I indicates simple contact between nerve and vessel;

- Grade II describes an artery displacing and/or distorting the nerve root

- Grade III is when an artery indents the nerve root, thus causing thinning of the nerve root

- **IMPORTANCE OF GRADING OF NVC:**
- Initial management of TN cases is mainly pharmacologic treatment.
- Grade I NVC and sometimes grade II NVC can be relieved by medical management alone.
- Microvascular decompression will be pain relieving surgery in reversal of TN refractory to medical management in grade III NVC.
- In most patients with classic TN, surgical decompression of the CN V root produces immediate intra operative improvement in nerve conduction and rapid symptom relief.

Results and discussion:

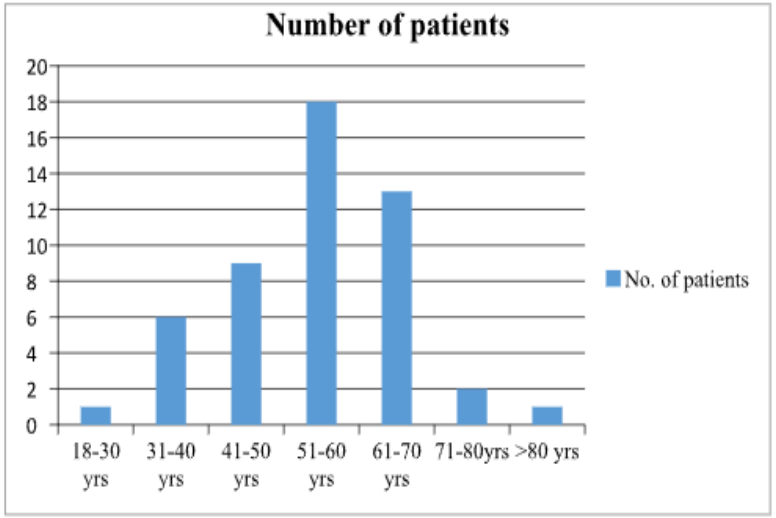
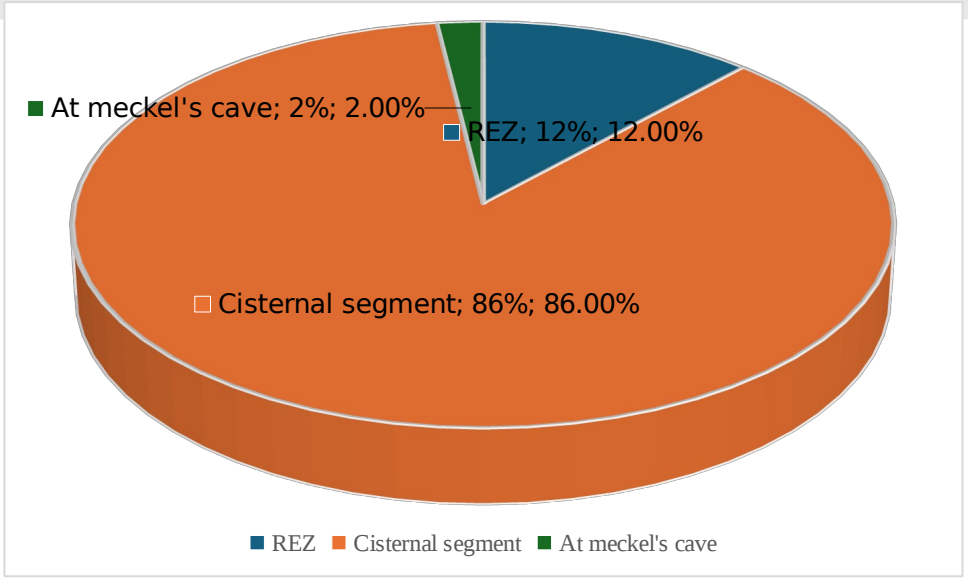
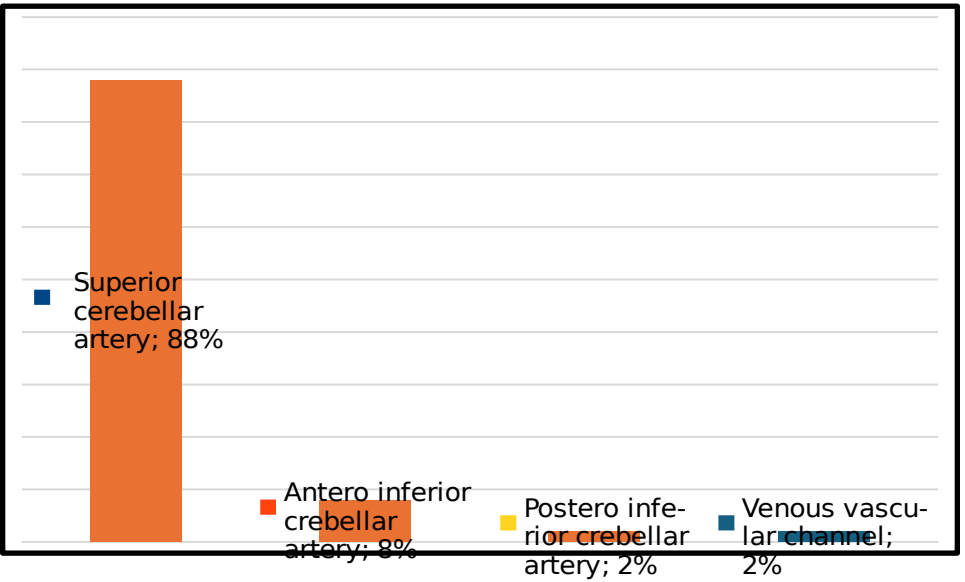


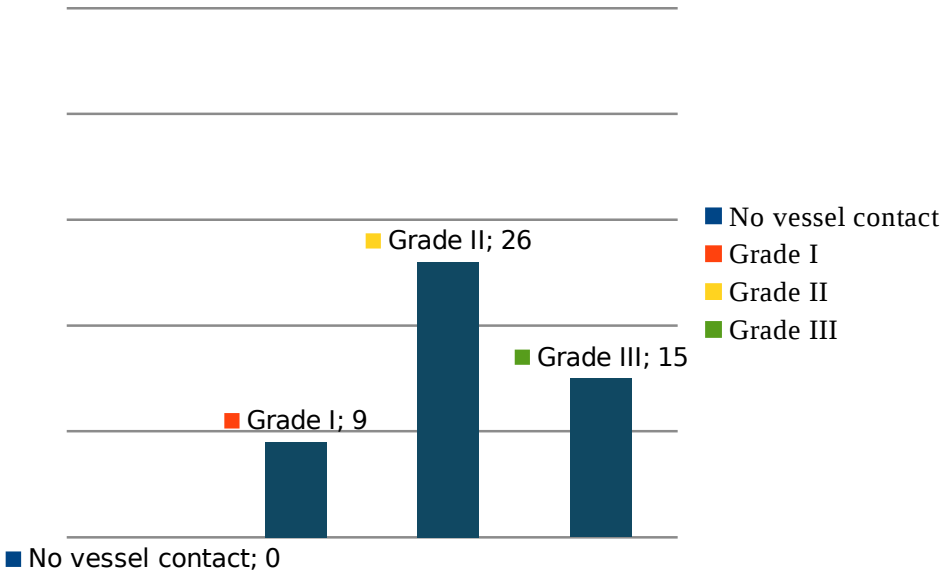
Fig.12: Bar diagram showing age distribution of trigeminal neuralgia.

Right side- 42%

Left side- 58%







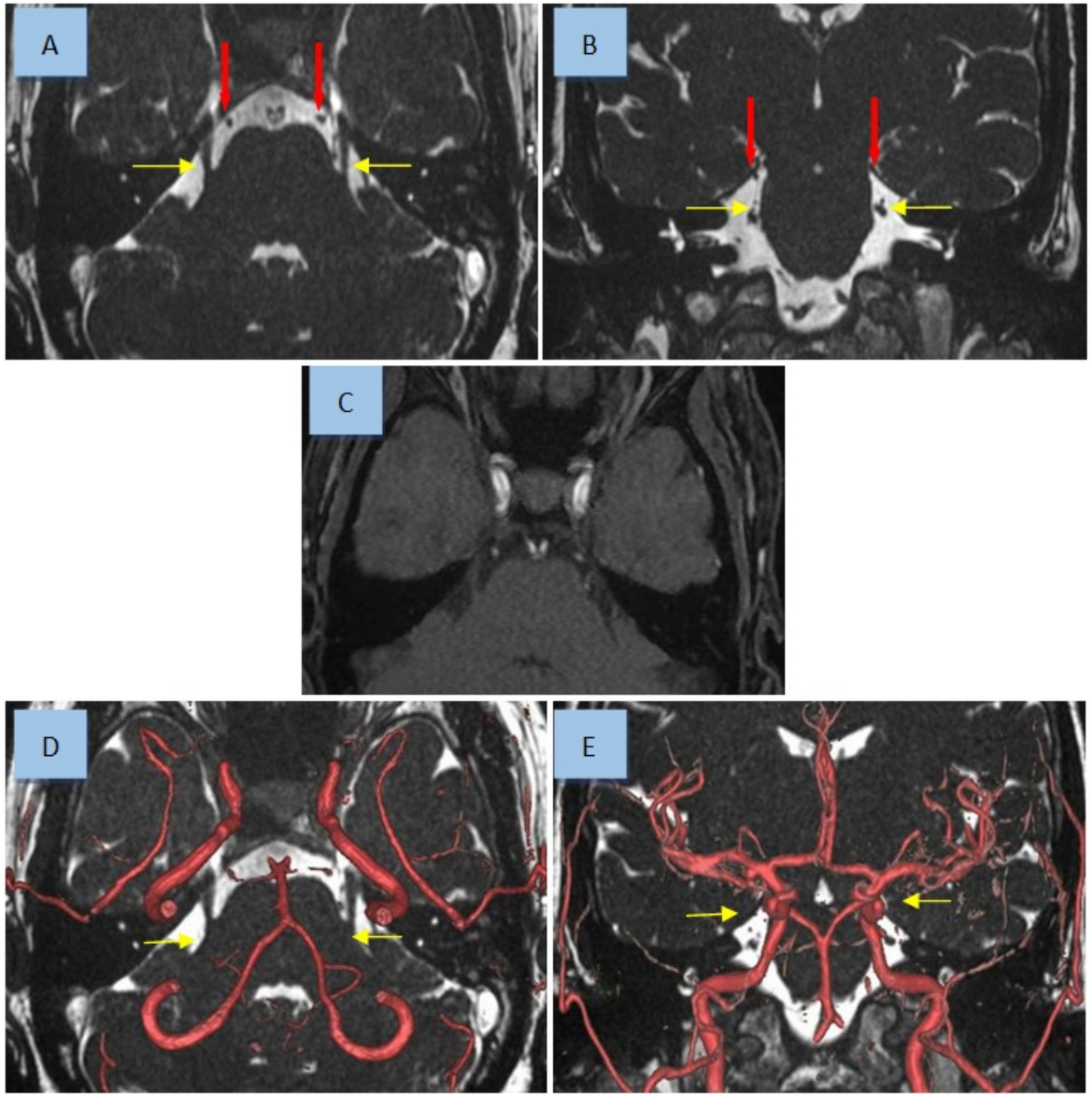
Surgical Findings and Its Correlation with MRI:

- Significant association noted between TN and the presence of an artery compressing on the trigeminal nerve, compared to the contralateral side of the pain
(X^2, $p < 0.01$).

-SCA was the predominant vessel.

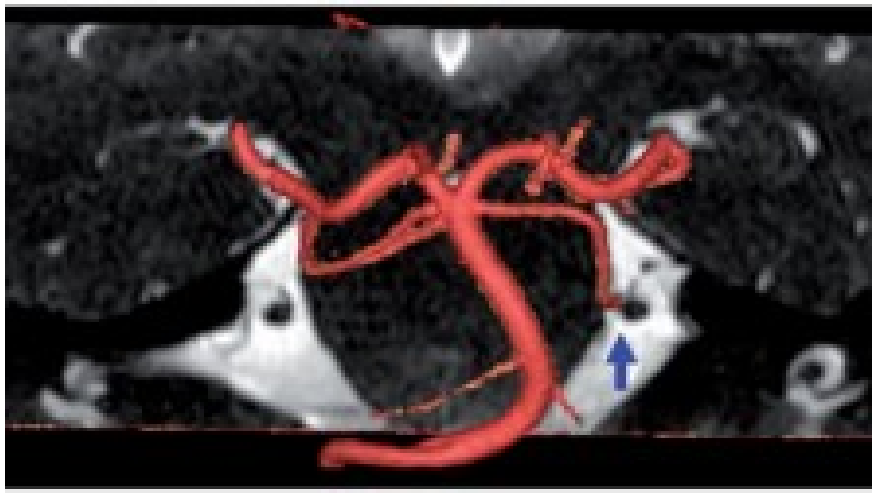
- At surgery, two patients were found to have unknown venules compressing trigeminal nerve, which were undetectable on MRI.

- The sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of MRI to detect NVC were 95.8%, 100%, 100% and 25%, respectively.

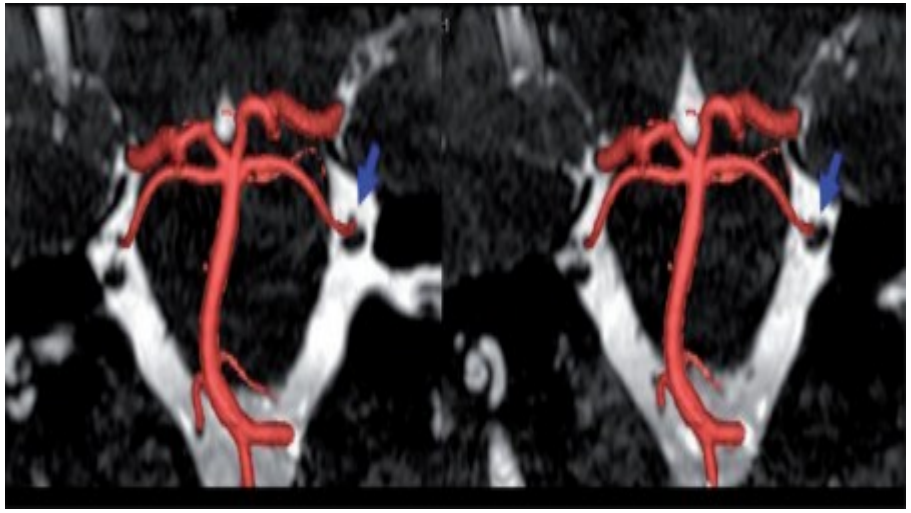


- Normal neuro vascular relationship of trigeminal nerves.

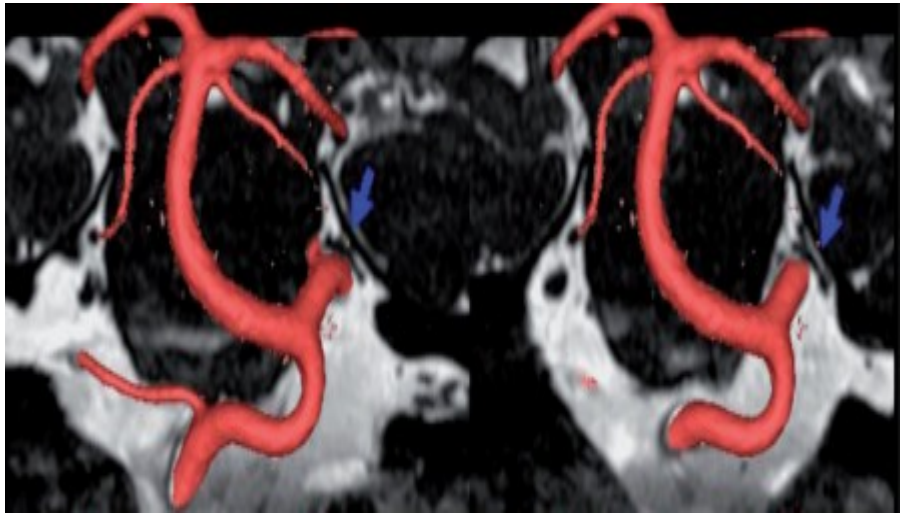
Illustrative cases:



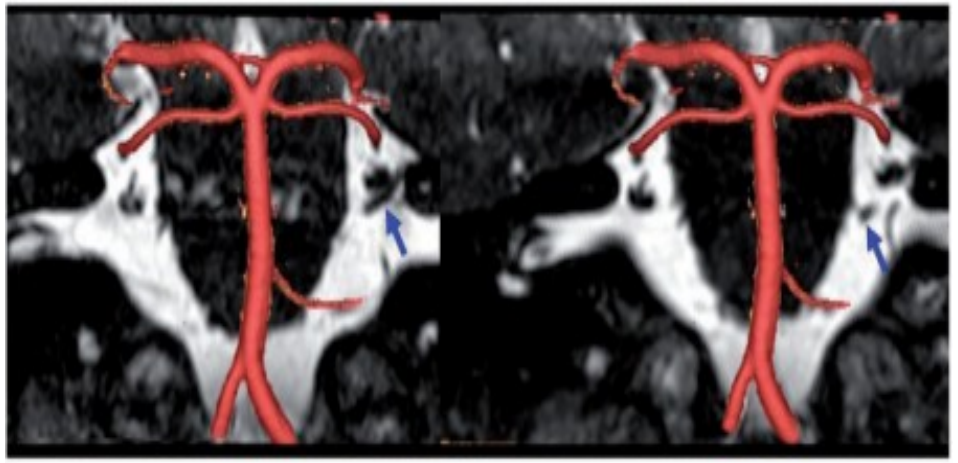
Grade I NVC by SCA



Grade III NVC:
Duplication of the left SCA seen, indents on superior and internal surface of the left trigeminal nerve



Grade II NVC by Vertebral artery



Vein contacting with trigeminal nerve

Observations:

- Combination of MRA and FIESTA images provides good visualization of the anatomic course and neuro vascular relationship of the trigeminal nerve than individual modalities.
- Arterial compression is more associated with clinical symptoms.
- Compression of a symptomatic nerve is more likely to be associated with arterial than venous compression.
- Nerves with severe compression are more likely to be symptomatic.
- The distribution of facial pain is associated with the site of NVC on the trigeminal nerve.
- The NVC grade of the symptomatic side was significantly higher than that of asymptomatic side ($p < 0.001$).
- Higher NVC grade increases the probability of morphological changes of nerves.

- **Advantages of fusion imaging:**
- The detection of NVC could be seen on both FIESTA and MRA, but precise detection and characterization of NVC is better seen on fusion imaging.
- Fusion imaging can differentiate the causative vessel of NVC as an artery or a vein. FIESTA cannot differentiate between arteries from veins.
- The grading of NVC can be better appreciated on fusion imaging, which is surgically important in planning the procedure and prognosis.
- No addition cost is implemented upon the patient, as no additional sequences are obtained.

REFERENCES:

1. Anderson VC, Berryhill PC, Sandquist MA, Ciaverella DP, Nesbit GM, Burchiel KJ. High-resolution three-dimensional magnetic resonance angiography and three-dimensional spoiled gradient-recalled imaging in the evaluation of neurovascular compression in patients with trigeminal neuralgia: A double-blind pilot study. Neurosurgery. 2006;58(4):666–671.

2. Miller JP, Acar F, Hamilton BE, Burchiel KJ. Radiographic evaluation of trigeminal neurovascular compression in patients with and without trigeminal neuralgia. J Neurosurg. 2009 Apr 1;110(4):627–632.

3. Haines SJ, Jannetta PJ, Zorub DS. Microvascular relations of the trigeminalnerve. J Neurosurg. 1980 Mar 1;52(3):381–386.

4. Hamlyn PJ, King TT. Neurovascular compression in trigeminal neuralgia: aclinical and anatomical study. J Neurosurg. 1992 Jun 1;76(6):948–954.

5. Rovit RL, Murali R, Jannetta PJ E. Microvascular decompression of thetrigeminal nerve root entry zone. Theoretical considerations, operative anatomy, surgical technique and results. In: Trigeminal Neuralgia Baltimore, MD: Williams and Williams. 1990. p. 201-222.

6. Yousry I, Moriggl B, Holtmannspoetter M, Schmid UD, Naidich TP, YousryTA. Detailed anatomy of the motor and sensory roots of the trigeminal nerve and their neurovascular relationships: a magnetic resonance imaging study. J Neurosurg. 2004 Sep 1;101(3):427–434.

7. Meaney JFM, Eldridge PR, Dunn LT, Nixon TE, Whitehouse GH, Miles JB. Demonstration of neurovascular compression in trigeminal neuralgia with magnetic resonance imaging. Comparison with surgical findings in consecutive operative cases. J Neurosurg. 1995 Nov;83(5):799–805.

8. Sindou M, Leston J, Decullier E, Chapuis F. Microvascular decompression for primary trigeminal neuralgia: long-term effectiveness and prognostic factors I a series of 362 consecutive patients with clear-cut neurovascular conflicts wh underwent pure decompression. J Neurosurg. 2007 Dec;107(6):1144–1153.

9. Burchiel KJ, Clarke H, Haglund M, Loeser JD. Long-term efficacy o microvascular decompression in trigeminal neuralgia. J Neurosurg. 198 Jul;69(1):35–38.

10. Awaji M, Okamoto K, Nishiyama K. Magnetic resonance cisternography fo preoperative evaluation of arachnoid cysts. Neuroradiology 2007;49(9):721–726.

Thank you