Long-Term Effects of Conventional Radiofrequency in Cases of Trigeminal Neuralgia

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Abstract

Aim: This study aimed to examine the long-term clinical and functional results of patients who underwent radiofrequency thermocoagulation (RFT) for trigeminal neuralgia (TN)

Methods: A retrospective case-control study was designed. Patients with radiofrequency thermocoagulation (RFT) for trigeminal neuralgia (TN) surgery were included. Clinical and functional outcomes of patients were examined by a visual analog scale (VAS) before the RFT and after the 15th day, 6th months 1 year,2 years and 4 years.

Results: 27 of the patients were female, and 6 were male in the study. In 90% of patients with primary trigeminal neuralgia, symptoms appear after the age of 40, with the most common age range being 40-70 years. In our series,27 patients had mandibular nerve involvement, and 6 had maxillary nerve involvement. The high pain scores in the pre-treatment (Pre-op) period (ranging from 7 to 10) decreased significantly in the post-treatment periods (15th day, 6 months, 1 year, 2 years, 4 years). In the analysis conducted with the Wilcoxon test, a significant difference was found between pre-op and all post-treatment periods.

Conclusions: Conventional RF thermocoagulation is a preferred method in the treatment of TN and among other percutaneous interventional and surgical treatment options due to its selective lesion formation, minimally invasive nature, high success rate, low complication rate and low cost. Our study includes long-term data that can confirm this result.

Keywords: *Radiofrequency thermocoagulation, Trigeminal neuralgia*

1. Introduction

TN is defined as severe, episodic pain occurring in one or more branches of the trigeminal nerve.[1,2] Due to its long-term effect, radiofrequency thermocoagulation (RFT) is used as a first-line treatment.[3]

Although its etiology is not fully understood, studied causes include damage to trigeminal connections resulting from multiple sclerosis (MS) or lacunar infarction, demyelination of the "root entry zone" of the trigeminal nerve, and, more commonly considered among neurosurgeons, vascular compression. According to Devor et al.'s hypothesis published in 2002, myelin loss in nerve fibers creates a "short-circuit" effect between progressing light touch and pain fibers, leading to severe pain.[4]

The first choice in the treatment of classical trigeminal neuralgia patients is medical treatment. Anticonvulsants are the most commonly used medications, with carbamazepine still being the gold standard. Additionally, pregabalin and gabapentin are frequently used drugs.

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Surgical treatment is an option for Trigeminal Neuralgia that cannot be treated with medication, but there is no single method for this. Various surgical methods, such as Trigeminal Radiofrequency (RF) rhizotomy, microvascular decompression (MVD), glycerol rhizolysis, trigeminal ganglion balloon compression, and radiation-surgery, may be effective in treatment, each with its own advantages and disadvantages. Among these methods, neither RF nor MVD has been proven superior to the other.[5]

Due to its long-term effect, low side effects, and short hospitalization period, radiofrequency thermocoagulation (RFT) is preferred as the first choice among interventional treatment options.[3]

RF rhizotomy to the Gasserian ganglion involves percutaneous lesioning using a special RF needle and electrode system through the foramen ovale to the retrogasserian fibers with RF energy. This method was described by Harris and Hartel at the beginning of the century and was used by Harris in large series for alcohol injections. The first use of RF energy in the Gasserian ganglion with direct current in a large series was carried out by Kirschner. Rhizotomy with RF energy (controlled thermocoagulation) was first described by Sweet.[6]

The series forming the basis of today's treatment protocols is the 353-patient series by Sweet et al., with no mortality or morbidity.[7] Controlled thermocoagulation was applied in this series, as in Schürman et al.'s series. Surgeons entering the foramen ovale with

the aid of radiographs learned where the pain was felt using electrical stimulations. They measured the temperature with the thermometer at the electrode tip and confirmed it by cooperating with the patient at the end of the procedure. The 6-year follow-up of this 353-patient series resulted in a 22% recurrence rate, 0% mortality and morbidity, and complete paresthesia in only 6 patients.

The authors concluded that the highly myelinated A-beta fibers are more resistant to heat, therefore preserving some touch sensation. By 1997, this method had been perfected with technological advancements and existing experiences, aiming to cause the least pain during the awake procedure by shifting all ablation to the retrogasserian region.[8]. During the awake procedure, cooperating with the patient, the distribution of facial sensory loss was controlled, thereby minimizing the incidence of undesirable and bothersome dysesthesias, such as corneal sensory loss.[9]

This study aimed to examine the long-term clinical and functional results of patients who underwent radiofrequency thermocoagulation (RFT) for trigeminal neuralgia (TN)

2. Materials And Methods

The ethics committee approval was obtained on June 26, 2024, with decision number 59 from Adana City Hospital. We examined 33 patients who underwent conventional RF with a diagnosis of trigeminal neuralgia at the Algology Clinic of Adana Numune Training and Research Hospital between May 2016 and December 2017. The 6-year follow-up results are presented in figure 1.

Inclusion Criteria:

- *Primary trigeminal neuralgia*
- *Ineffectiveness of medication treatment*
- *Pain visual analog scale (VAS) score above 7/10*
- *Absence of accompanying secondary disorders that could explain the symptoms*
- *Normal brain magnetic resonance imaging findings*
- *No previous interventional treatment*

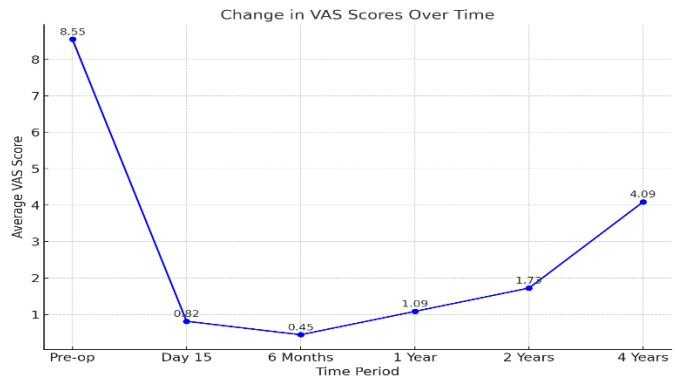
2.1. Procedure Technique

The procedure is performed under operating room conditions and radiological imaging guidance. The patient is placed in the supine position, an IV line is established, and monitoring is initiated. After local field cleaning and sterile draping, optimal imaging is achieved using C-arm fluoroscopy with an ipsilateral 15° oblique and 30° caudal angle. A 22-gauge, 100 mm RF needle with a 5 mm active tip is directed towards the foramen ovale, and the tunnel view is checked. Once the needle enters the foramen, the C-arm is positioned laterally, and the depth is checked. Sensory and motor responses are tested after appropriate positioning relative to the Gasserian ganglion.

Sensory stimulation is performed with a frequency of 50 Hz, a duration of 1 ms, and stimulation varying between 0.2 and 1 V, while motor stimulation is performed with a frequency of 2 Hz, a duration of 1 ms, and stimulation varying between 0.5 and 1.5 V. Cooperation with the patient is crucial. The patient is expected to feel sensations such as tickling, itching, and electrical sensations along the trigeminal tract corresponding to the pain. Additionally, the masseter function and ciliary reflex may be observed. Ablation is applied at 65°C, 70°C, 75°C, and 80°C for 1 minute each, for a total of 4 minutes. Due to severe pain during the ablation process, 1 mg/kg propofol and 50 micrograms of fentanyl are administered just before the procedure. Patients are discharged within an average of 3 hours after the procedure, once the sedation effect wears off. Patients were evaluated on the 15th day, 6th month, and 1, 2, 4, and 6 years after the procedure.

Figure 1

Change in VAS Score Over Time



3. Results

Pain scores in the pre-treatment (Pre-op) period (ranging from 7 to 10) decreased significantly in the post-treatment periods (15th day, 6 months, 1 year, 2 years, 4 years). In the analysis conducted with the Wilcoxon test, a significant difference was found between pre-op and all post-treatment periods.

P-values (0.00097, 0.0048) indicate that post-treatment VAS scores have significantly decreased compared to the pre-treatment period. This suggests that conventional radiofrequency (RF) treatment applied to patients with trigeminal neuralgia is effective both in the short and long term.

It is particularly noteworthy that pain levels were almost close to zero within the first year (15th day, 6 months, 1 year). This demonstrates that the treatment is highly successful in the short term. However, the recurrence of pain scores in some patients during the 2nd and 4th years (e.g., a p-value of 0.0048 for the 4th year) suggests that the long-term effect of the treatment is not the same for every patient. This implies that pain management and the treatment process should be tailored to individual patient needs.

In the expanded dataset, no significant differences were found between medical treatment types (carbamazepine, pregabalin, gabapentin). All three treatments provided similar reductions in VAS scores. This indicates that the effectiveness of medical treatments is comparable, and they assist in pain management when combined with RF treatment

4. Discussion

In our study, the minimum age was 41 and the maximum age was 68. Additionally, 27 of the patients were female, and 6 were male. In 90% of patients with primary trigeminal neuralgia, symptoms appear after the age of 40, with the most common age range being 40-70 years. It is more prevalent in women than in men, with a female-to-male ratio of 1.5:1. The patient series we examined in our study was consistent with both the age of onset and the female-to-male ratio of TN. Additionally, all patients met the clinical diagnostic criteria for primary TN.[7] Secondary causes of TN were ruled out in our patients through brain magnetic resonance imaging (MRI) and neurological examination.

In our series,27 patients had mandibular nerve involvement, and 6 had maxillary nerve involvement. The first treatment option for primary TN is medication. The initial approach always consists of medication.[1] Carbamazepine, oxcarbazepine, amitriptyline, gabapentin, and pregabalin are the most commonly used drugs. In

our series, 18 patients were using carbamazepine, 12 were using pregabalin, and 3 was using gabapentin. Medication treatment was discontinued in all patients after the procedure. As shown in figure 1, the VAS score decreased to 0 in 18 patients on the 15th day, to 2 in 12 patients, and to 1 in 3 patients. The VAS score exceeded 5 in 3 patients in the 2nd year and in 15 patients in the 4th year, and conventional RFT was repeated for these patients. Pregabalin 75 mg was started for all patients between the recurrence of pain and the interventional procedure, and it was discontinued once the pain decreased after the procedure. No side effects were observed in the patients.

Due to the higher morbidity-mortality, complication rates, and longer hospitalization period in microvascular decompression surgery, conventional radiofrequency is considered the first choice among percutaneous interventional treatment options.[8] In conventional RF, sufficient cooperation with the patient and the repeatability of the procedure reduce the complication rate and increase the success rate compared to other percutaneous interventional methods. The 25-year follow-up of 1600 patients by Kanpolat and colleagues demonstrated that when applied by an experienced clinician adhering to application rules, complication rates were very low, and procedure success was very high.[9] Therefore, success should be increased throughout the procedure by cooperating both radiographically and with the patient. No complications were observed in our series.

The findings of this study present a significant innovation when compared to previous studies in the literature.[10-14] In particular, the statistically significant decrease in preoperative pain in postoperative evaluations is consistent with the studies in the literature. This result provides a new perspective to the trigeminal neuralgia literature and provides important clues on how the findings can be used in a larger patient population or in clinical practice. However, some limitations should be taken into account in order to objectify the findings of this study and reach broader conclusions. Since the study sample was limited to a single clinic, the results have some limitations in terms of generalizability. In addition, since the methodology used is an observational design, more caution should be exercised in terms of causal relationships. Future studies should confirm these findings with larger and more diversified samples and using different methodological approaches and fill the gaps in the current literature.

5. Conclusion

This study demonstrated the efficacy of conventional radiofrequency thermocoagulation in the treatment of classic trigeminal neuralgia. The high pretreatment pain scores decreased significantly after treatment, and the short-term results were promising. However, long-term pain recurrence was observed in some patients, emphasizing the importance of individual treatment planning. It was concluded that RF thermocoagulation should be considered as the first choice compared to microsurgery, with its low complication rates and short hospital stay. The limited sample size and single-center nature of our study may affect the generalizability of the findings; therefore, future studies with larger and more diverse sample groups will reinforce the validity of these results.

Statement of ethics

Ethical permission was obtained from the Adana City Training and Research Hospital Clinical / Human Research Ethics Committee for this study date on May 26, 2024, and decision number 59 and Helsinki Declaration rules were followed to conduct this study.

Source of Finance

The authors declare that they have received no financial support for this study

Conflict of interest statement

The authors declare that they have no conflict of interest.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

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