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Effectiveness of Differentiated Treatment Strategies and Quality-of-Life Assessment in Patients with Trigeminal Neuralgia

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Abstract

Background and objective. Trigeminal neuralgia (TN) is a severe paroxysmal facial pain disorder for which treatment must be individualized. This study aimed to improve treatment outcomes in patients with TN through a differentiated approach that accounts for disease severity, somatic status and quality of life (QoL).

Methods. A 【**retrospective / prospective — specify**】 observational study of 171 patients with TN treated in the inpatient neurosurgery department of the multidisciplinary clinic of the Tashkent Medical Academy (2019–2023). Patients were allocated to three groups by treatment modality, disease severity and somatic status: conservative treatment plus peripheral trigeminal branch blocks (Group 1, n = 55); Gasserian ganglion blocks plus trigeminal branch exeresis (Group 2, n = 57); and microvascular decompression (MVD; Group 3, n = 59). Diagnosis was based on clinical criteria, high-resolution magnetic resonance imaging (MRI) and electroneuromyography (ENMG). Pain and QoL were assessed before and after treatment using institutional questionnaires.

Results. Positive outcomes were achieved in 163 of 171 patients (95.0%). The best results were obtained in Group 3 (MVD), where 87% of patients achieved significant improvement and none showed no change. Pain and QoL scores improved significantly in all groups after treatment ($P < 0.001$), most markedly after MVD.

Conclusion. A differentiated, severity- and comorbidity-based treatment strategy yields high rates of pain relief and QoL improvement in TN. MVD provides the most durable outcomes in surgically fit patients, while destructive and conservative approaches remain valuable for patients with contraindications to MVD.

Keywords: trigeminal neuralgia; microvascular decompression; differentiated approach; disease severity; quality of life; facial pain

Introduction

Trigeminal neuralgia (TN) is a relatively common condition, affecting an estimated 30 to 50 patients per 100,000 population in most countries. According to the World Health Organization (WHO), the incidence ranges from approximately 3 to 5 cases per 100,000 inhabitants per year, rising after the sixth decade of life. The precise prevalence and incidence are difficult to establish, because patients frequently consult different specialists depending on their place of residence and are not always correctly identified [1,2,3].

The International Classification of Headache Disorders, third edition (ICHD-3), distinguishes classical TN (associated with neurovascular compression producing morphological change in the trigeminal root), secondary TN (due to an identifiable underlying disorder such as a tumour or multiple sclerosis) and idiopathic TN (in which no cause is found). Classical TN accounts for the majority of cases and is the principal focus of surgical management [4,5].

When conservative pharmacological treatment of TN proves insufficiently effective, alternative approaches — including surgical intervention — must be considered [6,7]. Surgical methods can be divided into destructive procedures (percutaneous radiofrequency thermocoagulation, alcohol neurolysis, nerve blocks, balloon compression, trigeminal rhizotomy and stereotactic radiosurgery) and palliative procedures (deep brain stimulation and motor cortex stimulation) [8,9]. Although destructive methods may be minimally invasive, they act by damaging the trigeminal nerve root, which almost invariably produces sensory disturbance on the patient's face [9,10].

Microvascular decompression (MVD) of the trigeminal nerve root is a reconstructive, pathogenetically targeted procedure and is regarded as the treatment of choice when appropriate indications are present. The principal contraindication to MVD is severe somatic pathology that precludes general anaesthesia [8,11,12]. In such patients — for example, those with significant somatic comorbidity — destructive surgical methods become necessary, and the neurosurgeon must select the approach best suited to the individual [8].

Quality of life (QoL), grounded in the patient's subjective experience, has become an important criterion for evaluating treatment efficacy in clinical studies, reflecting the profound impact of TN on daily functioning and mental health [13,14,15].

Objective. To improve treatment outcomes in patients with trigeminal neuralgia through a differentiated approach that accounts for disease severity and quality-of-life assessment.

Materials and Methods

Study design and setting

This was a **【retrospective / prospective — specify】**, single-centre observational study of 171 patients with trigeminal neuralgia treated in the inpatient neurosurgery department of the multidisciplinary clinic of the Tashkent Medical Academy between 2019 and 2023.

Ethical approval

The study was approved by the **【full official name of the Ethics Committee / Institutional Review Board】** (approval No. **【approval number】**, dated **【DD.MM.YYYY】**). The study was conducted in accordance with the principles of the Declaration of Helsinki.

Informed consent

Written informed consent was obtained from all participants prior to inclusion. **【If the study was retrospective and based on archived records, replace with the exact wording used, e.g. "The Ethics Committee waived the requirement for informed consent for the retrospective analysis of anonymised clinical data."】**

Inclusion and exclusion criteria

Inclusion criteria. Adult patients (**【confirm minimum age, e.g. ≥ 18 years】**) with a clinical diagnosis of trigeminal neuralgia meeting the following criteria: unilateral paroxysmal facial pain; presence of a trigger zone; tenderness at Valleix points; pain provoked by eating and speaking; and a positive response to carbamazepine (finlepsin) in the early stages of the disease; treated in the department during 2019–2023.

Exclusion criteria. 【Please confirm/complete the exclusion criteria actually applied. Typical examples: secondary trigeminal neuralgia due to a confirmed intracranial tumour or demyelinating disease; incomplete clinical records; active infection or coagulopathy precluding surgery; refusal of the proposed treatment; loss to follow-up.】

Patient selection and group allocation

All patients were allocated to one of three groups on the basis of treatment modality, disease severity and somatic status. Surgically fit patients with a demonstrated neurovascular conflict were directed towards microvascular decompression, whereas patients with significant somatic comorbidity or contraindications to general anaesthesia were treated with destructive procedures or conservative therapy. Group 1 comprised 55 patients (32.2%) who received conservative treatment and peripheral trigeminal nerve branch blocks; Group 2 comprised 57 patients (33.3%) who underwent Gasserian ganglion blocks and trigeminal branch exeresis; and Group 3 comprised 59 patients (34.5%) who underwent microvascular decompression of the trigeminal nerve root (Table 1).

Table 1. Distribution of study patients by group (n = 171)

Group	Abs.	%
Group 1	**55**	**32.2**
Group 2	**57**	**33.3**
Group 3	**59**	**34.5**
Total	**171**	**100**

Diagnostic evaluation

All patients underwent comprehensive clinical, neurological and instrumental evaluation. At initial examination the key diagnostic criteria for TN were assessed: unilateral paroxysmal facial pain; presence of a trigger zone; tenderness at Valleix points; pain exacerbation during eating and speaking; and a positive response to carbamazepine (finlepsin) in the early stages. Additional features evaluated included hypertonia of the masticatory muscles, autonomic disturbances and hypoesthesia in the innervation zones of individual branches or the entire ipsilateral half of the face. TN was characterized by brief paroxysms lasting 2–15 minutes and recurring up to 30 times per day [10,16].

High-resolution MRI, performed at 1.5–3.0 Tesla using heavily T2-weighted sequences (3D-FIESTA, DRIVE or CISS), time-of-flight MR angiography (3D-TOF) and contrast-enhanced T1-weighted imaging, played a key role in identifying neurovascular conflict and excluding secondary causes. These sequences are now regarded as standard for the evaluation of TN [4,17,18]. Electroneuromyography (ENMG) was used to determine the level of nerve involvement (central or peripheral irritation type) with approximately 75% accuracy, informing the choice of surgical or conservative strategy.

Outcome assessment

Pain and quality of life were assessed before and after treatment using two questionnaires developed by the Republican Specialized Scientific and Practical Medical Center of Neurosurgery: the "Quality of Life Assessment in Trigeminal Neuralgia" questionnaire and the "Pain Syndrome Assessment in Trigeminal Neuralgia" questionnaire. The Pain Syndrome questionnaire scoring key defined mild TN as ≤ 10 points, moderate TN as 11–21 points and severe TN as 22–32 points; the QoL questionnaire scoring key defined minor impairment as ≤ 10 points, moderate impairment as 11–21 points and significant impairment as 22–33 points. These are institution-developed instruments; their psychometric validation is addressed in the Study Limitations section [20,21].

Statistical analysis

Quantitative data are presented as the mean ± standard error of the mean (M ± m). Comparisons of pain and QoL scores before and after treatment within each group were performed using 【**specify the exact test used, e.g. paired Student's t-test / Wilcoxon signed-rank test**】; comparisons between groups were performed using 【**specify, e.g. one-way ANOVA / Kruskal–Wallis test**】. Differences were considered statistically significant at $P < 0.05$. Statistical analysis was performed using

【specify software and version, e.g. SPSS Statistics v.26 / Microsoft Excel】.

Results

A total of 171 patients with trigeminal neuralgia were studied. Patients were classified by age according to WHO criteria (young age 14–19 years; younger middle age 20–44 years; older middle age 45–59 years; elderly 60–74 years; senile 75–89 years) and ranged from 24 to 79 years of age. Women predominated — 103 (60.2%) versus 68 men (39.8%) — a ratio of approximately 1.5:1. The majority of patients, 71 (41.5%), were in the older middle-age and elderly categories, and the peak number of cases fell in the 60–74-year age group: 52 patients (30.4%).

Somatic examination revealed that 69 of the 171 patients (40.5%) had comorbid conditions: arterial hypertension in 53 (31.0%), coronary artery disease in 13 (7.8%), diabetes mellitus in 19 (11.2%), hepatic pathology in 4 (2.6%) and renal insufficiency in 1 (0.9%).

Analysis of pain-triggering factors showed that chewing and speaking were the most frequent triggers, occurring in more than 93% of cases. Touch was the second most common trigger (up to 8%), while cold, tooth-brushing, washing, shaving and mouth opening each accounted for less than 5% of cases.

Among all 171 patients, trigger zones were identified in 33 cases (19.3%). The nasolabial triangle was the most common trigger location (48.5%), followed by the mental region (24.3%) and the frontozygomatic area (9.1%); the oral cavity, cheek, parotid region, Valleix points and the cervical region at the level of the C3–C4 spinous processes each accounted for 3–6% of cases.

Sensory disturbances in the trigeminal innervation zones were present in 92 patients (54%): hypoesthesia in 52.2%, paraesthesia in 40.2%, hyperesthesia in 6.5%, and complete anaesthesia in one case resulting from prior surgical interventions. This case occurred in Group 3, where repeated exeresis procedures had led to complete loss of sensation and trophic changes in the facial mimetic muscles on the affected side. Autonomic disturbances were observed in 18 patients (10.5%) — hyperaemia in 50.1%, lacrimation in 33.3% and hypersalivation in 16.6% — and resolved following treatment.

Analysis by the location of affected branches showed right-sided neuralgia in 134 patients (78.4%), left-sided in 34 (19.8%) and bilateral in 3 (1.8%). The second (maxillary) branch was most commonly affected (33.3%), followed by combined second-and-third-branch involvement (4.6%). Simultaneous involvement of two branches was the most frequent pattern (50.9%); all three branches were affected in 31.9% and a single branch in 17.2%.

Positive outcomes were achieved in 163 of the 171 patients (95.0%), with no change in 8 (5.0%). The best results were observed in Group 3, where all patients showed improvement: 87% achieved significant improvement and 13% showed improvement, with no cases of no change. In Group 2, 25.5% had significant improvement and 66.7% showed improvement; in Group 1, significant improvement was recorded in 9.2% and improvement in 83.3%, with a no-change rate exceeding 7% in both Groups 1 and 2. MVD proved to be the most effective procedure overall.

Quality of life and pain syndrome were evaluated before and after treatment. The QoL questionnaire revealed similarly low baseline scores across all groups before treatment; following treatment, QoL scores improved in all groups, with the most pronounced gains in Group 3 (Table 2). The Pain Syndrome questionnaire showed high pre-treatment scores corresponding to severe pain in Group 1, which decreased to the moderate level after treatment in Groups 1 and 2 (Table 3).

Table 2. Quality-of-Life Assessment questionnaire scores before and after treatment (n = 171)

Group	Patients (abs.)	Before treatment	After treatment
1	**55**	**13.95 ± 0.32**	**10.70 ± 0.22**
2	**57**	**25.22 ± 0.30**	**17.90 ± 0.21**
3	**59**	**27.22 ± 0.20**	**15.22 ± 0.19**
Total	**171**	**22.23 ± 0.22**	**14.60 ± 0.20**

Note: differences before and after treatment are statistically significant ($P < 0.001$).

Table 3. Pain Syndrome Assessment questionnaire scores before and after treatment (n = 171)

Group	Patients (abs.)	Before treatment	After treatment
1	55	27.31 ± 0.33	15.22 ± 0.03
2	57	23.31 ± 0.20	13.19 ± 0.29
3	59	21.22 ± 0.20	11.22 ± 0.19
Total	171	22.23 ± 0.22	17.94 ± 0.20

Note: differences before and after treatment are statistically significant ($P < 0.001$).

A review of patient histories highlighted the diagnostic complexity of TN. Among 5 patients with first-branch neuralgia, 3 had previously been diagnosed with migraine and treated accordingly. Nearly all Group 2 patients had initially sought dental care for tooth pain, and most had undergone dental treatment, including tooth extraction, before the correct diagnosis was established; the progressive worsening of symptoms ultimately led to appropriate therapy.

Using the Pain Syndrome scoring key, preoperative assessment identified mild pain in 41 patients (24.4%), moderate pain in 121 (71.3%) and severe pain in 9 (5.2%). Postoperatively, complete pain resolution was recorded in 166 patients (97.3%) and mild residual pain in 5 (2.9%). Using the QoL scoring key, 130 patients (76.5%) had significant impairment and 41 (24.4%) had moderate impairment preoperatively; postoperatively, 18 patients (10.4%) achieved significant improvement, 146 (85.4%) showed improvement and 7 (4.3%) had minor improvement.

Discussion

In this cohort of 171 patients, a differentiated treatment strategy — selecting the surgical or conservative modality according to disease severity, somatic status and quality of life — produced positive outcomes in 95.0% of patients, with the best results achieved by microvascular decompression, in which 87% of patients showed significant improvement. These findings support the central premise that the treatment of TN should be individualized rather than uniform. Current international guidance concurs: the European Academy of Neurology recommends MVD as the first-line surgical option for classical TN with a demonstrated neurovascular conflict, while reserving ablative and percutaneous procedures for patients who are unfit for, or decline, posterior-fossa surgery [8]. Our allocation, which directed surgically fit patients with neurovascular conflict to MVD and patients with significant somatic comorbidity to destructive or conservative management, is consistent with this comorbidity- and fitness-based selection paradigm [8,27].

The demographic profile of our cohort mirrors that reported internationally. The female predominance of approximately 1.5:1, the peak incidence in the 60–74-year age group, right-sided involvement in 78.4% of patients and the preponderance of maxillary (second-division) involvement are all in agreement with contemporary epidemiological data, which describe a female-to-male ratio of roughly 1.5–1.7:1, a rising incidence after the sixth decade, and right-sided and V2/V3 predominance [1,2,31]. This concordance supports the external validity of the cohort.

Accurate diagnosis remains a central challenge in TN. In our series, three of five patients with first-division neuralgia had previously been misdiagnosed with migraine, and nearly all Group 2 patients had first sought dental care — many undergoing tooth extraction — before the correct diagnosis was made. Such diagnostic delay and misattribution to odontogenic or primary headache disorders are well documented and frequently lead to unnecessary interventions [7,32]. High-resolution MRI combining heavily T2-weighted sequences (3D-FIESTA, DRIVE or CISS) with time-of-flight MR angiography is now standard for identifying neurovascular conflict and excluding secondary causes, and our diagnostic protocol — incorporating these sequences together with ENMG — is aligned with current practice [4,17,18].

The superior results achieved with MVD in the present study accord with the substantial body of evidence identifying it as the most effective and durable surgical treatment for classical TN. Pooled analyses report immediate pain-free rates of approximately 83% and long-term rates of about 65–76%, with recurrence in roughly 10% of patients [12,23,24]. The 87% rate of significant improvement in our Group 3 lies at the favourable end of this range; because pain-free rates decline over time, the reported outcomes should be interpreted together with the duration of follow-up [12,23]. The landmark long-term series of Barker et al. reported that 70% of patients remained pain-free without medication at 10 years, establishing the durability benchmark against which shorter-term results should be viewed

[11]. The low complication profile of MVD in experienced hands — with facial numbness, hearing loss and cerebrospinal fluid leak each occurring in only a small percentage of cases — further supports its use in appropriately selected patients [12,23].

By contrast, the destructive and peripheral procedures used in Groups 1 and 2, although effective in the short term, are recognized to provide less durable relief than MVD. Percutaneous and ablative techniques achieve high rates of immediate pain control but carry higher recurrence rates and a greater burden of sensory disturbance [25]. Peripheral neurectomy and exeresis, as used in our Group 2, typically yield relief measured in months to a few years, with frequent recurrence. Conservative pharmacological therapy — for which carbamazepine and oxcarbazepine remain first-line [8,19,29] — also loses efficacy over time, with more than half of initially responsive patients eventually requiring alternative treatment [28]. This progressive escalation is consistent with the least durable outcomes observed in our conservatively treated Group 1 and reinforces the rationale for offering definitive surgery, particularly MVD, to suitable candidates. Stereotactic radiosurgery, although not used in the present cohort, represents a further minimally invasive option for patients unfit for open surgery, with reported freedom from pain of around 85% but recurrence in approximately one quarter of patients [26].

Quality of life has become an essential endpoint in the evaluation of TN treatment, reflecting the profound impact of the disorder on daily functioning and mental health; recent data indicate that a substantial proportion of patients experience severe psychological distress, including suicidal ideation [15]. In our cohort, pain and QoL scores improved significantly across all three groups ($P < 0.001$), with the most pronounced gains after MVD, echoing reports that quality of life improves after decompression even in elderly patients [13,14,30]. An important consideration, however, concerns the outcome instruments used. Our study employed questionnaires developed by the Republican Specialized Scientific and Practical Medical Center of Neurosurgery, which have not undergone formal psychometric validation. This is not unique to our work: a systematic review applying COSMIN methodology found that the psychometric evidence supporting patient-reported outcome measures in TN is generally limited and that no fully validated disease-specific QoL instrument yet exists [20,21]. Among available tools, the Penn Facial Pain Scale-Revised, the Barrow Neurological Institute pain intensity score and generic measures such as the SF-36 currently have the strongest support [21,22]. Future prospective studies from our centre should incorporate these internationally recognized instruments to allow direct cross-study comparison.

Taken together, these findings demonstrate that a differentiated, severity- and comorbidity-based approach to TN achieves high rates of pain relief and quality-of-life improvement. The principal advantage of this strategy is that it extends effective treatment to patients who are not candidates for MVD — including those with serious somatic comorbidity — while still directing surgically fit patients toward the most durable option. This is consistent with the multidisciplinary, individualized models increasingly advocated in the literature [6,33]. At the same time, MVD should not be withheld on the basis of age alone, since decompression remains safe and effective in selected older patients [27,30].

Study Limitations

This study has several limitations that should be considered when interpreting its findings. First, it was a single-centre, **【retrospective / observational — specify】** study without randomization; because treatment allocation was determined by disease severity and somatic status rather than by chance, the comparison between groups is subject to confounding by indication, and healthier patients were more likely to undergo MVD. Second, the outcome instruments were institution-developed and have not been formally validated [21]. Third, **【specify the follow-up duration; if it was short or non-uniform, state this】**, which limits conclusions about the long-term durability of pain relief, since pain-free rates after all modalities decline over time [12,23]. Fourth, the absence of a standardized international outcome scale (such as the Barrow Neurological Institute score) limits direct comparability with other cohorts. Finally, as a study conducted at a single referral centre in one region, the generalizability of the results may be limited. Prospective, multicentre studies using validated, internationally recognized outcome measures are needed to confirm these findings.

Conclusions

1. Women predominated among the study patients — 103 (60.2%) versus 68 men (39.8%), a ratio of approximately 1.5:1. The majority, 71 patients (41.5%), were in the older middle-age and elderly categories, with the peak in the 60–74-year age group: 52 cases (30.4%), consistent with international data.
2. Somatic assessment revealed that 69 of 171 patients (40.5%) had comorbid conditions: arterial hypertension in 53 (31.0%), coronary artery disease in 13 (7.8%), diabetes mellitus in 19 (11.2%), hepatic pathology in 4 (2.6%) and renal insufficiency in 1 (0.9%). Accounting for somatic status is therefore essential when selecting the treatment modality.

3. Positive outcomes following treatment were achieved in 163 of 171 patients (95.0%), with no change in 8 (5.0%), confirming that all treatment modalities are sufficiently effective when applied in a differentiated manner; the most durable results were obtained with microvascular decompression.
4. Pain-syndrome assessment identified mild pain in 41 patients (24.4%), moderate pain in 121 (71.3%) and severe pain in 9 (5.2%) preoperatively; postoperatively, complete pain resolution was recorded in 166 patients (97.3%) and mild residual pain in 5 (2.9%).
5. Preoperative QoL assessment showed significant impairment in 130 patients (76.5%) and moderate impairment in 41 (24.4%); postoperatively, 18 patients (10.4%) achieved significant improvement, 146 (85.4%) showed improvement and 7 (4.3%) had minor improvement.

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