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Contemporary Treatment of Classical Trigeminal Neuralgia in Adults (Literature Review)

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Abstract: Classical trigeminal neuralgia is one of the most severe pain disorders in clinical neurology, yet its treatment pathway is more coherent than in many other neuropathic pain states. Current literature supports a stepwise model that begins with careful clinical diagnosis and magnetic resonance imaging, moves first through sodium channel blocker therapy, and then shifts early toward surgery when pain control is incomplete or drug toxicity becomes limiting.Carbamazepine and oxcarbazepine remain the core medical treatments because they produce high initial response rates, but long term care is frequently constrained by sedation, dizziness, imbalance, hyponatremia, and other adverse effects rather than by true late loss of efficacy.

Keywords: Classical Trigeminal Neuralgia, Carbamazepine, Oxcarbazepine, Microvascular Decompression, Stereotactic Radiosurgery, Balloon Compression, Radiofrequency Thermocoagulation, Glycerol Rhizolysis, Botulinum Toxin A

Introduction

Modern treatment of classical trigeminal neuralgia is guided by a simple clinical fact: the disorder is not only painful, but also unusually treatment responsive when the phenotype is recognized early and the escalation pathway is used well. Contemporary guidelines and major reviews agree that management should not be framed as a prolonged trial of ever more medications. Instead, medical treatment and surgical planning should be linked from the start, because the main reason patients leave first line therapy is poor tolerability, and the procedure with the best long term results is available for a clearly defined subgroup [1].

This evidence base also explains why treatment selection has become more structured over the last decade. High resolution magnetic resonance imaging is now part of routine workup not because imaging alone proves the diagnosis, but because it helps exclude secondary causes and clarifies whether the patient is a likely candidate for microvascular decompression [2] This shift has made the distinction between classical, idiopathic, and secondary trigeminal neuralgia clinically useful rather than merely descriptive. Among procedural options, microvascular decompression offers the most durable medication free pain relief in medically fit adults with classical disease and convincing neurovascular conflict, with long term series and comparative studies consistently favoring it over stereotactic radiosurgery and most percutaneous procedures [3,4,5]. Percutaneous procedures and radiosurgery remain important because they lower the burden of open surgery and broaden access to treatment for older or frailer patients, but this usually comes at the cost of more sensory disturbance, shorter durability, or delayed benefit [6,7]. Botulinum toxin A has a reproducible signal of benefit in refractory disease, whereas selective sodium channel drugs such as vixotrigine remain investigational [8,9].

The treatment choice used most often today can therefore be summarized as follows: confirm a classical phenotype, begin with carbamazepine or oxcarbazepine, do not persist with poorly tolerated therapy for too long, and offer early surgical discussion. In adults with classical trigeminal neuralgia and favorable operative risk, microvascular decompression is usually the preferred definitive procedure. In those with advanced age, substantial comorbidity, absent demonstrable neurovascular conflict, or reluctance to undergo craniotomy, stereotactic radiosurgery or a percutaneous ablative procedure becomes the more usual choice [10].

Diagnostic Framework that Shapes Treatment Choice

The present review concerns adults with classical trigeminal neuralgia, meaning a clinical syndrome of brief, severe, electric shock like unilateral facial pain with triggerability, together with neurovascular compression that produces morphologic changes of the trigeminal root. In this setting, magnetic resonance imaging should be obtained early with dedicated high resolution trigeminal sequences and vascular imaging where available.

This diagnostic step matters because treatment choice depends on more than symptom control. In the current

guideline model, imaging serves three purposes:

Excluding secondary causes such as tumor or demyelinating disease.

Supporting classification into classical versus nonclassical forms.

Defining whether microvascular decompression is anatomically plausible and worth discussing early [11,12]

Current reviews caution against using neurovascular contact alone as a diagnostic proof of trigeminal neuralgia, since contact can also be seen in asymptomatic individuals. What matters clinically is conflict associated with distortion, indentation, or atrophy of the nerve, especially when symptoms fit the classical phenotype.

Carbamazepine and oxcarbazepine remain the first line drugs across major guidelines and reviews [13]. Their central role has not changed because no newer oral treatment has shown a better balance of efficacy and evidence quality. In practical terms, this evidence base is strong but also narrow. Carbamazepine has the longest track record, beginning with early controlled work and continuing through guideline endorsed use [14]. Oxcarbazepine is generally treated as an equivalent first line option with a somewhat cleaner adverse effect profile in routine care. In the practical review by Lambru and colleagues, these drugs provided meaningful initial pain control in almost 90 percent of patients, with tabled responder rates ranging from 68 to 100 percent for carbamazepine and 100 percent for oxcarbazepine in the underlying trial literature.

Real world cohort data clarify why drug therapy often stops short of being a durable solution. In a carefully phenotyped cohort of classical trigeminal neuralgia, Di Stefano and colleagues found initial response rates of 98 percent for carbamazepine and 94 percent for oxcarbazepine, yet adverse effects forced treatment withdrawal or dose reduction to an unsatisfactory level in 27 percent and 18 percent of responders, respectively [15]. Late resistance was uncommon, which suggests that loss of efficacy is less central than poor tolerability in driving escalation to surgery. Later real world work reinforced the same message.

When first line therapy is ineffective or poorly tolerated, the next step is usually not a replacement of equal evidentiary strength but a pragmatic move to adjunct or second line agents while surgical referral is considered. The most commonly used drugs in this role are lamotrigine, baclofen, gabapentin, and pregabalin.

Among these, lamotrigine has the clearest trial support. The placebo controlled crossover study by Zakrzewska and colleagues showed benefit in refractory disease, which is why modern reviews continue to list it near the front of adjunct options [16]. Baclofen retains a role, especially where sedative effects are acceptable, while gabapentinoids are often chosen because they are easier to tolerate even if they are usually less potent against the core paroxysmal pain syndrome [17].

The logic of second line treatment is therefore modest rather than curative. These drugs may reduce attack burden or allow a lower dose of carbamazepine or oxcarbazepine, but they rarely change the overall treatment hierarchy. Current guidance still favors early surgical discussion when first line drugs fail or become intrusive in daily life.

Botulinum toxin A has moved from a niche option to a plausible adjunct for refractory disease, but its evidence base remains much smaller than that for first line oral therapy or surgery. The randomized placebo controlled trial by Wu and colleagues found benefit in pain reduction, and the meta analysis by Morra and colleagues pooled four randomized trials with 178 patients and found a responder risk ratio of 2.87, with marked reduction in daily attack frequency and no serious systemic toxicity, A newer review that included 23 studies also supported a meaningful responder signal, but the broader literature still mixes small randomized trials with uncontrolled series.

At present, botulinum toxin A is best viewed as an adjunct for selected refractory patients who are not well served by standard oral therapy and are not ready for or are not candidates for surgery . It is promising, but not yet a replacement for the established algorithm.

Surgical Treatment

Microvascular decompression, MVD, is the reference procedure for medically refractory classical trigeminal neuralgia in adults who are fit for posterior fossa surgery and have imaging or operative evidence of meaningful neurovascular conflict. Unlike ablative procedures, MVD aims to remove the cause of ectopic firing rather than to injure the nerve, which helps explain both its durability and its lower rate of persistent sensory deficit.

The best modern synthesis remains the meta analysis by Holste and colleagues, which pooled 3897 patients

from 46 studies and found pain freedom in 75.8 percent at last follow up. Their prognostic analysis is clinically important. Pain freedom was more likely with disease duration of 5 years or less, arterial rather than venous compression, superior cerebellar artery involvement, and a purely classical paroxysmal phenotype rather than mixed or constant pain. These findings align with current practice, where earlier referral and clear classical features support stronger enthusiasm for MVD.

Comparative studies sharpen this picture. In the prospective cohort reported by Wang and colleagues, first time MVD outperformed stereotactic radiosurgery in immediate pain freedom and long term durability. Pain free rates after MVD were 83 percent at 1 year, 61 percent at 5 years, and 44 percent at 10 years, versus 71 percent, 47 percent, and 27 percent after radiosurgery. Median time to recurrence was 94 months after MVD versus 53 months after radiosurgery. In a separate comparison against percutaneous procedures, Noorani and colleagues found superior initial pain relief with MVD, 87.0 percent versus 67.2 percent, and much longer durability, with 25 percent recurrence reached at 96 months after MVD and only 12 months after percutaneous surgery overall.

These data explain why guidelines increasingly frame MVD not as a last resort, but as the preferred definitive option for the right patient once medical therapy becomes inadequate. The tradeoff is operative risk. Contemporary summaries still note small but real risks of cerebrospinal fluid leak, infection, stroke, and death, which means age, frailty, and patient preference remain central to selection .

Percutaneous surgery remains essential because many patients with trigeminal neuralgia are older, medically complex, or unwilling to undergo craniotomy. The major methods are radiofrequency thermocoagulation, balloon compression, and glycerol rhizolysis. All can provide rapid relief, but all do so by intentionally injuring the trigeminal system, so sensory effects are part of the mechanism rather than an incidental complication.

The most useful overall conclusion from current evidence is that percutaneous procedures are not equivalent in adverse effect profile, and none matches MVD for durability.The systematic review by Texakalidis and colleagues found that radiofrequency thermocoagulation produced higher odds of immediate pain relief than glycerol rhizolysis, but also higher odds of trigeminal anesthesia.The same review found no clear overall efficacy difference between balloon compression and radiofrequency thermocoagulation, while balloon compression carried more mastication weakness and diplopia than glycerol rhizolysis . Direct comparative studies suggest that balloon compression often provides the best practical balance inside the percutaneous group. In the Noorani series, balloon compression had the best early and long term performance among percutaneous techniques, with 84.6 percent initial pain relief and a 25 percent recurrence point at 26 months, compared with 12 months for thermocoagulation and 5 months for glycerol rhizolysis. A randomized trial found no six month efficacy advantage of balloon compression over radiofrequency thermocoagulation, but radiofrequency produced more paresthetic symptoms at 30 days. A cohort comparison against glycerol rhizolysis also favored balloon compression for side effect profile, with less dysesthesia and less corneal sensory loss.

Taken together, this literature supports a common modern strategy: use MVD in fit adults with classical disease when long term durable relief is the goal, and use a percutaneous procedure when procedural burden must be minimized and some degree of numbness is acceptable. If a percutaneous option is needed, balloon compression often emerges as the most balanced default, while radiofrequency thermocoagulation may be preferred where stronger immediate lesioning is desired and sensory tradeoffs are accepted. Pure ophthalmic division pain requires caution with destructive procedures because of corneal risk.

Stereotactic radiosurgery, SRS, occupies a different niche. It is the least invasive cranial procedure for trigeminal neuralgia and is especially attractive in older patients, in those with substantial medical comorbidity, and in those who strongly prefer to avoid open surgery. Its main disadvantages are delayed onset of full effect and lower long term durability than MVD.

Large radiosurgical series confirm that SRS is effective, but they also show recurrence as a persistent long term issue. In the Gamma Knife cohort reported by Régis and colleagues, 91.75 percent of patients were initially pain free, and actuarial pain free rates without medication were 71.8 percent at 3 years, 64.9 percent at 5 years, 59.7 percent at 7 years, and 45.3 percent at 10 years [13]. One third of initial responders recurred, with median recurrence at 24 months, and facial hypesthesia accumulated over time, reaching about 20 percent at 5 years, though very bothersome numbness remained rare. Other long term series show a similar pattern of good initial control followed by steady attrition.

The comparative question, however, is more important than the single arm results. When matched against MVD in first time surgery, radiosurgery offers less durable pain freedom and often a slower path to maximal benefit. For this reason, current practice usually treats SRS as a strong alternative when operative burden or anesthesia risk outweighs the durability advantage of MVD, not as a coequal default for medically fit adults with classical disease.

Recurrence after an initially successful procedure is common enough that any practical review should account for salvage strategy. The available literature is weaker here and is dominated by observational series, but a recent meta analysis of repeat surgery suggests that repeat MVD and percutaneous rhizotomy provide better complete pain relief than repeat SRS in recurrent or refractory disease. Internal neurolysis has also been explored for patients without clear neurovascular compression, yet the evidence base remains limited and sensory complications are frequent.

This part of the treatment pathway remains less standardized than first line decision making. Even so, the broad principle is consistent with primary treatment: the more the phenotype resembles classical neurovascular compression in a fit patient, the stronger the argument for decompression rather than repeated destructive treatment.

The literature now supports a fairly stable decision model for adults with classical trigeminal neuralgia.

Use botulinum toxin A as an adjunct in selected refractory cases, while recognizing that it does not yet reorder the standard treatment hierarchy.

The central practical point is that the choice is no longer between drug treatment and surgery as separate eras of care. Current evidence supports a continuum in which drug tolerability, magnetic resonance imaging findings, patient age, operative risk, and desire for durability are weighed from the outset. In that continuum, MVD remains the preferred definitive procedure for the typical medically fit adult with classical trigeminal neuralgia, while radiosurgery and percutaneous procedures preserve effective but less durable options for patients in whom low invasiveness matters most.

Conclusion

Current treatment of classical trigeminal neuralgia in adults is defined less by novelty than by sharper patient selection. Carbamazepine and oxcarbazepine remain the pharmacologic foundation, but they often fail in practice because of adverse effects rather than loss of efficacy.This makes early surgical planning rational rather than premature. Across contemporary guidelines, comparative cohorts, and meta analyses, microvascular decompression provides the most durable medication free pain relief and therefore occupies the leading procedural role in medically fit adults with classical disease and meaningful neurovascular conflict. Percutaneous procedures and stereotactic radiosurgery remain indispensable because they extend treatment to older and higher risk patients, although they trade some durability for lower procedural burden and, in the case of percutaneous techniques, more sensory morbidity. Botulinum toxin A is a credible adjunct for refractory cases, and selective sodium channel therapies remain scientifically attractive, but neither has yet displaced the current hierarchy.The contemporary evidence therefore supports a clear clinical rule: treat early with first line sodium channel blockers, but if control is poor or toxicity is intrusive, move without delay to a procedure chosen according to anatomy, fitness, and the desired balance between invasiveness and long term pain freedom.

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