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Abstract

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Frame-Based versus Frameless Stereotactic Radiosurgery for Treatment of Trigeminal Neuralgia

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Abstract

Objectives:

Trigeminal neuralgia is an often debilitating chronic facial pain syndrome with lifetime prevalence of 0.7 per 100,000 people per year, which can be effectively treated with stereotactic radiosurgery (SRS). Frameless (mask-based) SRS techniques have been associated with improved patient comfort and decreased pain during the procedure, while still achieving a high degree of accuracy and obviation of risks associated with frame application. Our goal was to compare pain outcomes, particularly rates of and time to recurrence, as well as adverse events, in our single-institution series of patients who underwent frame- or mask-based SRS for treatment of trigeminal neuralgia.

Methods:

We retrospectively examined medical records of all patients who underwent SRS for facial pain at our institution between January 2011 and December 2022 with post-treatment follow up. Our practice changed from frame-based to frameless SRS treatment in January 2017. Pre-treatment information was collected on demographics and trigeminal neuralgia history, including duration and distribution of symptoms, Barrow Neurologic Institute (BNI) pain intensity scale score, triggers, imaging characteristics, and prior medications and procedural interventions. We collected follow-up data on response to treatment, presence of facial pain at 6 months, BNI scale score, and medication changes post-procedure. Recurrence was considered clinically significant return of trigeminal neuralgia symptoms after treatment with BNI scale score of 4 or greater. If recurrence occurred, date of recurrence, BNI scale score, additional procedures, and success of additional procedures were documented.

Results:

We identified 132 patients with trigeminal neuralgia who underwent SRS treatment with adequate follow up data for analysis. Ninety-one patients (68.9%) underwent frame-based treatment, vs. 41 (31.1%) who underwent frameless treatment. There were no differences in demographics, distribution, or duration of symptoms between the groups. Pre-treatment BNI pain score was similar, with mean 3.8 ± 0.7 in the frame-based group and 3.7 ± 0.6 in the frameless group. Mean radiation dose was 88.4 ± 5.1 Gray for frame-based treatment vs. 88.3 ± 5.4 Gray for frameless treatment. Response rate to radiation was similar between the two groups, with 94.5% of patients responding in the frame-based group compared to 90.2% in the frameless group. However, rates of pain control at one year were higher in the frame-based group (97.8%) compared to frameless (79.2%, $p=.017$). This difference did not achieve statistical significance at two (90.9% vs. 78.6%) or five (84.2% vs. 66.7%) years. Rates of acute (14.5% vs. 4.9%) and chronic (18.9% vs 17.6%) adverse effects were similar between groups. Rates of recurrence were not statistically significantly different between patients receiving frame-based (60.4%) and frameless (37.5%) therapy.

Conclusion(s):

While frameless radiosurgery may improve patient comfort compared to frame-based SRS, there remains discrepancy in the literature as to its relative efficacy and durability. We hypothesized that, given similar patient characteristics and radiation dosing, there would be no difference between frame-based and mask-

based treatment. Although there was no difference in response rate, there initially appeared to be improved durability in frame-based compared to frameless treatment, with higher rates of pain control at one year. This was not borne out in analysis at two and five years post-treatment, although the small number of patients with follow up at these timepoints in the frameless group ($n = 14$ and $n = 3$, respectively) limits the interpretation of this finding. Prospective, registry-based studies with more complete follow-up data would provide more insight as to the respective durability of frameless vs. frame-based SRS for trigeminal neuralgia.