

ROLE OF INTEGRAL DOSE IN TREATMENT OUTCOME OF TRIGEMINAL NEURALGIA FRAMELESS RADIOSURGERY

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Objective

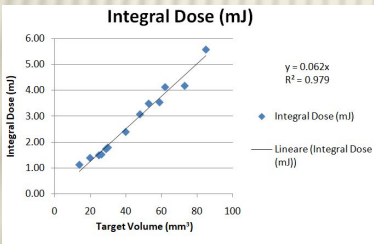
- Stereotactic radiosurgery (SRS) of Trigeminal Neuralgia (TN) has demonstrated to be a valuable treatment option to control trigeminal pain since the first “stereotactic gangliotomy” performed by Dr. Lars Leksell in 1951 with Gamma Knife.
- Cyberknife (CK) and dedicated Linear accelerators (LINAC) have been successfully used to treat TN with safety and efficacy in the last 20 years. These novel Linac TN SRS treatments are frameless and provide the less invasive treatment modality for TN.
- The radiobiological effect of radiosurgery is supposed to be more related to the energy delivered to the nerve root volume rather than to the maximal dose released at a restricted location of the nerve.
- **Aim of the study:** systematic review of the published paper of frameless radiosurgery of TN in order to find a correlation between the Integral Dose to the nerve and the treatment outcome.

Method

- Bibliographic research of the Pubmed database with the keywords: “CK+Trigeminal” and “Linac+Trigeminal” in “All Fields”.
- **Inclusion criteria:** prospective and retrospective studies written in the English Language and reporting outcomes on RS with CK or LINAC. **Exclusion criteria:** studies inclusive of re-treatments and papers with the same authors describing results on previously published population.
- Preliminary identification of 26 distinct studies for CK and 18 for Linac treatments. Selection of 13 papers including information on prescription doses and nerve volumes irradiated.

Author and Year	Technology	Number of cases	Prescribed Dose (Gy)	Target Length (mm)	Target volume (mm ³)	Integral Dose (mj)	Treatment success (%)	Side Effects (%)
Romanelli et al. 2019	Cyberknife	387	60	6	30	1.80	76	20.10
Romanelli et al. 2018	Cyberknife	138	60	5.7	29	1.74	93.5	18.10
Conti et al. 2020	Cyberknife	262	60	5.5	25	1.50	81.4	18
Conti et al. 2017	Cyberknife	27	58	4.85	26.4	1.53	85	27
Villavicencio et al. 2008	Cyberknife	95	60	6	40	2.40	67	47
Kerolus et al. 2017	LINAC	18	81	-	14	1.13	78	39
Rashid et al. 2018	LINAC	46	70	-	20	1.40	74	61
Tang et al. 2011	Cyberknife	14	66	6.8	52.9	3.49	78.60	21.40
Karam et al. 2014	Cyberknife	25	64.12	-	48	3.08	72	8
Lim et al. 2005	Cyberknife	41	65.5	7.2	85	5.57	92.7	51.20
Lim et al. 2006	Cyberknife	29	66.4	7.5	62.1	4.12	90	24
Lazzara et al. 2013	Cyberknife	16	57.17	6	73.01	4.17	88	12.50
Stergioula et al. 2024	Cyberknife	50	60	-	59	3.54	84	62

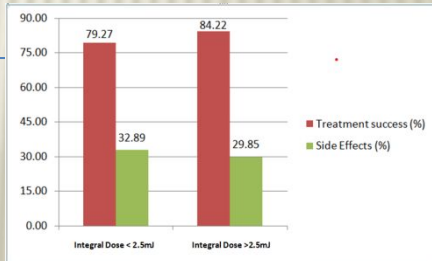
Results



	Number of cases	Mean ID Value (mj)	Treatment success (%)	Side Effects (%)
Integral Dose < 2.5mj	973	1.64±0.4	79.27	32.89
Integral Dose > 2.5mj	175	4±0.87	84.22	29.85

Treatment success: Complete pain relief, tolerable pain or adequately controlled pain with medications.

Potential side effects: sensory disturbances, facial numbness, dysesthesia.



Increasing ID there is a better outcome of treatments, without increase in incidence of trigeminal dysfunction.

Integral dose = Dose x Nerve Volume

Plot of the ID versus the Target Volume for the cohort of studies. The ID varies linearly with the target volume. A least square regression analysis yields a linear polynomial function with slope=62Gy.

Conclusions

The present study shows that ID is a valuable parameter to predict the outcome of a treatment. For Linac based, non isocentric treatments, the target volume can be modulated to fit individual anatomy and it is possible to treat elongated structures such as the trigeminal nerve with optimized conformality and sparing adjacent structures like the brainstem. ID can therefore be tailored to reach a clinical objective. A limitation of the study is that the number of cases and follow up duration varies among the different papers examined