Safety and effectiveness of frameless linac-based stereotactic radiosurgery on tremor in patients with essential tremor or Parkinson's disease – Preliminary results

Kevin So[1], Andrew Evans[2], Girish Nair[3], Sarah Farrand[4], Ann Sloan[5], Alex Yeung[6], Michael Dally[1]

1. Radiation Oncologist, Icon Cancer Centre, Radiation Oncology, Epworth Richmond, Richmond, Victoria, Australia 2. Neurologist, Neurosciences Department, Epworth Richmond, Richmond, Victoria Australia 3. Neurosurgeon, Epworth Richmond, Richmond, Victoria, Australia 4. Neuropsychiatrist, Epworth Richmond, Richmond, Victoria, Australia 5. Neuropsychologist, Epworth Richmond, Richmond, Victoria, Australia 6. Neurologist, The Royal Melbourne Hospital, Parkville, Victoria, Australia

Background

Most of the published literature for stereotactic radiosurgical (SRS) thalamotomy utilises the gamma-knife system. The TREMOR trial is a phase 2, prospective, single-institution Australian study (ANZCTR Reg. ID: 380238) exploring the safety, efficacy, and feasibility of frameless linac based SRS thalamotomy in patients with medically refractory essential tremor (ET) or tremor-dominant Parkinson's disease (TD-PD). Here we report the preliminary data from the first five participants treated on the trial.

Methodology

Eligible patients were 18 years or older with disabling ET or TD-PD, who were medically-refractory or intolerant to medication and unsuitable or declined surgery and MRI focused ultrasound. SRS thalamotomy was delivered using the Novalis Tx™ (Varian Medical Systems, USA) linear accelerator and a 4mm tertiary collimator with orthogonal KV image guidance and a robotic treatment couch with 6 degrees of freedom (ExacTrac™, Brainlab AG, Germany). Patients were immobilised using a customized frameless thermoplastic cranial mask. The dose delivered was 130Gy in a single fraction to the ventral intermedius nucleus (VIM). The VIM target was identified utilising a standard co-ordinate-based system.

Results

Median age of participants was 77 (range 62-90). Four participants had essential tremor, and one had tremor-dominant Parkinson's disease. All participants were right hand dominant.

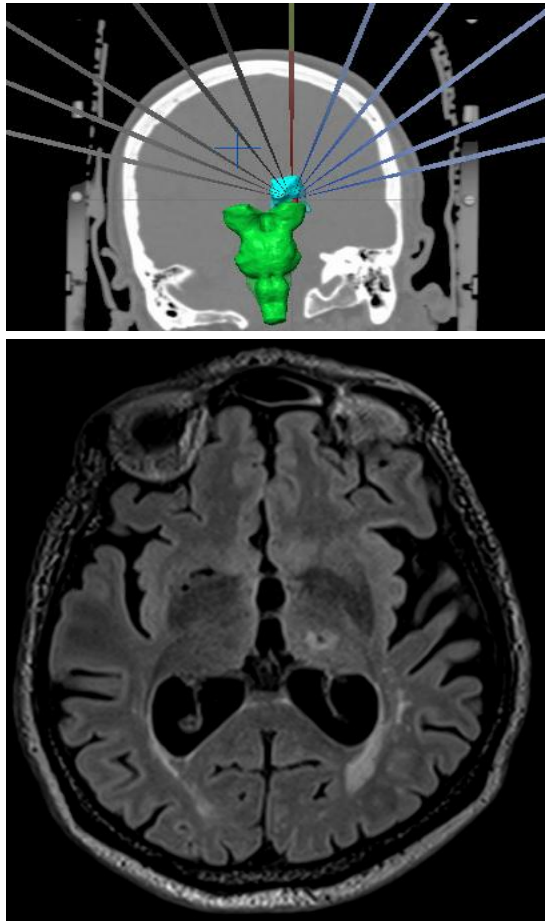

Fig 1: Beam arrangement with 11 non-coplanar arcs (above) T2 hyperintense lesion within the left thalamus (below)

To date four participants have completed 6-month follow-up and five participants have completed 12-month follow-up. The mean pre-treatment Fahn Tolosa Marin Clinical Rating Scale (FTMRS) upper extremity postural tremor score was 2.67, which fell to 0.75 and action/intention tremor was 2.33 dropping to 1.50 at 12 months post-radiosurgery. The mean FTMRS handwriting score was 3.67 at baseline and this also reduced to 2.25 at 12-months post-procedure.

Overall, two of five participants (40%) at the 6-month follow up and three of four participants (75%) at 12-month follow up had improved action tremor scores whilst three of five (60%) and all four (100%) participants had improvement in postural tremor at 6- and 12-months respectively. The one participant who had worsening tremor and handwriting scores at six months was the only participant treated with tremor-dominant Parkinson's disease who was on no active medical therapies due to intolerance. Two participants were noted to have worsening tremor on their contralateral, non-treated side over the 12-month follow up period.

There were no treatment-related toxicities or adverse events recorded.

Conclusion

Early analysis on the use of frameless linac-based SRS thalamotomy for essential tremor and tremor-dominant Parkinson's disease demonstrates encouraging results at reducing tremor and treatment appears safe and well tolerated.