COMPARISON OF SINGLE FRACTION VERSUS FRACTIONATED RADIOSURGERY FOR ACOUSTIC NEUROMAS

by: Gil Lederman, M.D.

The rationale of radiosurgery or pinpoint radiation has always been strong. A main issue has been that equipment developed for radiosurgery was initially developed by surgeons. I suspect surgical training and in fact lack of radiation training led to the concept of the single intervention is much like invasive surgery.

The problem with single fraction radiosurgery is, however, that it ignores the principles of radiation that have been developed over the past 100 years.

During those decades it has been shown that fractionation or dividing the radiation dose leads to a higher tolerance of the normal, healthy surrounding tissues. It is not only for cancer results that divided dose fractionation of the radiation is undertaken although that is, indeed, an issue. It is to protect the normal, healthy surrounding tissues.

Those principles are true throughout the body and they should be especially true in the brain where normal, delicate structures such as the brain stem and cranial nerves surround even benign tumors like the acoustic neuroma.

A recent study by Ito et al, from the University of Tokyo, has outlined their results of acoustic neuroma patients treated on the gamma knife. There were 46 patients who underwent radiosurgery between June 1990 and June 1994 and followed there. The patients ranged in age from 13 to 77 years with a median of 54. Tumor diameter ranged from 0 to 25 millimeters (mm) with a mean of 12.

Maximum tumor dose ranged from 20 to 40 Gray with peripheral doses of 12 to 20 Gray. One to 8 isocenters - or spheres of radiation - were used with a mean of 3.2 and median follow-up was 39 months.

All patients were treated using Gamma Knife at the center with a dose prescribed at the 50% isodose line and 30 patients in the 60% or 70% isodose line at six patients each. This is the point about the tumor where the curves of radiation fall off. Their results showed that in 2 patients or 4% the tumor increased by 2mm or more in diameter. Eighteen percent of the 38 patients with any hearing before treatment became totally deaf after single-shot radiosurgery within an average time of three months.

The risk factors for deafness after single-shot radiosurgery included the diagnosis of neurofibromatosis too and the number of isocenters. The authors noted that, "pre-treatment hearing level was not associated."

Pure-tone audiometry worsened in 61% of the patients with an onset of time of eight months. Low-tone average diminished in 53% of the patients and high-tone 46% of the patients.

Sixty-nine percent of the patients with a preserved caloric response (a test using altered temperature water injected into the ears) before treatment lost this after treatment with a time of eight months on average. The peripheral tumor radiation dose and the maximum tumor radiation dose were associated here.

Twenty-two percent of patients had facial palsy or weakness within six months. Risks of developing face weakness included the patient's age, tumor size, and the number of isocenters.

Fifty percent of the patients additionally had facial palsy or transient facial spasm after treatment with an average time of six months. Trigeminal nerve dysfunction occurred in 30% of patients.

Furthermore, authors noted that, "of the five patients who had undergone microsurgery prior to radiosurgery, three had already had facial palsy. In two of those three patients, exacerbation of facial palsy occurred after radiosurgery. All of the five patients had moderate to severe hearing loss before radiosurgery, which was exacerbated after treatment in three patients."

Why is the fractionated radiosurgery data from our group so different from this? A variety of answers but the main one is more versatile equipment and fractionation. We have not seen a permanent facial paralysis and, in fact, there has been no trigeminal neuropathy.

The vast majority of patients (over 80%) treated with fractionated radiosurgery have maintained their hearing with about 10% of patients actually improving their hearing as documented by pure-tone audiometry. Only about 10% have had diminished hearing.

Furthermore, the group has been able to treat large as well as small tumors with tumors measuring up to 5 centimeters in diameter and 32 cubic centimeters in volume undergoing fractionation.

The follow-up of time is similar to the Tokyo study but the complications have not been seen. While obviously both methods are superior to surgery, it is clear which method offers the opportunity of less hot-spots, dose homogeneity and fewer collimators therefore producing less hot-spots. That is clearly associated with fractionated stereotactic radiosurgery program.

Of course, years of follow-up will be necessary to determine the outcome but at this interval - an important milestone since most recurrences and complications occur within the first several years - fractionated radiosurgery offers the tremendous appeal of being a non-invasive procedure avoiding a head-frame with pins in the skull and as well the versatility of a greater number of collimators and protection of the normal, healthy surrounding crucial structures.

P.S.

For current information about our unique fractionated stereotactic radiosurgery program, please call or write (212-995-6700), e-mail: gil.lederman@rsny.org.