

Purpose

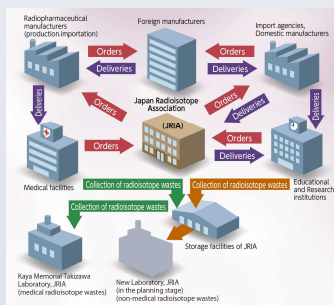
- 1) To report on the utilization of brachytherapy sources in Japan, based on our analysis of 26,530 source shipments from 2004 -2011
- 2) To assess the influence of Japan's Fukushima Nuclear Power Plant Accident (Mar 2011) on the nation's brachytherapy source supply.

Materials and Methods

Japan Radioisotope Association (JRIA) has been playing a major role in supplying almost all radiation therapy sources in Japan.

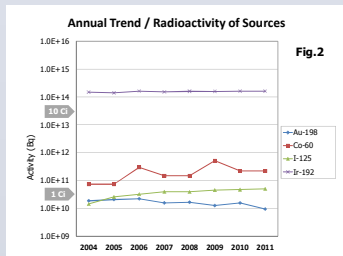
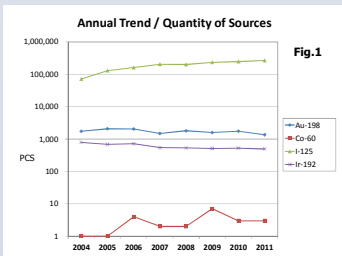
Moreover, JRIA has established a comprehensive database of radioisotope distribution in Japan and provides statistical data to end-users and policymakers.

This database has been extensively used to analyze the annual trend of source utilization, including a comparison of institution users.



Results

Annual trend of total quantity and radioactivity of sources, as shown in Fig.1 and 2.



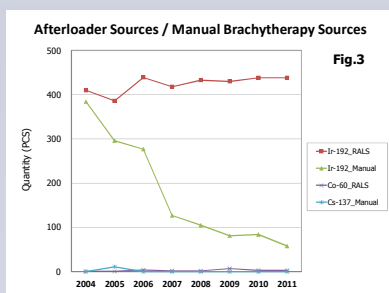
(1) Ir-192 for Remote Afterloader

Currently approx. 140 institutions use the Ir-192 remote afterloading device; moreover, there has been a slight increase in source quantity and total amount of radioactivity. Ir-192 devices are replacing the small number of extant Co-60 afterloading devices.

For Afterloader	2004	2005	2006	2007	2008	2009	2010	2011
Ir-192 (pcs)	410	386	439	418	433	430	438	438
Co-60 (pcs)	1	1	4	2	2	7	3	3

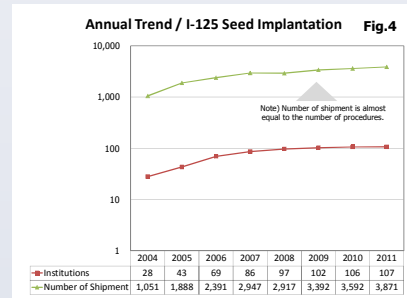
(2) Ir-192 Wire Sources

Manual brachytherapy Ir-192 and Cs-137 sources are used in some 12 institutions but their utilization has been rapidly decreasing.



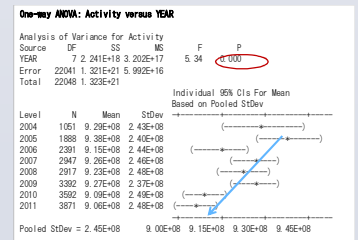
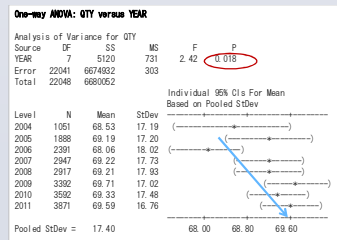
(3) I-125 Seeds

Approx. 113 institutions are practicing I-125 seed implantation, and the number of institutions doing so has increased 3 or more times, as compared with 2004.

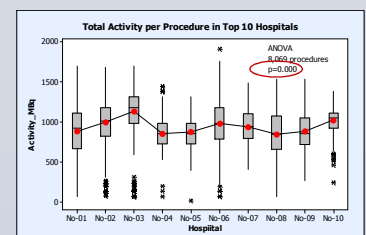
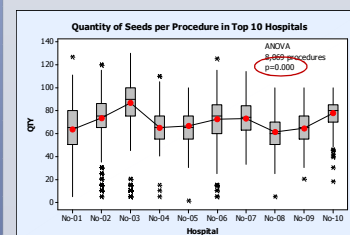


The average quantity of seeds per procedure and radioactivity per procedure are 69.2 (SD=17.4, N=22,048) and 924MBq (SD=248, N=22,048), respectively, from 2004-2011.

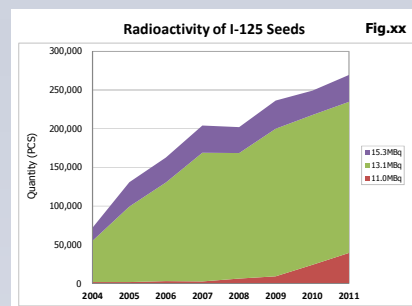
The average quantity of seeds per procedure is increasing each year (p=0.018, ANOVA); however, radioactivity per procedure has decreased each year (p=0.000, ANOVA).



There are significant differences in the quantity of seeds per procedure as well as radioactivity per procedure among Japan's top 10 institutions having the largest volume of procedures. (Both p=0.000, ANOVA)



13.1MBq seeds are most preferred by physicians, and the ratio of 11.0MBq seeds are rapidly increasing these several years.



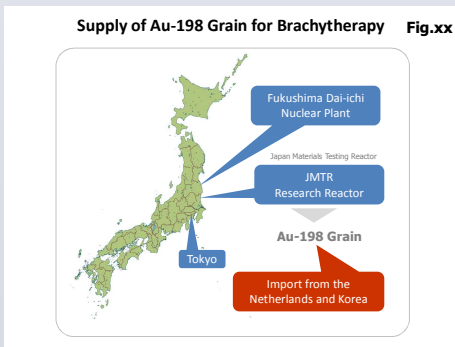
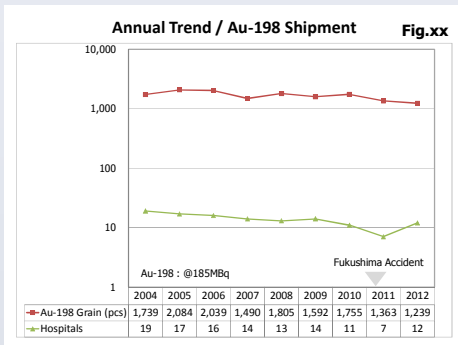


(4) Au-198 Grain

Au-198 Grain therapy had been carried out in approx. 20 institutions in the past but that number is now down by half.

Quantity of sources and activity per year has decreased to 1,363 pieces and 9.4GBq, respectively in 2011.

*2 Au-198 Grain had been manufactured at a research reactor in Japan, but the reactor was damaged in the Great East Japan Earthquake on March 11, 2011 and it remains down, as of March, 2013.



(5) Influence of Japan's Fukushima Nuclear Power Plant Accident

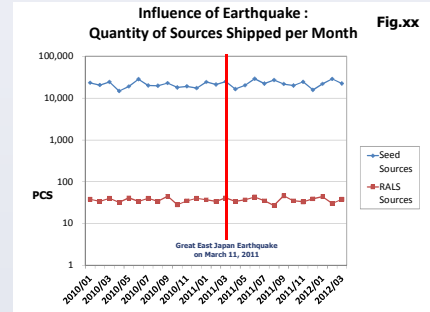
We used the Chi-square test to analyze the quantity of each Ir-192, I-125, and Au-198 source. Our results show that the quantity of Au-198 has decreased significantly (p=0.000) since the Nuclear Accident.

The annual quantity of Ir-192 and I-125 continues to show an increase, which indicates no short-term influence from the Nuclear Accident.

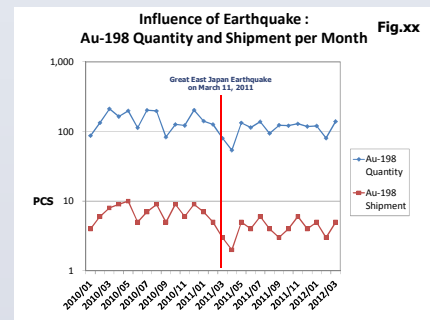
Chi-Square Test: Influence of Accident

Number of Shipment				
Chi-Square Test: Au-198, I-125, Ir-192				
Expected counts are printed below observed counts				
	Au-198	I-125	Ir-192	Total
2009	68	3392	457	3917
	63.92	3417.93	435.15	
2010	84	3592	466	4142
	67.59	3614.26	460.15	
2011	51	3871	459	4381
	71.49	3822.81	486.70	
Total	203	10855	1382	12440
Chi-Sq = 0.261 + 0.197 + 1.097 + 3.984 + 0.137 + 0.074 + 5.873 + 0.607 + 1.576 = 13.807				
DF = 4, P-Value = 0.008				

Number of Sources				
Chi-Square Test: Au-198_Q, I-125_Q, Ir-192_Q				
Expected counts are printed below observed counts				
	Au-198_Q	I-125_Q	Ir-192_Q	Total
2009	1592	236457	511	238560
	1476.29	2.37E+05	479.24	
2010	1755	249036	522	251313
	1555.21	2.49E+05	504.86	
2011	1363	269379	496	271238
	1678.51	2.69E+05	544.89	
Total	4710	754872	1529	761111
Chi-Sq = 9.070 + 0.092 + 2.104 + 25.667 + 0.189 + 0.582 + 59.306 + 0.494 + 4.387 = 101.890				
DF = 4, P-Value = 0.000				



Although the great earthquake brought a severe damage on the infrastructures such as transportation and communication, we could maintain the stable supply of medical isotopes.



As for Au-198, domestic manufacturing had completely stopped after the earthquake. JRIA had switched supplier to Dutch and Korean manufacturer afterwards.

Conclusions

- ✓ Ir-192 sources are mainly used in afterloading devices while the number of users and the quantity of radioactivity remains quite stable in Japan.
- ✓ I-125 implantation indicates a substantial increase in Japan. Our statistical analysis indicates that there are significant differences in the quantity of sources and radioactivity per procedure on an annual basis among institutions.
- ✓ Utilization of Au-198 Grain has been decreasing rapidly due to the sudden stop of supply caused by the March 11, 2011 Earthquake.
- ✓ Except for Au-198, the Nuclear Accident has had no notable influence on brachytherapy in Japan in the short-term from the viewpoint of source supply.

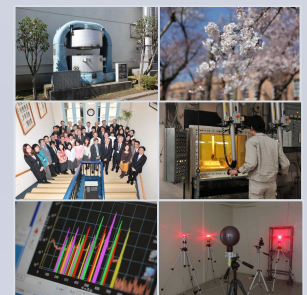
Acknowledgement

We appreciate the help received from Mr. M. Muramoto of JRIA with the statistical analyses.

About JRIA

The Japan Radioisotope Association (JRIA) is a public non-profit organization, operated by the JRIA's members in accordance with the following aims and objectives:

1. To promote the utilization of radioisotopes and to ensure their safety
2. To supply radiopharmaceuticals and labeled compounds, and to produce and supply sealed sources for medical, research and industrial purposes
3. To manage radioisotope waste and disused sealed sources



Disclosure

FINANCIAL RELATIONSHIP: We do not have a financial interest, arrangement, or affiliation with a commercial organization that may have a direct or indirect interest in the subject matter of my presentation.