

Characteristics and Comparison of RSO Isotopes including Sn-117m

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CE98: Targeting Radionuclide Therapy in Various Non-Malignant
Arthritic Conditions Using Radiosynoviorthesis (RSO)

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Disclosures

- Employment with Serene, LLC – manufacturers of Sn-117m colloid

Radiosynoviorthesis (RSO)

- A.k.a. Radiosynovectomy (RSV)
- Treatment for arthritis (synovitis)
- Used worldwide for over 60 years
- Radioactive colloid injected directly into the synovial cavity
 - Intracavitary radiotherapy to reduce pain, effusion, perfusion and inflammation (synovitis)
- Commercial isotopes are **Y-90**, **Re-186**, **Er-169**
 - **Y-90** for large joints (knee)
 - **Re-186** for mid-size joints (elbow, wrist, ankle)
 - **Er-169** for small joints (fingers)

Radionuoviorthesis Isotopes

Isotope	t _{1/2} (d)	Imaging Particle	Energy (keV)	Therapy Particle	Maximum Energy (keV)	Range (mean) Tissue (mm)	Range (max) Tissue (mm)	Typical Dose (mCi)	Joint Size
Sn-117m	13.6	γ	158.6	C.E.	151	0.27	0.3	0.5-1.0	Small/Med
Er-169	9.3	None	-	β ⁻	350	0.14	1.1	1	Small
Re-186	3.7	γ	137	β ⁻	1070	1.1	4.4	2.5	Medium
Y-90	2.7	B	-	β ⁻	2280	4.1	11	4	Large
P-32	14.3	B	-	β ⁻	1711	2.8	8.4	2	Large
Au-198	2.7	γ	412	β ⁻	960	0.9	4.2	7	Large/Med
Sm-153	1.9	γ	103	β ⁻	808	0.55	3.3	5	Medium
Re-188	0.7	γ	155	β ⁻	2120	3.1	10.4	10	Large
Ho-166	1.1	γ	81	β ⁻	1855	2.6	9.2	10	Large
Dy-165	0.1	γ	95	β ⁻	1289	1.3	5.9	270	Large
Tm-170	129	γ	84	β ⁻	968	0.9	4.2	1.6-4.8	Medium

Commercial RSO Isotopes

	Isotope	Joint size	Colloidal compounds	Half-life (days)	Imaging particle	Therapy particle	Tissue range (mm) mean, max	Typical dose (mCi)
Standard isotopes currently in use globally (human dose)	Er-169	Small	Citrate	9.3	None	β	0.14, 1.1	1
	Re-186	Medium	Sulfide	3.7	γ (lower quality)	β	1.1, 4.4	2.5
	Y-90	Large	Silicate, citrate	2.7	Brem.	β	4.1, 11	4
Future	Sn-117m	Small/Med	Hydroxide	14	γ (high quality)	CE	0.27, 0.30	0.5-2.0

All (except Sn-117m) – wide particle size range allows for potential leakage from the joint resulting in systemic distribution

All (except Sn-117m) – irradiate beyond the targeted tissue (i.e., the synovium)

Y-90, Re-186 – shorter half-life causes some logistical problems outside of Europe

Er-169 – supply, reliability issues reported.

Colloid Manufacturing

- Centralized manufacturing – unit doses and bulk
 - Limited availability in some countries and regions

- Local - “kit” produced Re-188 using cold Sn colloid base



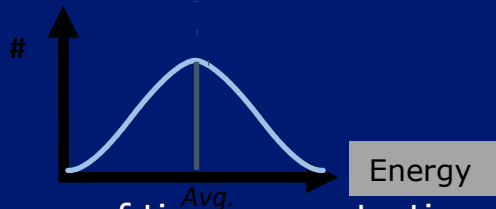
(Courtesy of Prof. Jae Min Jeong, SNU)

Characteristics of Sn-117m

Sn-117m was extensively developed at BNL starting in the 1980s

- Reactor production
- Chemistry development
- Oncology trials

Beta

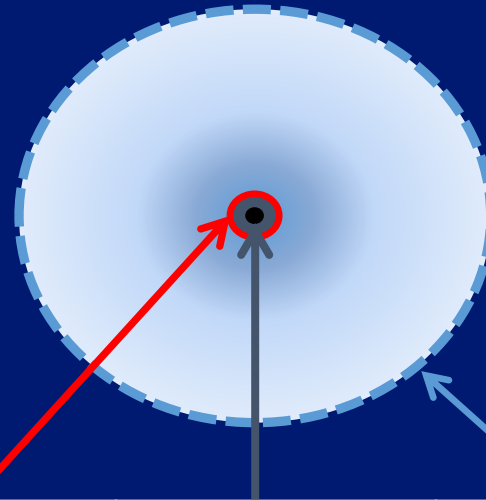


Produces a *range* of tissue penetration

Conversion Electron (CE)



Penetrates up to a *set distance* (discrete energy)

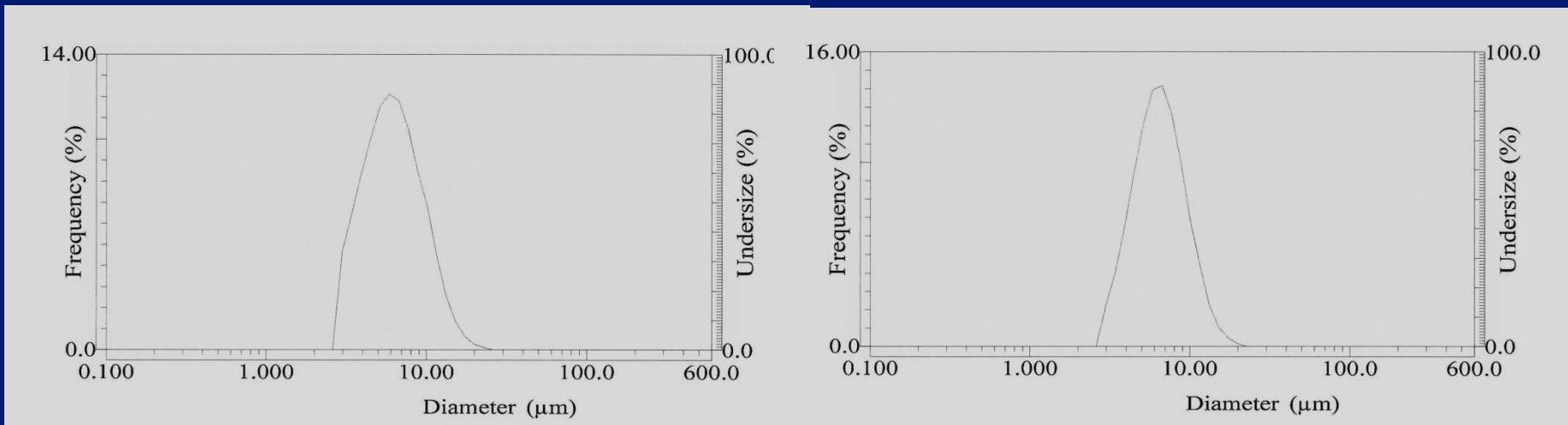


	Sn-117m (CE)	Alpha Particles	Beta Particles
Range in tissue (μm)	300	40-90	50-5000
Shielding needed during administration	No	No	Yes

Sn-117m RSO Colloid

Retention of colloid in normal rat joint:

Time	7 days	2 weeks	6 weeks
Retention	>99.9%	>99.9%	99.8%



Stability studies – colloid size particle distribution at manufacture

Mean = 6.28 μm SD = 2.76 μm

Stability studies – colloid size particle distribution at 5 weeks in room temperature

Mean = 6.43 μm SD = 2.47 μm

Sn-117m RSO Colloid is Unique

- Tin forms an **ideal colloid**
 - Used as the base for some existing RSO colloids
 - Very stable/long-lived
 - Biocompatible
 - Reproducible
- **Optimal size** range
 - No particles smaller than 1 μm – i.e., no leakage
 - No particles above $\sim 20 \mu\text{m}$ – i.e., complete phagocytosis
- Suitable **half-life**
 - Phagocytosed radioactive colloids migrate to deeper synovial tissues – i.e., potential to treat larger joints
- Irradiation of unintended tissues is avoided

Summary

- RSO is a well established procedure to treat **arthritis/synovitis**
- Commercially available isotopes are:
 - **Y-90** for **large joints**
 - **Re-186** for **mid-size joints**
 - **Er-169** for **small joints**
- **Sn-117m** is a new isotope that is proving useful for **small** and **mid-size** joints (possibly also large)
- Existing colloids **leak** out to some degree resulting in systemic distribution
- New **Sn-117m colloid is unique** in having no leakage or systemic problems
- Sn-117m has the potential to treat all sizes of joints