

Blue Cross Blue Shield of Massachusetts is an Independent Licenses of the Blue Cross and Blue Shield Association

# Medical Policy Stereotactic Radiosurgery and Stereotactic Body Radiotherapy

# Table of Contents

- **Policy: Commercial**
- Description
- Policy: Medicare
- Authorization Information

**Policy History** 

- References
  - **Coding Information**
  - **Endnotes**

# **Policy Number: 277**

BCBSA Reference Number: 6.01.10

# **Related Policies**

- Charged-Particle (Proton or Helium Ion) Radiation Therapy #437
- Clinical Exception Form for Stereotactic Radiosurgery and Stereotactic Body Radiation Therapy (SBRT), #922
- Intracavitary Balloon Catheter Brain Brachytherapy for Malignant Gliomas or Metastasis to the Brain, #602

Information Pertaining to All Policies

- Intensity-Modulated Radiotherapy of the Breast and Lung, #163
- Intensity-Modulated Radiotherapy of the Prostate, #090 •
- Intensity-Modulated Radiotherapy: Abdomen and Pelvis, #165
- Intensity-Modulated Radiotherapy: Central Nervous System Tumors, #910 •

#### **Policv** Commercial Members: Managed Care (HMO and POS), PPO, and Indemnity

#### Stereotactic Radiosurgery (SRS) for Intracranial Lesions<sup>1</sup>

#### **Primary Malignant Brain Lesions**

#### High Grade Gliomas (grade 3-4)

Stereotactic Radiosurgery (SRS) may be considered MEDICALLY NECESSARY for high grade gliomas in individuals with good performance status (based on either of the following):

- ECOG 0, 1, or 2 OR
- Karnofsky Scale greater than or equal to 70% AND

When one of the following conditions is met:

- Recurrent disease **OR**
- To treat a previously irradiated field.

Low Grade Gliomas (grade 1-2)

Stereotactic Radiosurgery (SRS) may be considered <u>MEDICALLY NECESSARY</u> for low grade gliomas in individuals with good performance status (based on either of the following):

- ECOG 0, 1, or 2 **OR**
- Karnofsky Scale greater than or equal to 70% AND

When one of the following conditions is met:

- Initial treatment OR
- Recurrent disease OR
- To treat a previously irradiated field.

#### Medulloblastoma supratentorial primitive neuroectodermal tumors (PNET) Ependymoma

Stereotactic Radiosurgery (SRS) may be considered <u>MEDICALLY NECESSARY</u> for medulloblastoma, supratentorial PNET, ependymoma when the following condition is met:

• Only to treat a previously irradiated field.

#### **CNS** lymphoma

Stereotactic Radiosurgery (SRS) may be considered <u>MEDICALLY NECESSARY</u> for CNS lymphoma when the following condition is met:

• Only to treat a previously irradiated field.

#### **Metastatic Brain Lesions**

Stereotactic Radiosurgery (SRS) may be considered <u>MEDICALLY NECESSARY</u> for metastatic brain lesions when **ANY** of the following conditions are met:

- For individuals with good performance status (based on either of the following):
  - ECOG 0, 1, or 2 **OR**
  - Karnofsky Scale greater than or equal to 70%
- To treat a previously irradiated field.

#### **Benign Brain Lesions**

#### Intracranial arteriovenous malformations (AVMs)

Stereotactic radiosurgery (SRS) may be considered <u>MEDICALLY NECESSARY</u> for AVMs when the following condition is met:

• For treatment of intracranial arteriovenous malformations.

#### **Pituitary adenomas**

Stereotactic radiosurgery (SRS) may be considered <u>MEDICALLY NECESSARY</u> for pituitary adenomas when **ANY** of the following conditions are met:

- When individual is symptomatic **OR**
- To treat a previously irradiated field.

#### Meningioma

Stereotactic radiosurgery (SRS) may be considered <u>MEDICALLY NECESSARY</u> for meningioma when **ANY** of the following conditions are met:

- When lesion is unresectable or recurrent, or if there is residual disease following surgery OR
- To treat a previously irradiated field.

Other benign brain tumors: acoustic neuromas, craniopharyngiomas, pineal gland tumors, schwannomas Stereotactic radiosurgery (SRS) may be considered <u>MEDICALLY NECESSARY</u> for other benign brain tumors when the following condition is met:

- For treatment of other benign brain tumors, including acoustic neuromas, craniopharyngiomas, pineal gland tumors, schwannomas
- Glomus jugulare tumors.

### SRS for Ocular Lesions<sup>1</sup>

#### **Uveal Melanoma**

Stereotactic Radiosurgery (SRS) may be considered <u>MEDICALLY NECESSARY</u> for uveal melanoma when **ANY** of the following conditions are met:

- For treatment of melanoma of the choroid OR
- To treat a previously irradiated field.

#### SRS for Other Neurologic Conditions; Trigeminal Neuralgia<sup>1</sup>

Stereotactic radiosurgery (SRS) may be considered <u>MEDICALLY NECESSARY</u> for trigeminal neuralgia when **ANY** of the following conditions are met:

- When symptoms are refractory to standard medical management OR
- To treat a previously irradiated field.

Stereotactic radiosurgery using a gamma ray or linear-accelerator unit may be considered <u>MEDICALLY</u> <u>NECESSARY</u> for:

Mesial temporal lobe epilepsy refractory to medical management when standard alternative surgery is not an option

Stereotactic radiosurgery is **INVESTIGATIONAL** for other applications including, but not limited to, the treatment of functional disorders (other than trigeminal neuralgia), including chronic pain and tremor.

#### SRS or SBRT for Bone Metastases<sup>1</sup>

Stereotactic Radiosurgery (SRS) **or** Stereotactic Body Radiation Therapy (SBRT) may be considered **MEDICALLY NECESSARY** for bone metastasis when **ALL** of the following conditions are met:

- To treat a previously irradiated field
- Re-treatment with EBRT would result in significant risk of adjacent organ injury.

Note: When SRS/SBRT is being requested to treat a patient with oligometastatic disease with potentially curative intent, please refer to separate criteria in the <u>Oligometastatic Extracranial Disease section</u> of the policy.

#### SBRT for Spine Lesions; Primary or Metastatic Lesions of the Spine<sup>1</sup>

Stereotactic Body Radiation therapy (SBRT) may be considered <u>MEDICALLY NECESSARY</u> for spine lesions when **either** of the following conditions is met:

- When other treatment options are not available (both must be met)
  - Not amenable to surgical resection (at least one must apply)
- Related to prior surgery, tumor location, or surgical candidacy **OR**
- Surgery alone is not an option AND
  - When lesions are not amenable to 3D conformal techniques OR
- To treat a previously irradiated field.

Note: When SRS/SBRT is being requested to treat a patient with oligometastatic disease with potentially curative intent, please refer to separate criteria in the <u>Oligometastatic Extracranial Disease</u> section of the policy.

#### SBRT for Prostate Cancer<sup>1</sup>

#### Low risk of recurrence\*

Stereotactic Body Radiation Therapy (SBRT) may be considered <u>MEDICALLY NECESSARY</u> for prostate cancer when **ANY** of the following conditions are met:

- When anticipated survival is greater than 10 years OR
- To treat a previously irradiated field.

#### Intermediate risk of recurrence\*

Stereotactic Body Radiation Therapy (SBRT) may be considered <u>MEDICALLY NECESSARY</u> for prostate cancer when the following condition is met:

- When anticipated survival is greater than 10 years OR
- To treat a previously irradiated field.

#### High risk of recurrence\*

Stereotactic Body Radiation Therapy (SBRT) may be considered <u>MEDICALLY NECESSARY</u> for prostate cancer when the following condition is met:

• Only to treat a previously irradiated field.

#### Post-prostatectomy\*

Stereotactic Body Radiation Therapy (SBRT) may be considered <u>MEDICALLY NECESSARY</u> for prostate cancer when the following condition is met:

• Only to treat a previously irradiated field.

### Local recurrence\*

Stereotactic Body Radiation Therapy (SBRT) may be considered <u>MEDICALLY NECESSARY</u> for prostate cancer when the following condition is met:

• Only to treat a previously irradiated field.

### **Disease Definitions**

\*Low-risk of recurrence (ALL must be present to qualify as low risk)

- Stage T1-T2a AND
- Gleason score of 6 AND
- Prostate-specific antigen (PSA) below 10 ng/mL.

#### \*Intermediate-risk of recurrence (ANY one characteristic)

- Stage T2b to T2c OR
- Gleason score of 7 OR
- PSA 10-20 ng/mL.

#### \*High-risk of recurrence (ANY one characteristic)

- Stage T3a OR
- Gleason score 8-10 OR
- PSA greater than 20 ng/mL.

#### \*Localized disease

- T stage of T1-3a (tumor has spread through the capsule on one or both sides but has not invaded the seminal vesicles or other structures) **AND**
- N0 (no lymph node involvement).

#### SBRT for Pancreatic Cancer<sup>1</sup>

Stereotactic Body Radiation Therapy (SBRT) may be considered <u>MEDICALLY NECESSARY</u> for pancreatic cancer when **EITHER** of the following conditions is met:

- To treat locally advanced or recurrent disease without evidence of distant metastasis OR
- To treat a previously irradiated field.

#### SBRT for Extracranial Oligometastatic Disease<sup>1</sup>

Stereotactic Body Radiation Therapy (SBRT) may be considered MEDICALLY NECESSARY for

- extracranial oligometastatic disease when ALL of the following conditions are met:
  One (1) to three (3) metastatic lesions involving the lungs, liver, or bone AND
- One (1) to three (3) metastatic lesions involving the lungs, liver, or bone **AND**
- Primary tumor is breast, colorectal, melanoma, non-small cell lung, prostate, renal cell, or sarcoma AND
- Primary tumor is controlled AND
- No prior history of metastatic disease AND
- Good performance status
  - ECOG 0, 1, or 2 **OR**

• Karnofsky Scale greater than or equal to 70%.

Stereotactic Body Radiation Therapy (SBRT) and Stereotactic Radiosurgery (SRS) are **INVESTIGATIONAL** for other conditions except as outlined in the policy statements above.

# **Prior Authorization Information**

#### Inpatient

 For services described in this policy, precertification/preauthorization <u>IS REQUIRED</u> for all products if the procedure is performed <u>inpatient</u>.

#### Outpatient

 For services described in this policy, see below for products where prior authorization <u>might be</u> <u>required</u> if the procedure is performed <u>outpatient</u>.

	Outpatient
Commercial Managed Care (HMO and POS)	Prior authorization is <b>not required.</b>
Commercial PPO and Indemnity	Prior authorization is <b>not required.</b>

When stereotactic radiosurgery or Stereotactic Body Radiation Therapy (SBRT) are performed using fractionation for the medically necessary indications described above, it may be considered <u>MEDICALLY</u> <u>NECESSARY</u>.\*\*

\*\*Fractionated SRS refers to SRS or SBRT performed more than once on a specific site. SRS is most often single-fraction treatment; however, multiple fractions may be necessary when lesions are near critical structures.

SBRT is commonly delivered over 3 to 5 fractions.

# **CPT Codes / HCPCS Codes / ICD Codes**

Inclusion or exclusion of a code does not constitute or imply member coverage or provider reimbursement. Please refer to the member's contract benefits in effect at the time of service to determine coverage or non-coverage as it applies to an individual member.

Providers should report all services using the most up-to-date industry-standard procedure, revenue, and diagnosis codes, including modifiers where applicable.

The following codes are included below for informational purposes only; this is not an all-inclusive list.

The above <u>medical necessity criteria MUST</u> be met for the following codes to be covered for Commercial Members: Managed Care (HMO and POS), PPO, and Indemnity:

# **CPT Codes**

CPT codes:	
	Code Description
61796	Stereotactic radiosurgery (particle beam, gamma ray, or linear accelerator); 1 simple cranial lesion
61797	Stereotactic radiosurgery (particle beam, gamma ray, or linear accelerator); each additional cranial lesion, simple
61798	Stereotactic radiosurgery (particle beam, gamma ray, or linear accelerator); 1 complex cranial lesion
61799	Stereotactic radiosurgery (particle beam, gamma ray, or linear accelerator); each additional cranial lesion, complex
61800	Application of stereotactic headframe for stereotactic radiosurgery
77371	Radiation treatment delivery, stereotactic radiosurgery (SRS), complete course of treatment of cranial lesion(s) consisting of 1 session; multi-source Cobalt 60 based

77372	Radiation treatment delivery, stereotactic radiosurgery (SRS), complete course of
	treatment of cranial lesion(s) consisting of 1 session; linear accelerator based
77432	Stereotactic radiation treatment management of cranial lesion(s) (complete course of
	treatment consisting of 1 session)

# **HCPCS Codes**

HCPCS codes:	Code Description
G0339	Image guided robotic linear accelerator-based stereotactic radiosurgery, complete
	course of therapy in one session or first session of fractionated treatment
G0340	Image guided robotic linear accelerator-based stereotactic radiosurgery, delivery
	including collimator changes and custom plugging, fractionated treatment, all lesions,
	per session, second through fifth sessions, maximum 5 sessions per course of
	treatment

# The following ICD Diagnosis Codes are considered medically necessary when submitted with the CPT and/or HCPCS codes above if medical necessity criteria are met:

ICD-10-CM	
Diagnosis	
codes:	Code Description
C69.30	Malignant neoplasm of unspecified choroid
C69.31	Malignant neoplasm of right choroid
C69.32	Malignant neoplasm of left choroid
C69.40	Malignant neoplasm of unspecified ciliary body
C69.41	Malignant neoplasm of right ciliary body
C69.42	Malignant neoplasm of left ciliary body
C70.0	Malignant neoplasm of cerebral meninges
C70.9	Malignant neoplasm of meninges, unspecified
C71.0	Malignant neoplasm of cerebrum, except lobes and ventricles
C71.1	Malignant neoplasm of frontal lobe
C71.2	Malignant neoplasm of temporal lobe
C71.3	Malignant neoplasm of parietal lobe
C71.4	Malignant neoplasm of occipital lobe
C71.5	Malignant neoplasm of cerebral ventricle
C71.6	Malignant neoplasm of cerebellum
C71.7	Malignant neoplasm of brain stem
C71.8	Malignant neoplasm of overlapping sites of brain
C71.9	Malignant neoplasm of brain, unspecified
C72.20	Malignant neoplasm of unspecified olfactory nerve
C72.21	Malignant neoplasm of right olfactory nerve
C72.22	Malignant neoplasm of left olfactory nerve
C72.30	Malignant neoplasm of unspecified optic nerve
C72.31	Malignant neoplasm of right optic nerve
C72.32	Malignant neoplasm of left optic nerve
C72.40	Malignant neoplasm of unspecified acoustic nerve
C72.41	Malignant neoplasm of right acoustic nerve
C72.42	Malignant neoplasm of left acoustic nerve
C72.50	Malignant neoplasm of unspecified cranial nerve
C72.59	Malignant neoplasm of other cranial nerves
C72.9	Malignant neoplasm of central nervous system, unspecified
C75.1	Malignant neoplasm of pituitary gland

# ICD-10 Diagnosis Codes

C75.2	Malignant neoplasm of craniopharyngeal duct
C75.5	Malignant neoplasm of aortic body and other paraganglia
C79.31	Secondary malignant neoplasm of brain
C79.32	Secondary malignant neoplasm of cerebral meninges
C79.40	Secondary malignant neoplasm of unspecified part of nervous system
C79.49	Secondary malignant neoplasm of other parts of nervous system
D32.0	Benign neoplasm of cerebral meninges
D32.9	Benign neoplasm of meninges, unspecified
D33.0	Benign neoplasm of brain, supratentorial
D33.1	Benign neoplasm of brain, infratentorial
D33.2	Benign neoplasm of brain, unspecified
D33.3	Benign neoplasm of cranial nerves
D33.7	Benign neoplasm of other specified parts of central nervous system
D33.9	Benign neoplasm of central nervous system, unspecified
D35.2	Benign neoplasm of pituitary gland
D35.3	Benign neoplasm of craniopharyngeal duct
D42.0	Neoplasm of uncertain behavior of cerebral meninges
D42.9	Neoplasm of uncertain behavior of meninges, unspecified
D43.0	Neoplasm of uncertain behavior of brain, supratentorial
D43.1	Neoplasm of uncertain behavior of brain, infratentorial
D43.2	Neoplasm of uncertain behavior of brain, unspecified
D44.3	Neoplasm of uncertain behavior of pituitary gland
D44.4	Neoplasm of uncertain behavior of craniopharyngeal duct
D44.7	Neoplasm of uncertain behavior of aortic body and other paraganglia
D49.6	Neoplasm of unspecified behavior of brain
D49.7	Neoplasm of unspecified behavior of endocrine glands and other parts of nervous
050.0	system
G50.0	
G93.81	
Q28.2	Arteriovenous malformation of cerebral vessels
Q28.3	Uther malformations of cerebral vessels

The above medical necessity criteria MUST be met for the following codes to be covered for Commercial Members: Managed Care (HMO and POS), PPO, Indemnity, Medicare HMO Blue and Medicare PPO Blue:

# **CPT Codes**

CPT codes:	
	Code Description
63620	Stereotactic radiosurgery (particle beam, gamma ray, or linear accelerator); 1 spinal lesion
63621	Stereotactic radiosurgery (particle beam, gamma ray, or linear accelerator); each additional spinal lesion

# **HCPCS Codes**

HCPCS	
codes:	Code Description
G0339	Image guided robotic linear accelerator-based stereotactic radiosurgery, complete course of therapy in one session or first session of fractionated treatment
G0340	Image guided robotic linear accelerator-based stereotactic radiosurgery, delivery including collimator changes and custom plugging, fractionated treatment, all lesions,

per session, second through fifth sessions, maximum 5 sessions per course of
treatment

# The following ICD Diagnosis Codes are considered medically necessary when submitted with the CPT and/or HCPCS codes above if medical necessity criteria are met:

ICD-10-CM Diagnosis	
codes:	Code Description
C41.2	Malignant neoplasm of vertebral column
C70.1	Malignant neoplasm of spinal meninges
C72.0	Malignant neoplasm of spinal cord
C72.1	Malignant neoplasm of cauda equina
C72.9	Malignant neoplasm of central nervous system, unspecified
D32.1	Benign neoplasm of spinal meninges
D33.4	Benign neoplasm of spinal cord
D33.7	Benign neoplasm of other specified parts of central nervous system
D33.9	Benign Neoplasm of Central Nervous System, Unspecified
D42.1	Neoplasm of uncertain behavior of spinal meninges
D43.4	Neoplasm of uncertain behavior of spinal cord

# **ICD-10 Diagnosis Codes**

The above medical necessity criteria MUST be met for the following codes to be covered for Commercial Members: Managed Care (HMO and POS), PPO, and Indemnity:

# **CPT Codes**

CPT codes:	Code Description
32701	Thoracic target(s) delineation for stereotactic body radiation therapy (SRS/SBRT),
	(photon or particle beam), entire course of treatment
77373	Stereotactic body radiation therapy, treatment delivery, per fraction to 1 or more
	lesions, including image guidance, entire course not to exceed 5 fractions
77435	Stereotactic body radiation therapy, treatment management, per treatment course, to 1
	or more lesions, including image guidance, entire course not to exceed 5 fractions

# **HCPCS Codes**

HCPCS	
codes:	Code Description
G0339	Image guided robotic linear accelerator-based stereotactic radiosurgery, complete course of therapy in one session or first session of fractionated treatment
G0340	Image guided robotic linear accelerator-based stereotactic radiosurgery, delivery including collimator changes and custom plugging, fractionated treatment, all lesions, per session, second through fifth sessions, maximum 5 sessions per course of treatment

The following ICD Diagnosis Codes are considered medically necessary when submitted with the CPT and/or HCPCS codes above if medical necessity criteria are met:

#### ICD-10 Diagnosis Codes

ICD-10-CM Diagnosis	
codes:	Code Description
C18.0	Malignant neoplasm of cecum

C18.1	Malignant neoplasm of appendix	
C18.2	Malignant neoplasm of ascending colon	
C18.3	Malignant neoplasm of hepatic flexure	
C18.4	Malignant neoplasm of transverse colon	
C18.5	Malignant neoplasm of splenic flexure	
C18.6	Malignant neoplasm of descending colon	
C18.7	Malignant neoplasm of sigmoid colon	
C18.8	Malignant neoplasm of overlapping sites of colon	
C18.9	Malignant neoplasm of colon, unspecified	
C19	Malignant neoplasm of rectosigmoid junction	
C20	Malignant neoplasm of rectum	
C22.0		
C22.8	Malignant neoplasm of liver, primary, unspecified as to type	
C25.0	Malignant neoplasm of head of pancreas	
C25.1	Malignant neoplasm of body of pancreas	
C25.2	Malignant neoplasm of tail of pancreas	
C25.3	Malignant neoplasm of pancreatic duct	
C25.4	Malignant neoplasm of endocrine pancreas	
C25.7	Malignant neoplasm of other parts of pancreas	
C25.8	Malignant neoplasm of overlapping sites of pancreas	
C25.9	Malignant neoplasm of pancreas, unspecified	
C34.00	Malignant neoplasm of unspecified main bronchus	
C34.01	Malignant neoplasm of right main bronchus	
C34.02	Malignant neoplasm of left main bronchus	
C34.10	Malignant neoplasm of upper lobe, unspecified bronchus or lung	
C34.11	Malignant neoplasm of upper lobe, right bronchus or lung	
C34.12	Malignant neoplasm of upper lobe, left bronchus or lung	
C34.2	Malignant neoplasm of middle lobe, bronchus or lung	
C34.30	Malignant neoplasm of lower lobe, unspecified bronchus or lung	
C34.31	Malignant neoplasm of lower lobe, right bronchus or lung	
C34.32	Malignant neoplasm of lower lobe, left bronchus or lung	
C34.80	Malignant neoplasm of overlapping sites of unspecified bronchus and lung	
C34.81	Malignant neoplasm of overlapping sites of right bronchus and lung	
C34.82	Malignant neoplasm of overlapping sites of left bronchus and lung	
C34.90	Malignant neoplasm of unspecified part of unspecified bronchus or lung	
C34.91	Malignant neoplasm of unspecified part of right bronchus or lung	
C34.92	Malignant neoplasm of unspecified part of left bronchus or lung	
C40.00	Malignant neoplasm of scapula and long bones of unspecified upper limb	
C40.01	Malignant neoplasm of scapula and long bones of right upper limb	
C40.02	Malignant neoplasm of scapula and long bones of left upper limb	
C40.10	Malignant neoplasm of short bones of unspecified upper limb	
C40.11	Malignant neoplasm of short bones of right upper limb	
C40.12	Malignant neoplasm of short bones of left upper limb	
C40.20	Malignant neoplasm of long bones of unspecified lower limb	
C40.21	Malignant neoplasm of long bones of right lower limb	
C40.22	Malignant neoplasm of long bones of left lower limb	
C40.30	Malignant neoplasm of short bones of unspecified lower limb	
C40.31	Malignant neoplasm of short bones of right lower limb	
C40.32	Malignant neoplasm of short bones of left lower limb	
C40.80	Malignant neoplasm of overlapping sites of bone and articular cartilage of unspecified limb	

C40.81	Malignant neoplasm of overlapping sites of bone and articular cartilage of right limb	
C40.82	Malignant neoplasm of overlapping sites of bone and articular cartilage of left limb	
C40.90	Malignant neoplasm of unspecified bones and articular cartilage of unspecified limb	
C40.91	Malignant neoplasm of unspecified bones and articular cartilage of right limb	
C40.92	Malignant neoplasm of unspecified bones and articular cartilage of left limb	
C41.0	Malignant neoplasm of bones of skull and face	
C41.0	Malignant neoplasm of mandible	
C41.1	Malignant neoplasm of vertebral column	
041.2	Malignant neoplasm of venebral column	
C41.3	Malignant neoplasm of ribs, sternum and clavicle	
C41.4	Malignant neoplasm of pelvic bones, sacrum and coccyx	
C41.9	Malignant neoplasm of bone and articular cartilage, unspecified	
C43.0	Malignant melanoma of lip	
C43.10	Malignant melanoma of unspecified eyelid, including canthus	
C43.111	Malignant melanoma of right upper eyelid, including canthus	
C43.112	Malignant melanoma of right lower eyelid, including canthus	
C43.121	Malignant melanoma of left upper eyelid, including canthus	
C43.122	Malignant melanoma of left lower eyelid, including canthus	
C43.20	Malignant melanoma of unspecified ear and external auricular canal	
C43.21	Malignant melanoma of right ear and external auricular canal	
C43.22	Malignant melanoma of left ear and external auricular canal	
C43.30	Malignant melanoma of unspecified part of face	
C43.31	Malignant melanoma of nose	
C43.39	Malignant melanoma of other parts of face	
C43.4	Malignant melanoma of scalp and neck	
C43.8	Malignant melanoma of overlapping sites of skin	
C43.51	Malignant melanoma of anal skin	
C43.52	Malignant melanoma of skin of breast	
C43.59	Malignant melanoma of other part of trunk	
C43.60	Malignant melanoma of unspecified upper limb, including shoulder	
C43.61	Malignant melanoma of right upper limb, including shoulder	
C43.62	Malignant melanoma of left upper limb, including shoulder	
C43.70	Malignant melanoma of unspecified lower limb, including hip	
C43.71	Malignant melanoma of right lower limb, including hip	
C43.72	Malignant melanoma of left lower limb, including hip	
C43.8	Malignant melanoma of overlapping sites of skin	
C43.9	Malignant melanoma of skin, unspecified	
C49.0	Malignant neoplasm of connective and soft tissue of head, face and neck	
C49.10	Malignant neoplasm of connective and soft tissue of unspecified upper limb, including	
	shoulder	
C49.11	Malignant neoplasm of connective and soft tissue of right upper limb, including shoulder	
C49.12	Malignant neoplasm of connective and soft tissue of left upper limb, including shoulder	
C49.20	Malignant neoplasm of connective and soft tissue of unspecified lower limb, including	
	hip	
C49.21	Malignant neoplasm of connective and soft tissue of right lower limb, including hip	
C49.22	Malignant neoplasm of connective and soft tissue of left lower limb, including hip	
C49.3	Malignant neoplasm of connective and soft tissue of thorax	
C49.4	Malignant neoplasm of connective and soft tissue of abdomen	
C49.5	Malignant neoplasm of connective and soft tissue of pelvis	
C49.6	Malignant neoplasm of connective and soft tissue of trunk, unspecified	
C49.8	Malignant neoplasm of overlapping sites of connective and soft tissue	
C49.9	Malignant neoplasm of connective and soft tissue, unspecified	
C50.011	Malignant neoplasm of nipple and areola, right female breast	
C50.012	Malignant neoplasm of nipple and areola, left female breast	

C50.019	Malignant neoplasm of nipple and areola, unspecified female breast
C50.021	Malignant neoplasm of nipple and areola, right male breast
C50.022	Malignant neoplasm of nipple and areola, left male breast
C50.029	Malignant neoplasm of nipple and areola, unspecified male breast
C50.111	Malignant neoplasm of central portion of right female breast
C50.112	Malignant neoplasm of central portion of left female breast
C50.119	Malignant neoplasm of central portion of unspecified female breast
C50.121	Malignant neoplasm of central portion of right male breast
C50.122	Malignant neoplasm of central portion of left male breast
C50.129	Malignant neoplasm of central portion of unspecified male breast
C50.211	Malignant neoplasm of upper-inner quadrant of right female breast
C50.212	Malignant neoplasm of upper-inner quadrant of left female breast
C50.219	Malignant neoplasm of upper-inner quadrant of unspecified female breast
C50.221	Malignant neoplasm of upper-inner quadrant of right male breast
C50.222	Malignant neoplasm of upper-inner quadrant of left male breast
C50.229	Malignant neoplasm of upper-inner quadrant of unspecified male breast
C50.311	Malignant neoplasm of lower-inner quadrant of right female breast
C50.312	Malignant neoplasm of lower-inner quadrant of left female breast
C50.319	Malignant neoplasm of lower-inner quadrant of unspecified female breast
C50.321	Malignant neoplasm of lower-inner quadrant of right male breast
C50.322	Malignant neoplasm of lower-inner quadrant of left male breast
C50.329	Malignant neoplasm of lower-inner quadrant of unspecified male breast
C50.411	Malignant neoplasm of upper-outer quadrant of right female breast
C50.412	Malignant neoplasm of upper-outer quadrant of left female breast
C50.419	Malignant neoplasm of upper-outer quadrant of unspecified female breast
C50.421	Malignant neoplasm of upper-outer quadrant of right male breast
C50.422	Malignant neoplasm of upper-outer quadrant of left male breast
C50.429	Malignant neoplasm of upper-outer quadrant of unspecified male breast
C50.511	Malignant neoplasm of lower-outer quadrant of right female breast
C50.512	Malignant neoplasm of lower-outer quadrant of left female breast
C50.519	Malignant neoplasm of lower-outer quadrant of unspecified female breast
C50.521	Malignant neoplasm of lower-outer quadrant of right male breast
C50.522	Malignant neoplasm of lower-outer quadrant of left male breast
C50.529	Malignant neoplasm of lower-outer quadrant of unspecified male breast
C50.611	Malignant neoplasm of axillary tail of right female breast
C50.612	Malignant neoplasm of axillary tail of left female breast
C50.619	Malignant neoplasm of axillary tail of unspecified female breast
C50.621	Malignant neoplasm of axillary tail of right male breast
C50.622	Malignant neoplasm of axillary tail of left male breast
C50.629	Malignant neoplasm of axillary tail of unspecified male breast
C50.811	Malignant neoplasm of overlapping sites of right female breast
C50.812	Malignant neoplasm of overlapping sites of left female breast
C50.819	Malignant neoplasm of overlapping sites of unspecified female breast
C50.821	Malignant neoplasm of overlapping sites of right male breast
C50.822	Malignant neoplasm of overlapping sites of left male breast
C50.829	Malignant neoplasm of overlapping sites of unspecified male breast
C50.911	Malignant neoplasm of unspecified site of right female breast
C50.912	Malignant neoplasm of unspecified site of left female breast
C50.919	Malignant neoplasm of unspecified site of unspecified female breast
C50.921	Malignant neoplasm of unspecified site of right male breast
C50.922	Malignant neoplasm of unspecified site of left male breast
C50.929	Malignant neoplasm of unspecified site of unspecified male breast
C61	Malignant neoplasm of prostate

C64.1	Malignant neoplasm of right kidney, except renal pelvis	
C64.2	Malignant neoplasm of left kidney, except renal pelvis	
C64.9	Malignant neoplasm of unspecified kidney, except renal pelvis	
C68.8	Malignant neoplasm of overlapping sites of urinary organs	
C68.9	Malignant neoplasm of urinary organ, unspecified	
C69.30	Malignant neoplasm of unspecified choroid	
C69.31	Malignant neoplasm of right choroid	
C69.32	Malignant neoplasm of left choroid	
C70.1	Malignant neoplasm of spinal meninges	
C71.0	Malignant neoplasm of cerebrum, except lobes and ventricles	
C71.1	Malignant neoplasm of frontal lobe	
C71.2	Malignant neoplasm of temporal lobe	
C71.3	Malignant neoplasm of parietal lobe	
C71.4	Malignant neoplasm of occipital lobe	
C71.5	Malignant neoplasm of cerebral ventricle	
C71.6	Malignant neoplasm of cerebellum	
C71.7	Malignant neoplasm of brain stem	
C71.8	Malignant neoplasm of overlapping sites of brain	
C71.9	Malignant neoplasm of brain, unspecified	
C72.0	Malignant neoplasm of spinal cord	
C72.1	Malignant neoplasm of cauda equina	
C72.9	Malignant neoplasm of central nervous system, unspecified	
C74.00	Malignant neoplasm of cortex of unspecified adrenal gland	
C74.01	Malignant neoplasm of cortex of right adrenal gland	
C74.02	Malignant neoplasm of cortex of left adrenal gland	
C74.10	Malignant neoplasm of medulla of unspecified adrenal gland	
C74.11	Malignant neoplasm of medulla of right adrenal gland	
C74.12	Malignant neoplasm of medulla of left adrenal gland	
C74.90	Malignant neoplasm of unspecified part of unspecified adrenal gland	
C74.91	Malignant neoplasm of unspecified part of right adrenal gland	
C74.92	Malignant neoplasm of unspecified part of left adrenal gland	
C78.00	Secondary malignant neoplasm of unspecified lung	
C78.01	Secondary malignant neoplasm of right lung	
C78.02	Secondary malignant neoplasm of left lung	
C78.5	Secondary malignant neoplasm of large intestine and rectum	
C78.7	Secondary malignant neoplasm of liver and intrahepatic bile duct	
C79.00	Secondary malignant neoplasm of unspecified kidney and renal pelvis	
C79.01	Secondary malignant neoplasm of right kidney and renal pelvis	
C79.09	Secondary malignant neoplasm of left kidney and renal pelvis	
C79.31	Secondary malignant neoplasm of brain	
C79.32	Secondary malignant neoplasm of cerebral meninges	
C79.40	Secondary Malignant Neoplasm of Unspecified Part of Nervous System	
C79.49	Secondary Malignant Neoplasm of Other Parts of Nervous System	
C79.51	Secondary malignant neoplasm of bone	
C79.52	Secondary malignant neoplasm of bone marrow	
C79.81	Secondary malignant neoplasm of breast	
C7A.022	Malignant carcinoid tumor of the ascending colon	
C7A.023	Malignant carcinoid tumor of the transverse colon	
C7A.024	Malignant carcinoid tumor of the descending colon	
C7A.025	Malignant carcinoid tumor of the sigmoid colon	
C7A.026	Malignant carcinoid tumor of the rectum	

C7A.029	Malignant carcinoid tumor of the large intestine, unspecified portion
C96.4	Sarcoma of dendritic cells (accessory cells)
D02.20	Carcinoma in situ of unspecified bronchus and lung
D02.21	Carcinoma in situ of right bronchus and lung
D02.22	Carcinoma in situ of left bronchus and lung
D32.1	Benign neoplasm of spinal meninges
D33.0	Benign neoplasm of brain, supratentorial
D33.1	Benign neoplasm of brain, infratentorial
D33.2	Benign neoplasm of brain, unspecified
D33.4	Benign neoplasm of spinal cord
D33.7	Benign Neoplasm of Other Specified Parts of Central Nervous System
D33.9	Benign Neoplasm of Central Nervous System, Unspecified
D35.2	Benign neoplasm of pituitary gland
D35.4	Benign neoplasm of pineal gland
D42.1	Neoplasm of Uncertain Behavior of Spinal meninges
D42.9	Neoplasm of Uncertain Behavior Of meninges, Unspecified
D43.4	Neoplasm of uncertain behavior of spinal cord
G50.0	Trigeminal neuralgia
Q28.2	Arteriovenous malformation of cerebral vessels

# **Prior Authorization Information**

#### Inpatient

 For services described in this policy, precertification/preauthorization <u>IS REQUIRED</u> for all products if the procedure is performed <u>inpatient</u>.

#### Outpatient

 For services described in this policy, see below for products where prior authorization <u>might be</u> <u>required</u> if the procedure is performed <u>outpatient</u>.

	Outpatient
Commercial Managed Care (HMO and POS)	Prior authorization is <b>not required</b> .
Commercial PPO and Indemnity	Prior authorization is <b>not required</b> .
Medicare HMO Blue <sup>sM</sup>	Prior authorization is <b>not required</b> .
Medicare PPO Blue <sup>sm</sup>	Prior authorization is <b>not required</b> .

# Description

#### **Conformal Radiotherapy**

Stereotactic radiosurgery (SRS) and stereotactic body radiotherapy (SBRT) are techniques that use highly focused, conformal radiation beams to treat both neoplastic and non-neoplastic conditions. Although SRS and SBRT may be completed with one session (single-fraction), SRS typically refers to a single-session procedure to ablate the target lesion. However, either technique may require additional sessions (typically not >5) over a course of days, referred to as fractionated radiotherapy.

Platforms available for SRS and SBRT are distinguished by their source of radiation; they include gamma radiation from cobalt 60 sources; high-energy photons from linear accelerator (LINAC) systems; and particle beams (eg, protons). Particle beam therapy is not covered in this evidence review.

SRS and SBRT have been used for a range of malignant and nonmalignant conditions. A comprehensive assessment that encompasses all potential uses is beyond the scope of this evidence review. Thus, a brief introduction follows for common applications of SRS and SBRT for which published evidence has been identified in database searches.

# Summary

Stereotactic radiosurgery (SRS) and stereotactic body radiotherapy (SBRT) are 3-dimensional conformal radiotherapy methods that deliver highly focused, convergent radiotherapy beams on a target that is defined with 3-dimensional imaging techniques with the ability to spare adjacent radiosensitive structures. SRS primarily refers to such radiotherapy applied to intracranial lesions. SBRT refers to therapy generally applied to other areas of the body. Both techniques differ from conventional external-beam radiotherapy, which involves exposing large areas of tissue to relatively broad fields of radiation over multiple sessions. The following conclusions are based on a review of the evidence, including, but not limited to, published evidence and clinical expert opinion solicited via BCBSA's Clinical Input Process.

#### Stereotactic Radiosurgery

For individuals who have non-neoplastic intracranial conditions (eq. arteriovenous malformations, trigeminal neuralgia), non-neoplastic neurologic conditions (eg, epilepsy, tremor and movement disorders, chronic pain), benign neoplastic intracranial lesion(s) (eq. acoustic neuromas, pituitary adenoma, meningiomas, craniopharyngioma, glomus jugulare tumors), and malignant neoplastic intracranial lesion(s) (eq, gliomas, astrocytomas, brain metastases), or uveal melanoma who receive SRS, the evidence includes randomized controlled trials (RCTs), nonrandomized retrospective cohort studies, and observational studies or case series. The relevant outcomes are overall survival (OS), symptoms, and treatment-related morbidity. General limitations of the body of evidence include a lack of trials that directly compare SRS with comparators, patient heterogeneity within and between studies, and failure to use standardized methods to collect and report outcomes (benefits and harms). There are several contextual factors to consider, such as SRS offers a noninvasive, highly precise radiotherapy alternative to surgery (particularly important for patients unable to undergo resection due to the presence of underlying comorbidities), intracranial lesions often are difficult to access surgically (and may be associated with a high-risk for devastating adverse sequelae), intracranial lesions typically are located adjacent to vital organs and structures that are highly susceptible to radiation toxicities, and the accuracy and precision of SRS in this context make this technique a viable alternative to standard, nonconformal external-beam radiotherapy. Finally, given the rarity of many of the conditions under review, direct comparative trials are unlikely.

The evidence is sufficient to determine that the technology results in a meaningful improvement in the net health outcome for patients with:

- arteriovenous malformations;
- trigeminal neuralgia refractory to medical management;
- acoustic neuromas;
- pituitary adenomas;
- nonresectable residual or recurrent meningiomas;
- malignant neoplastic intracranial lesion(s) (eg, gliomas, astrocytomas); and
- solitary or multiple brain metastases.

**For individuals with epilepsy (primary or secondary tumor-related),** the evidence for the use of SRS as a treatment for epilepsy includes case reports in primary epileptic disorders and case reports for tumor-related epilepsy. The relevant outcomes are symptoms and treatment-related morbidity. The evidence is insufficient to determine the effects of the technology on health outcomes.

**For individuals with mesial temporal lobe epilepsy** refractory to medical management, the published evidence for the use of SRS includes a pilot prospective noncomparative intervention and a single RCT comparing SRS to anterior temporal lobectomy (ATL). The relevant outcomes are symptoms and treatment-related morbidity. The RCT did not meet participant accrual targets and, thus, did not demonstrate the noninferiority of SRS to ATL. Seizure remission rates between 25 and 36 months were reported on a total of 58 patients (31 in SRS arm and 27 in ATL arm). Seizure remission rates suggest that ATL (78%) has an advantage over SRS (52%) in terms of proportion with seizure remission. The published evidence for SRS in mesial temporal lobe epilepsy is insufficient. However, in 2018, clinical expert opinion input reported the less-invasive nature of SRS with acceptable seizure remission rates over time may be appropriate for the specific subpopulation of patients with mesial temporal epilepsy refractory to medical management when the standard alternative treatments are not an option. Thus, for

this specific subpopulation, SRS would provide a clinically meaningful improvement in net health outcome. The evidence is sufficient to determine the impact of the technology results in a meaningful improvement in the net health outcome.

**For individuals with tremor and movement disorder**, the evidence related to the use of SRS includes a systematic review and uncontrolled cohort studies, many of which reported outcomes from the treatment of tremors of varying etiologies. There is a retrospective analysis of a single-center experience. The relevant outcomes are symptoms and treatment-related morbidity. Most studies report improvements in standardized tremor scores, although few studies used a blinded evaluation of tremor score, allowing for bias in assessment. No studies comparing SRS with alternative methods of treatment or a control group were identified. Limited long-term follow-up is available, making the long-term risk-benefit ratio of an invasive therapy uncertain. Clinical expert opinion input reported systematic reviews of retrospective studies that reported a reduction in tremors after SRS but confirmed that alternative approaches to thalamotomy are appropriate. The evidence is insufficient to determine the effects of the technology on health outcomes.

**For individuals with chronic pain syndromes** refractory to standard medical and psychological treatments, the evidence includes a systematic review of noncomparative studies. The relevant outcomes are symptoms and treatment-related morbidity. Clinical expert opinion input reported that intracranial SRS for treatment of chronic pain (other than associated with trigeminal neuralgia) was not an appropriate alternative to other surgical interventions. The evidence is insufficient to determine the effects of the technology on health outcomes.

For individuals in the subgroup of uncommon benign neoplastic intracranial lesions (acoustic neuroma, pituitary adenoma, craniopharyngioma, and glomus jugulare tumors) the published evidence for the use of SRS remains limited to systematic reviews of nonrandomized observational studies, other nonrandomized observational studies, and case series. The relevant outcomes are symptoms and treatment-related morbidity. These reports would suggest that long-term outcomes of fractionated radiosurgery for these benign neoplasms are associated with good local control and, acceptable treatment-related side effects. The likelihood of high-quality systematically acquired evidence is low due to the rarity of the conditions and the published evidence is insufficient to determine the effects of the technology on health outcomes. However, in 2018, clinical expert opinion input continues to support an individualized approach to the use of SRS for these tumors with the recognition that outcomes are affected by factors such as the location of the tumor and type of SRS used (hypofractionated, fractionated or single-session treatment). Thus, for the subpopulation of patients with uncommon benign neoplastic intracranial tumors (acoustic neuroma, pituitary adenoma craniopharyngioma, and glomus jugulare tumors), SRS would provide a clinically meaningful improvement in net health outcome. The evidence is sufficient to determine the impact of the technology results in a meaningful improvement in the net health outcome.

**For individuals with uveal melanoma**, evidence for use of SRS is limited to case series. The relevant outcomes are OS survival, symptoms, and treatment-related morbidity. The published literature is insufficient to demonstrate improved outcomes with SRS over other accepted radiation modalities in the treatment of uveal melanoma. The condition is rare with poor clinical outcomes and treatment options. There are currently no active clinical trials to evaluate SRS to treat uveal melanoma and, therefore, there are limited prospects for accumulating additional high-quality data. In 2018, clinical expert opinion input reported that the use of SRS to treat uveal melanoma could provide patients with low-risk disease (based on tumor size using the Collaborative Ocular Melanoma Study definition of small and medium) an option to avoid or postpone enucleation with preservation of some visual acuity and functional abilities. Thus, for individuals with uveal melanoma, SRS would provide a clinically meaningful improvement in net health outcome. The evidence is sufficient to determine the impact of the technology results in a meaningful improvement in the net health outcome.

#### Stereotactic Body Radiotherapy

For individuals with primary and metastatic spinal or vertebral body tumors who have received prior radiotherapy who are treated with SBRT, the observational literature primarily addresses metastases that

recur after prior radiotherapy. The relevant outcomes are OS survival, symptoms, and treatment-related morbidity. Repeat administration of conventional radiation therapy increases the risk of treatment-related myelopathies. Nonrandomized study results are sufficient to determine that SBRT improves outcomes (reduce pain) in patients with spinal (vertebral) tumors. In addition, in 2018, clinical expert opinion input reported that SBRT is an important treatment option for patients whose spinal tumors have had prior radiotherapy because of the ability to spare the spinal cord and escalate tumor dose. Thus, for individuals with primary or metastatic spinal or vertebral body tumors in patients who have received prior spinal radiotherapy, SBRT would provide a clinically meaningful improvement in net health outcome. The evidence is sufficient to determine the impact of the technology results in a meaningful improvement in the net health outcome.

**For individuals with non-small cell lung cancer** there is no direct comparative evidence for the use of SBRT compared to surgical resection in patients with stage T1 and T2a without the nodal or distant disease. The relevant outcomes are OS survival, symptoms, and treatment-related morbidity. The published evidence is insufficient to determine the effect on net health outcomes. However, observational data and safety and efficacy results of an Australian randomized phase III trial of SBRT for patients with early-stage lung cancer (reported in abstract form) indicate that survival rates may be similar for these patients and those who are not candidates for surgical resection because of comorbid conditions. In 2018, clinical expert opinion input continued to support that SBRT is an important treatment option for patients who are poor surgical candidates or who do not wish to undergo surgery. Thus, for this specific subpopulation, SBRT would provide a clinically meaningful improvement in net health outcome. The evidence is sufficient to determine the impact of the technology results in a meaningful improvement in the net health outcome.

For individuals with primary hepatocellular carcinoma, there are no RCTs reported on the use of SBRT for hepatocellular carcinoma. The relevant outcomes are OS survival, symptoms, and treatmentrelated morbidity. Studies have used heterogeneous treatment schedules, treatment planning techniques, patient populations, and outcome measures. The optimal dose and fractionation scheme are unknown. Although promising local control rates of 71% to 100% at 1 year have been reported, there is only retrospective study reporting on the use of SBRT in conjunction with or as an alternative to established treatment modalities, including systemic therapy, radiofrequency ablation, and transarterial chemoembolization. Similar short-term lesion-control rates have been reported for metastatic liver disease. Palliative treatment, including for larger lesions (>3 cm), has also been reported. The use of SBRT, either alone or in conjunction with other liver-directed therapies, is emerging as a bridge to transplant. Overall, the evidence from published literature is insufficient to determine the effect on net health outcomes. However, clinical expert opinion input confirmed the lack of RCTs and reported on nonrandomized observational studies that support the use of SBRT as an alternative locoregional treatment for patients with inoperable primary hepatocellular carcinoma or metastatic lesions. Clinical input also referred to national guidelines that have rendered the same recommendation. Thus, for this specific subpopulation including primary or metastatic tumor of the liver that is considered inoperable, SBRT would provide a clinically meaningful improvement in net health outcomes. The evidence is sufficient to determine the impact of the technology results in a meaningful improvement in the net health outcome.

#### **SBRT for Prostate Cancer**

SBRT for prostate cancer is an emerging modality. This technology delivers a high biologic dose of radiation over a short period of time. The hypofraction associated with SBRT shortens the treatment time to five visits, compared to the 7 to 9 weeks typically required for IMRT. This shortened treatment time is (one week vs 8 to 9 weeks) is appreciated by individuals. The key outcomes include both tumor control and toxicity, primarily focusing on acute and chronic rectal and genitourinary complications. While there have been no controlled studies directly comparing SBRT and alternative techniques of conformal therapy (for example, IMRT) many prospective case series and retrospective cohort studies of subjects with localized low-risk and intermediate-risk prostate cancer and prolonged life expectancies have consistently reported that SBRT is associated with an acceptable toxicity profile and tumor control that is comparable to other radiation techniques. As with other treatments for prostate cancer, it is unlikely that randomized comparisons will be performed. Published studies to date include single institution reports,

multi-institutional phase I/II studies looking at dose and systematic reviews. Hannan has recently published five-year results of a prospective phase I/II trial of SBRT in 91 low-risk to intermediate-risk patients. About two-thirds of the patients had intermediate-risk disease. Doses of 45-50 Gy in five fractions were given. The five-year freedom from biochemical failure was 98.6%. Grade 3 or greater late urinary and gastrointestinal toxicities were 5.5% and 7%, respectively. The highest rates of toxicity were seen in the 50 Gy cohort and the authors recommend against this dose. At the lower doses, toxicities are similar to that seen in dose-escalated IMRT. The most recent systematic review of SBRT for prostate cancer looked at 1,472 patients in 14 studies. The most common fractionation ranged from 35-36.25 Gy in five fractions. Most of these reports were for patients treated with Cyberknife. Biochemical progression-free survival ranged from 81%-100%. Acute and late grade 3 urinary and gastrointestinal toxicities ranged from 0-0.5% (acute) to 0.5%-1.3% (late). In May 2013, ASTRO updated its Model Policy for SBRT and states "It is ASTRO's opinion that data supporting the use of SBRT for prostate cancer have matured to a point where SBRT could be considered an appropriate alternative for select patients with low to intermediate risk disease."

#### SBRT for Pancreatic Cancer

Initial experience with single fraction SBRT for unresectable pancreatic cancer resulted in favorable local control rates but high rates of late gastrointestinal complications. Subsequent studies using fractionated SBRT have shown lower rates of late toxicity. A recent retrospective review of locally advanced pancreatic cancer cases in the National Cancer Database (NCDB) compared outcomes between 7,819 patients treated with conventional radiation with outcomes in 631 patients treated with SBRT. Two-year overall survival was 16.3% with conventional radiation versus 20.3% in patients treated with SBRT (p<0.001). This benefit was maintained in the propensity matched analysis. Another retrospective study compared outcomes in the NCDB between chemo alone, chemo plus EBRT, chemo plus IMRT and chemo plus SBRT. Median overall survival results were 9.9 months, 10.9 months, 12 months and 13.9 months respectively. For the match propensity cohort, overall survival was superior with SBRT versus chemotherapy alone (p<0.018). SBRT is considered medically necessary for the treatment of locally advanced, non-metastatic adenocarcinoma of the pancreas.

For individuals with renal cell carcinoma (RCC), the evidence for the use of SBRT consists of small case series, a systematic review of case series and retrospective reviews. The relevant outcomes are OS survival, symptoms, and treatment-related morbidity. Generally, high rates of local control have been reported for primary RCC. Adverse effects include nephron loss and kidney shrinkage, however, avoidance of nephrectomy in patients with hypertension or solitary kidney may be desirable. RCC is considered to be relatively radioresistant. Case series have reported good local control in patients with spinal metastases. There are no RCTs that have evaluated SBRT for primary RCC or metastatic lesions to the brain or spine that permit comparisons between SBRT and currently established treatment modalities for RCC. The published evidence is insufficient to determine that the impact of the technology results in an improvement in the net health outcome. Limited clinical expert opinion input reported that SBRT may be appropriate for patients with primary RCC who are not good surgical candidates and, for relapsed or stage IV disease referred to guideline-based recommendations. Thus, for this specific subpopulation, SBRT would provide a clinically meaningful improvement in net health outcome. The evidence is sufficient to determine the impact of the technology results in a meaningful improvement in the net health outcome.

**For individuals with** <u>oligometastatic disease</u>, the evidence for the use of SBRT for the management of oligometastases at multiple sites, including the lungs, adrenal glands, and bones (other than spine or vertebral body) consists of relatively small, noncomparative studies that confirm clinically important rates of local control. The relevant outcomes are OS survival, symptoms, and treatment-related morbidity. Systemic therapy is most frequently the preferred therapy for patients with metastatic disease of these selected tumor types. The published evidence is insufficient to determine that the technology results in a meaningful improvement in the net health outcome. Limited clinical expert opinion input reported that given the emergence of highly effective systemic therapies; SBRT used to treat oligo progression maintains the patient on the same line of systemic therapy, delaying the need for another line of therapy that is likely to be less effective. Clinical input also reported that SBRT may represent the singular option for some patients with oligometastatic disease that includes one or both adrenal glands in

patients who are poor surgical and radiofrequency ablation candidates. Thus, for this specific subpopulation, SBRT would provide a clinically meaningful improvement in net health outcome. The evidence is sufficient to determine the impact of the technology results in a meaningful improvement in the net health outcome.

Date	Action
1/2021	SBRT: New medically necessary indications and criteria described for: pancreatic
	cancer, prostate cancer, spine lesions; primary or metastatic lesions of the spine,
	and extracranial oligometastatic disease based on expert opinion. SBRT clinical
	exception form #922 retired. Effective 1/1/2021.
	SRS: New medically necessary indications and criteria described for: intracranial
	lesions, ocular lesions, and other neurologic conditions; trigeminal neuralgia. Effective
	1/1/2021.
	SRS or SBRT: New medically necessary indications and criteria described for: bone
	metastases. Clarified coding information. Effective 1/1/2021.
	Medicare information removed. See MP #132 Medicare Advantage Management for
	local coverage determination and national coverage determination reference.
1/2020	BCBSA National medical policy review. Description, summary and references updated.
	Policy statements unchanged.
6/2019	BCBSA National medical policy review. New medically necessary indications described.
	Investigational statements revised. Clarified coding information. Effective 6/1/2019.
2/2019	Clarified coding language
12/2017	BCBSA National medical policy review. Medically necessary criteria clarified.
11/2016	SBRT Clinical Exception Form for Prostate Cancer clarified.
11/2015	New references added from BCBSA National medical policy.
2/2015	BCBSA National medical policy review. New investigational indications described.
	Clarified coding information. Effective 2/1/2015.
1/2015	Clarified coding information.
8/2014	Clinical exception clarified.
7/2014	Clinical exception clarified. Coding information clarified.
5/2014	Updated Coding section with ICD10 procedure and diagnosis codes. Effective 10/2015.
3/2014	BCBSA National medical policy review. New investigational indications described.
	Effective 3/2014.
1/2014	Coding information clarified.
2/2013	BCBSA National medical policy review. Changes to policy statement. Effective
4/0040	
1/2013	Updated to add new CPT code 32701.
11/2011-	Medical policy ICD 10 remediation: Formatting, editing and coding updates. No changes
4/2012	to policy statements.
7/2011	Reviewed - Medical Policy Group - Hematology and Oncology. No changes to policy
4/0044	Statements.
1/2011	Reviewed - Medical Policy Group - Neurology and Neurosurgery. No changes to policy
6/2010	Statements.
0/2010	BOBSA policy review. No changes to policy statements.
1/2010	Reviewed - Medical Policy Group - Neurology and Neurosurgery. No changes to policy
0/1/2000	Statements. BCBSA policy roview. Changes to policy statement
1/2009	Boulowed Medical Policy Group, Neurology and Neurosurgery. No changes to policy
1/2009	statements
1/2008	Reviewed - Medical Policy Group - Neurology No changes to policy statements
1/2000	Reviewed - Medical Policy Group - Neurology. No changes to policy statements
1/2007	Treviewed - medical Folicy Group - mediology. No changes to policy statements.

# **Policy History**

# Information Pertaining to All Blue Cross Blue Shield Medical Policies

Click on any of the following terms to access the relevant information: <u>Medical Policy Terms of Use</u> <u>Managed Care Guidelines</u> <u>Indemnity/PPO Guidelines</u> <u>Clinical Exception Process</u> <u>Medical Technology Assessment Guidelines</u>

# References

- 1. Mohr JP, Parides MK, Stapf C, et al. Medical management with or without interventional therapy for unruptured brain arteriovenous malformations (ARUBA): a multicentre, non-blinded, randomised trial. Lancet. Feb 15 2014;383(9917):614-621. PMID 24268105
- Magro E, Gentric JC, Darsaut TE, et al. Responses to ARUBA: a systematic review and critical analysis for the design of future arteriovenous malformation trials. J Neurosurg. Feb 2017;126(2):486-494. PMID 27128584
- Mau CY, Sabourin VM, Gandhi CD, et al. SLAM: Stereotactic Radiosurgery of Large Arteriovenous Malformations: meta-analysis of hemorrhage in high-grade Pollock-Flickinger arteriovenous malformations. World Neurosurg. Jan 2016;85:32-41. PMID 26325212
- 4. Bowden G, Kano H, Tonetti D, et al. Stereotactic radiosurgery for arteriovenous malformations of the cerebellum. J Neurosurg. Mar 2014;120(3):583-590. PMID 24160482
- Fokas E, Henzel M, Wittig A, et al. Stereotactic radiosurgery of cerebral arteriovenous malformations: long-term follow-up in 164 patients of a single institution. J Neurol. Aug 2013;260(8):2156-2162. PMID 23712798
- Kano H, Kondziolka D, Flickinger JC, et al. Stereotactic radiosurgery for arteriovenous malformations, Part 6: multistaged volumetric management of large arteriovenous malformations. J Neurosurg. Jan 2012;116(1):54-65. PMID 22077447
- Matsuo T, Kamada K, Izumo T, et al. Linear accelerator-based radiosurgery alone for arteriovenous malformation: more than 12 years of observation. Int J Radiat Oncol Biol Phys. Jul 1 2014;89(3):576-583. PMID 24803036
- Paul L, Casasco A, Kusak ME, et al. Results for a series of 697 AVMs reated by Gamma Knife: Influence of angiographic features on the obliteration rate. Neurosurgery. Jul 18 2014;75(5):568-583; dicussion 582-563; quiz 583. PMID 25050575
- Potts MB, Sheth SA, Louie J, et al. Stereotactic radiosurgery at a low marginal dose for the treatment of pediatric arteriovenous malformations: obliteration, complications, and functional outcomes. J Neurosurg Pediatr. Jul 2014;14(1):1-11. PMID 24766309
- Cohen-Inbar O, Lee CC, Xu Z, et al. A quantitative analysis of adverse radiation effects following Gamma Knife radiosurgery for arteriovenous malformations. J Neurosurg. Oct 2015;123(4):945-953. PMID 25909572
- Ding D, Starke RM, Kano H, et al. Stereotactic radiosurgery for Spetzler-Martin Grade III arteriovenous malformations: an international multicenter study. J Neurosurg. Apr 15 2016:1-13. PMID 27081906
- Ding D, Starke RM, Kano H, et al. Radiosurgery for cerebral arteriovenous malformations in A Randomized Trial of Unruptured Brain Arteriovenous Malformations (ARUBA)-eligible patients: a multicenter study. Stroke. Feb 2016;47(2):342-349. PMID 26658441
- Ding D, Xu Z, Yen CP, et al. Radiosurgery for cerebral arteriovenous malformations in elderly patients: effect of advanced age on outcomes after intervention. World Neurosurg. Sep 2015;84(3):795-804. PMID 25997797
- Hanakita S, Shin M, Koga T, et al. Risk reduction of cerebral stroke after stereotactic radiosurgery for small unruptured brain arteriovenous malformations. Stroke. May 2016;47(5):1247-1252. PMID 27073242
- Starke RM, Kano H, Ding D, et al. Stereotactic radiosurgery for cerebral arteriovenous malformations: evaluation of long-term outcomes in a multicenter cohort. J Neurosurg. Mar 4 2016:1-9. PMID 26943847

- El-Ghanem M, Kass-Hout T, Kass-Hout O, et al. Arteriovenous Malformations in the Pediatric Population: Review of the Existing Literature. Interv Neurol. Sep 2016;5(3-4):218-225. PMID 27781052
- Tonetti D, Kano H, Bowden G, et al. Hemorrhage during pregnancy in the latency interval after stereotactic radiosurgery for arteriovenous malformations. J Neurosurg. Dec 2014;121 Suppl:226-231. PMID 25434957
- Headache Classification Committee of the International Headache Society. The International Classification of Headache Disorders. 3rd Edition (beta version). Cephalgia. Jul 2013;33(9):629-808. PMID 23771276
- 19. Zakrzewska JM, Akram H. Neurosurgical interventions for the treatment of classical trigeminal neuralgia. Cochrane Database Syst Rev. Sep 07 2011(9):Cd007312. PMID 21901707
- 20. Yen CP, Schlesinger D, Sheehan JP. Gamma Knife(R) radiosurgery for trigeminal neuralgia. Expert Rev Med Devices. Nov 2011;8(6):709-721. PMID 22029468
- 21. Dhople AA, Adams JR, Maggio WW, et al. Long-term outcomes of Gamma Knife radiosurgery for classic trigeminal neuralgia: implications of treatment and critical review of the literature. Clinical article. J Neurosurg. Aug 2009;111(2):351-358. PMID 19326987
- 22. Barbaro NM, Quigg M, Ward MM, et al. Radiosurgery versus open surgery for mesial temporal lobe epilepsy: the randomized, controlled ROSE trial. Epilepsia. Jun 2018;59(6):1198-1207. PMID 29600809
- Quigg M, Barbaro NM, Ward MM et al. Visual field defects after radiosurgery versus temporal lobectomy for mesial temporal lobe epilepsy: Findings of the ROSE trial.. Seizure, 2018 Nov 9;63:62-67. PMID 30408713
- 24. Feng ES, Sui CB, Wang TX, et al. Stereotactic radiosurgery for the treatment of mesial temporal lobe epilepsy. Acta Neurol Scand. Dec 2016;134(6):442-451. PMID 26846702
- Blue Cross and Blue Shield Association. Special report: stereotactic radiosurgery for intracranial lesions by gamma beam, linear accelerator, and proton beam methods. Jan 1999:26-27. PMID 10346748
- 26. Regis J, Bartolomei F, Rey M, et al. Gamma knife surgery for mesial temporal lobe epilepsy. J Neurosurg. Dec 2000;93 Suppl 3:141-146. PMID 11143232
- 27. Schrottner O, Eder HG, Unger F, et al. Radiosurgery in lesional epilepsy: brain tumors. Stereotact Funct Neurosurg. Oct 1998;70 Suppl 1:50-56. PMID 9782235
- 28. Whang CJ, Kwon Y. Long-term follow-up of stereotactic Gamma Knife radiosurgery in epilepsy. Stereotact Funct Neurosurg. Jan 1996;66(Suppl 1):349-356. PMID 9032879
- 29. Dallapiazza RF, Lee DJ, De Vloo P et al. Outcomes from stereotactic surgery for essential tremor.. J. Neurol. Neurosurg. Psychiatry, 2018 Oct 20;90(4). PMID 30337440
- 30. Raju SS, Niranjan A, Monaco EA et al. Stereotactic radiosurgery for medically refractory multiple sclerosis-related tremor.. J. Neurosurg., 2017 Jul 1;128(4). PMID 28665251
- Niranjan A, Raju SS, Kooshkabadi A, et al. Stereotactic radiosurgery for essential tremor: Retrospective analysis of a 19-year experience. Mov Disord. May 2017;32(5):769-777. PMID 28319282
- 32. Witjas T, Carron R, Krack P, et al. A prospective single-blind study of Gamma Knife thalamotomy for tremor. Neurology. Nov 03 2015;85(18):1562-1568. PMID 26446066
- 33. Kooshkabadi A, Lunsford LD, Tonetti D, et al. Gamma Knife thalamotomy for tremor in the magnetic resonance imaging era. J Neurosurg. Apr 2013;118(4):713-718. PMID 23373801
- Ohye C, Higuchi Y, Shibazaki T, et al. Gamma knife thalamotomy for Parkinson disease and essential tremor: a prospective multicenter study. Neurosurgery. Mar 2012;70(3):526-535; discussion 535-526. PMID 21904267
- 35. Lim SY, Hodaie M, Fallis M, et al. Gamma knife thalamotomy for disabling tremor: a blinded evaluation. Arch Neurol. May 2010;67(5):584-588. PMID 20457958
- 36. Kondziolka D, Ong JG, Lee JY, et al. Gamma Knife thalamotomy for essential tremor. J Neurosurg. Jan 2008;108(1):111-117. PMID 18173319
- 37. Young RF, Jacques S, Mark R, et al. Gamma knife thalamotomy for treatment of tremor: long-term results. J Neurosurg. Dec 2000;93 Suppl 3:128-135. PMID 11143229
- 38. Roberts DG, Pouratian N. Stereotactic radiosurgery for the treatment of chronic intractable pain: a systematic review. Oper Neurosurg (Hagerstown). Oct 01 2017;13(5):543-551. PMID 28521018

- 39. Persson O, Bartek J, Jr., Shalom NB, et al. Stereotactic radiosurgery vs. fractionated radiotherapy for tumor control in vestibular schwannoma patients: a systematic review. Acta Neurochir (Wien). Jun 2017;159(6):1013-1021. PMID 28409393
- 40. Muzevic D, Legcevic J, Splavski B, et al. Stereotactic radiotherapy for vestibular schwannoma. Cochrane Database Syst Rev. Dec 16 2014(12):Cd009897. PMID 25511415
- 41. Badakhshi H, Muellner S, Wiener E, et al. Image-guided stereotactic radiotherapy for patients with vestibular schwannoma. A clinical study. Strahlenther Onkol. Jun 2014;190(6):533-537. PMID 24589920
- 42. Williams BJ, Xu Z, Salvetti DJ, et al. Gamma Knife surgery for large vestibular schwannomas: a single-center retrospective case-matched comparison assessing the effect of lesion size. J Neurosurg. Aug 2013;119(2):463- 471. PMID 23706053
- 43. Woolf DK, Williams M, Goh CL, et al. Fractionated stereotactic radiotherapy for acoustic neuromas: long-term outcomes. Clin Oncol (R Coll Radiol). Dec 2013;25(12):734-738. PMID 23973046
- 44. Pollock BE, Driscoll CL, Foote RL, et al. Patient outcomes after vestibular schwannoma management: a prospective comparison of microsurgical resection and stereotactic radiosurgery. Neurosurgery. Jul 2006;59(1):77-85; discussion 77-85. PMID 16823303
- 45. Chang SD, Gibbs IC, Sakamoto GT, et al. Staged stereotactic irradiation for acoustic neuroma. Neurosurgery. Jun 2005;56(6):1254-1261; discussion 1261-1253. PMID 15918941
- 46. Chung HT, Ma R, Toyota B, et al. Audiologic and treatment outcomes after linear accelerator-based stereotactic irradiation for acoustic neuroma. Int J Radiat Oncol Biol Phys. Jul 15 2004;59(4):1116-1121. PMID 15234046
- 47. Meijer OW, Vandertop WP, Baayen JC, et al. Single-fraction vs. fractionated linac-based stereotactic radiosurgery for vestibular schwannoma: a single-institution study. Int J Radiat Oncol Biol Phys. Aug 1 2003;56(5):1390-1396. PMID 12873685
- 48. Chen Y, Li ZF, Zhang FX, et al. Gamma knife surgery for patients with volumetric classification of nonfunctioning pituitary adenomas: a systematic review and meta-analysis. Eur J Endocrinol. Oct 2013;169(4):487-495. PMID 23904281
- 49. Lee CC, Kano H, Yang HC, et al. Initial Gamma Knife radiosurgery for nonfunctioning pituitary adenomas. J Neurosurg. Mar 2014;120(3):647-654. PMID 24405068
- 50. Sheehan JP, Starke RM, Mathieu D, et al. Gamma Knife radiosurgery for the management of nonfunctioning pituitary adenomas: a multicenter study. J Neurosurg. Aug 2013;119(2):446-456. PMID 23621595
- 51. Lee CC, Yang HC, Chen CJ, et al. Gamma Knife surgery for craniopharyngioma: report on a 20-year experience. J Neurosurg. Dec 2014;121 Suppl:167-178. PMID 25434950
- Hashizume C, Mori Y, Kobayashi T, et al. Stereotactic radiotherapy using Novalis for craniopharyngioma adjacent to optic pathways. J Neurooncol. Jun 2010;98(2):239-247. PMID 20422439
- 53. Hasegawa T, Kobayashi T, Kida Y. Tolerance of the optic apparatus in single-fraction irradiation using stereotactic radiosurgery: evaluation in 100 patients with craniopharyngioma. Neurosurgery. Apr 2010;66(4):688- 694; discussion 694-685. PMID 20190668
- 54. Combs SE, Thilmann C, Huber PE, et al. Achievement of long-term local control in patients with craniopharyngiomas using high precision stereotactic radiotherapy. Cancer. Jun 1 2007;109(11):2308-2314. PMID 17469176
- 55. Ivan ME, Sughrue ME, Clark AJ, et al. A meta-analysis of tumor control rates and treatment-related morbidity for patients with glomus jugulare tumors. J Neurosurg. May 2011;114(5):1299-1305. PMID 21029039
- 56. Wakefield DV, Venable GT, VanderWalde NA, et al. Comparative neurologic outcomes of salvage and definitive Gamma Knife radiosurgery for glomus jugulare: a 20-year experience. J Neurol Surg B Skull Base. Jun 2017;78(3):251-255. PMID 28593112
- 57. Ibrahim R, Ammori MB, Yianni J, et al. Gamma Knife radiosurgery for glomus jugulare tumors: a single-center series of 75 cases. J Neurosurg. May 2017;126(5):1488-1497. PMID 27392265
- 58. El-Shehaby AM, Reda WA, Abdel Karim KM, et al. Gamma Knife radiosurgery for low-grade tectal gliomas. Acta Neurochir (Wien). Feb 2015;157(2):247-256. PMID 25510647
- 59. Clark GM, McDonald AM, Nabors LB, et al. Hypofractionated stereotactic radiosurgery with concurrent bevacizumab for recurrent malignant gliomas: the University of Alabama at Birmingham experience. Neurooncol Pract. Dec 2014;1(4):172-177. PMID 26034629

- Dodoo E, Huffmann B, Peredo I, et al. Increased survival using delayed gamma knife radiosurgery for recurrent high-grade glioma: a feasibility study. World Neurosurg. Nov 2014;82(5):e623-632. PMID 24930898
- Cabrera AR, Cuneo KC, Desjardins A, et al. Concurrent stereotactic radiosurgery and bevacizumab in recurrent malignant gliomas: a prospective trial. Int J Radiat Oncol Biol Phys. Aug 1 2013;86(5):873-879. PMID 23725997
- 62. Cuneo KC, Vredenburgh JJ, Sampson JH, et al. Safety and efficacy of stereotactic radiosurgery and adjuvant bevacizumab in patients with recurrent malignant gliomas. Int J Radiat Oncol Biol Phys. Apr 1 2012;82(5):2018- 2024. PMID 21489708
- 63. Roos D. What is the randomised evidence for surgery and stereotactic radiosurgery for patients with solitary (or few) brain metastases? Int J Evid Based Healthc. Mar 2011;9(1):61-66. PMID 21332664
- Park HS, Chiang VL, Knisely JP, et al. Stereotactic radiosurgery with or without whole-brain radiotherapy for brain metastases: an update. Expert Rev Anticancer Ther. Nov 2011;11(11):1731-1738. PMID 22050022
- 65. Patil CG, Pricola K, Garg SK, et al. Whole brain radiation therapy (WBRT) alone versus WBRT and radiosurgery for the treatment of brain metastases. Cochrane Database Syst Rev. Jun 16 2010(6):CD006121. PMID 20556764
- Patil CG, Pricola K, Sarmiento JM, et al. Whole brain radiation therapy (WBRT) alone versus WBRT and radiosurgery for the treatment of brain metastases. Cochrane Database Syst Rev. Sep 12 2012(9):Cd006121. PMID 22972090
- 67. Chang DT, Schellenberg D, Shen J, et al. Stereotactic radiotherapy for unresectable adenocarcinoma of the pancreas. Cancer. Feb 1 2009;115(3):665-672. PMID 19117351
- 68. Kondziolka D, Patel A, Lunsford LD, et al. Stereotactic radiosurgery plus whole brain radiotherapy versus radiotherapy alone for patients with multiple brain metastases. Int J Radiat Oncol Biol Phys. Sep 1 1999;45(2):427-434. PMID 10487566
- 69. Weltman E, Salvajoli JV, Brandt RA, et al. Radiosurgery for brain metastases: a score index for predicting prognosis. Int J Radiat Oncol Biol Phys. Mar 15 2000;46(5):1155-1161. PMID 10725626
- 70. Yu C, Chen JC, Apuzzo ML, et al. Metastatic melanoma to the brain: prognostic factors after gamma knife radiosurgery. Int J Radiat Oncol Biol Phys. Apr 1 2002;52(5):1277-1287. PMID 11955740
- 71. Aoyama H, Shirato H, Tago M, et al. Stereotactic radiosurgery plus whole-brain radiation therapy vs stereotactic radiosurgery alone for treatment of brain metastases: a randomized controlled trial. JAMA. Jun 7 2006;295(21):2483-2491. PMID 16757720
- 72. Tian LJ, Zhuang HQ, Yuan ZY. A comparison between cyberknife and neurosurgery in solitary brain metastases from non-small cell lung cancer. Clin Neurol Neurosurg. Oct 2013;115(10):2009-2014. PMID 23850045
- Yamamoto M, Serizawa T, Shuto T, et al. Stereotactic radiosurgery for patients with multiple brain metastases (JLGK0901): a multi-institutional prospective observational study. Lancet Oncol. Apr 2014;15(4):387-395. PMID 24621620
- 74. Yomo S, Hayashi M. Upfront stereotactic radiosurgery in patients with brain metastases from small cell lung cancer: retrospective analysis of 41 patients. Radiat Oncol. Jul 08 2014;9(1):152. PMID 25005424
- 75. Rava P, Leonard K, Sioshansi S, et al. Survival among patients with 10 or more brain metastases treated with stereotactic radiosurgery. J Neurosurg. Aug 2013;119(2):457-462. PMID 23662828
- Raldow AC, Chiang VL, Knisely JP, et al. Survival and intracranial control of patients with 5 or more brain metastases treated with gamma knife stereotactic radiosurgery. Am J Clin Oncol. Oct 2013;36(5):486-490. PMID 22706180
- 77. Reynolds MM, Arnett AL, Parney IF, et al. Gamma knife radiosurgery for the treatment of uveal melanoma and uveal metastases. Int J Retina Vitreous. Jun 2017;3:17. PMID 28560050
- 78. Eibl-Lindner K, Furweger C, Nentwich M, et al. Robotic radiosurgery for the treatment of medium and large uveal melanoma. Melanoma Res. Feb 2016;26(1):51-57. PMID 26484738
- Wackernagel W, Holl E, Tarmann L, et al. Local tumour control and eye preservation after gammaknife radiosurgery of choroidal melanomas. Br J Ophthalmol. Feb 2014;98(2):218-223. PMID 24169651
- 80. Furdova A, Sramka M, Chorvath M, et al. Stereotactic radiosurgery in intraocular malignant melanoma-- retrospective study. Neuro Endocrinol Lett. Mar 2014;35(1):28-36. PMID 24625918

- 81. Zehetmayer M. Stereotactic photon beam irradiation of uveal melanoma. Dev Ophthalmol. 2012;49:58-65. PMID 22042013
- 82. Dunavoelgyi R, Dieckmann K, Gleiss A, et al. Local tumor control, visual acuity, and survival after hypofractionated stereotactic photon radiotherapy of choroidal melanoma in 212 patients treated between 1997 and 2007. Int J Radiat Oncol Biol Phys. Sep 1 2011;81(1):199-205. PMID 20675066
- Sarici AM, Pazarli H. Gamma-knife-based stereotactic radiosurgery for medium- and large-sized posterior uveal melanoma. Graefes Arch Clin Exp Ophthalmol. Jan 2013;251(1):285-294. PMID 22944897
- 84. Muller K, Naus N, Nowak PJ, et al. Fractionated stereotactic radiotherapy for uveal melanoma, late clinical results. Radiother Oncol. Feb 2012;102(2):219-224. PMID 21864922
- 85. Furdova A, Slezak P, Chorvath M, et al. No differences in outcome between radical surgical treatment (enucleation) and stereotactic radiosurgery in patients with posterior uveal melanoma. Neoplasma. May 2010;57(4):377-381. PMID 20429631
- Gerszten PC, Ozhasoglu C, Burton SA, et al. CyberKnife frameless stereotactic radiosurgery for spinal lesions: clinical experience in 125 cases. Neurosurgery. Jul 2004;55(1):89-98; discussion 98-89. PMID 15214977
- Degen JW, Gagnon GJ, Voyadzis JM, et al. CyberKnife stereotactic radiosurgical treatment of spinal tumors for pain control and quality of life. J Neurosurg Spine. May 2005;2(5):540-549. PMID 15945428
- 88. Sahgal A, Atenafu EG, Chao S, et al. Vertebral compression fracture after spine stereotactic body radiotherapy: a multi-institutional analysis with a focus on radiation dose and the spinal instability neoplastic score. J Clin Oncol. Sep 20 2013;31(27):3426-3431. PMID 23960179
- Gerszten PC, Burton SA, Ozhasoglu C, et al. Radiosurgery for spinal metastases: clinical experience in 500 cases from a single institution. Spine (Phila Pa 1976). Jan 15 2007;32(2):193-199. PMID 17224814
- Chang EL, Shiu AS, Mendel E, et al. Phase I/II study of stereotactic body radiotherapy for spinal metastasis and its pattern of failure. J Neurosurg Spine. Aug 2007;7(2):151-160. PMID 17688054
- 91. Solda F, Lodge M, Ashley S, et al. Stereotactic radiotherapy (SABR) for the treatment of primary non-small cell lung cancer; systematic review and comparison with a surgical cohort. Radiother Oncol. Oct 2013;109(1):1-7. PMID 24128806
- Harkenrider MM, Bertke MH, Dunlap NE. Stereotactic body radiation therapy for unbiopsied earlystage lung cancer: a multi-institutional analysis. Am J Clin Oncol. Aug 2014;37(4):337-342. PMID 23660597
- 93. Jeppesen SS, Schytte T, Jensen HR, et al. Stereotactic body radiation therapy versus conventional radiation therapy in patients with early stage non-small cell lung cancer: an updated retrospective study on local failure and survival rates. Acta Oncol. Oct 2013;52(7):1552-1558. PMID 23902274
- 94. Allibhai Z, Taremi M, Bezjak A, et al. The impact of tumor size on outcomes after stereotactic body radiation therapy for medically inoperable early-stage non-small cell lung cancer. Int J Radiat Oncol Biol Phys. Dec 1 2013;87(5):1064-1070. PMID 24210082
- 95. Hof H, Muenter M, Oetzel D, et al. Stereotactic single-dose radiotherapy (radiosurgery) of early stage nonsmall- cell lung cancer (NSCLC). Cancer. Jul 1 2007;110(1):148-155. PMID 17516437
- 96. Timmerman R, Paulus R, Galvin J, et al. Stereotactic body radiation therapy for inoperable early stage lung cancer. Jama. Mar 17 2010;303(11):1070-1076. PMID 20233825
- 97. Stanic S, Paulus R, Timmerman RD, et al. No clinically significant changes in pulmonary function following stereotactic body radiation therapy for early- stage peripheral non-small cell lung cancer: an analysis of RTOG 0236. Int J Radiat Oncol Biol Phys. Apr 01 2014;88(5):1092-1099. PMID 24661663
- Chang JY, Senan S, Paul MA, et al. Stereotactic ablative radiotherapy versus lobectomy for operable stage I non-small-cell lung cancer: a pooled analysis of two randomised trials. Lancet Oncol. Jun 2015;16(6):630-637. PMID 25981812
- 99. Fernando HC, Timmerman R. American College of Surgeons Oncology Group Z4099/Radiation Therapy Oncology Group 1021: a randomized study of sublobar resection compared with stereotactic body radiotherapy for high-risk stage I non-small cell lung cancer. J Thorac Cardiovasc Surg. Sep 2012;144(3):S35-38. PMID 22795435

- 100. Zheng X, Schipper M, Kidwell K, et al. Survival outcome after stereotactic body radiation therapy and surgery for stage i non-small cell lung cancer: a meta-analysis. Int J Radiat Oncol Biol Phys. Jul 19 2014;90(3):603-611. PMID 25052562
- Nguyen NP, Garland L, Welsh J, et al. Can stereotactic fractionated radiation therapy become the standard of care for early stage non-small cell lung carcinoma. Cancer Treat Rev. Dec 2008;34(8):719-727. PMID 18657910
- 102. Koto M, Takai Y, Ogawa Y, et al. A phase II study on stereotactic body radiotherapy for stage I nonsmall cell lung cancer. Radiother Oncol. Dec 2007;85(3):429-434. PMID 18022720
- 103. Kupelian PA, Komaki R, Allen P. Prognostic factors in the treatment of node-negative nonsmall cell lung carcinoma with radiotherapy alone. Int J Radiat Oncol Biol Phys. Oct 1 1996;36(3):607-613. PMID 8948345
- 104. Yu JB, Soulos PR, Cramer LD, et al. Comparative effectiveness of surgery and radiosurgery for stage I non- small cell lung cancer. Cancer. Jul 15 2015;121(14):2341-2349. PMID 25847699
- 105. Ezer N, Veluswamy RR, Mhango G, et al. Outcomes after Stereotactic Body Radiotherapy versus Limited Resection in Older Patients with Early-Stage Lung Cancer. J Thorac Oncol. Aug 2015;10(8):1201-1206. PMID 26200275
- 106. Crabtree TD, Puri V, Robinson C, et al. Analysis of first recurrence and survival in patients with stage I non-small cell lung cancer treated with surgical resection or stereotactic radiation therapy. J Thorac Cardiovasc Surg. Apr 2014;147(4):1183-1191; discussion 1191-1182. PMID 24507980
- Port JL, Parashar B, Osakwe N, et al. A propensity-matched analysis of wedge resection and stereotactic body radiotherapy for early stage lung cancer. Ann Thorac Surg. Jul 29 2014;98(4):1152-1159. PMID 25085557
- 108. Varlotto J, Fakiris A, Flickinger J, et al. Matched-pair and propensity score comparisons of outcomes of patients with clinical stage I non-small cell lung cancer treated with resection or stereotactic radiosurgery. Cancer. Aug 1 2013;119(15):2683-2691. PMID 23605504
- 109. Timmerman RD, Park C, Kavanagh BD. The North American experience with stereotactic body radiation therapy in non-small cell lung cancer. J Thorac Oncol. Jul 2007;2(7 Suppl 3):S101-112. PMID 17603304
- 110. Wang PM, Chung NN, Hsu WC, et al. Stereotactic body radiation therapy in hepatocellular carcinoma: Optimal treatment strategies based on liver segmentation and functional hepatic reserve. Rep Pract Oncol Radiother. Nov-Dec 2015;20(6):417-424. PMID 26696781
- 111. Reed GB, Jr., Cox AJ, Jr. The human liver after radiation injury. A form of veno-occlusive disease. Am J Pathol. Apr 1966;48(4):597-611. PMID 5327788
- 112. Sharma H. Role of external beam radiation therapy in management of hepatocellular carcinoma. J Clin Exp Hepatol. Aug 2014;4(Suppl 3):S122-125. PMID 25755603
- 113. Tao C, Yang LX. Improved radiotherapy for primary and secondary liver cancer: stereotactic body radiation therapy. Anticancer Res. Feb 2012;32(2):649-655. PMID 22287758
- 114. Bettinger D, Pinato DJ, Schultheiss M et al. Stereotactic Body Radiation Therapy as an Alternative Treatment for Patients with Hepatocellular Carcinoma Compared to Sorafenib: A Propensity Score Analysis.. Liver Cancer, 2019 Oct 12;8(4). PMID 31602371
- 115. Wahl DR, Stenmark MH, Tao Y, et al. Outcomes after stereotactic body radiotherapy or radiofrequency ablation for hepatocellular carcinoma. J Clin Oncol. Feb 10 2016;34(5):452-459. PMID 26628466
- 116. Jacob R, Turley F, Redden DT, et al. Adjuvant stereotactic body radiotherapy following transarterial chemoembolization in patients with non-resectable hepatocellular carcinoma tumours of >/= 3 cm. HPB (Oxford). Feb 2015;17(2):140-149. PMID 25186290
- 117. Su TS, Lu HZ, Cheng T, et al. Long-term survival analysis in combined transarterial embolization and stereotactic body radiation therapy versus stereotactic body radiation monotherapy for unresectable hepatocellular carcinoma >5 cm. BMC Cancer. Nov 03 2016;16(1):834. PMID 27809890
- Zhong NB, Lv GM, Chen ZH. Stereotactic body radiotherapy combined with transarterial chemoembolization for huge (>/=10 cm) hepatocellular carcinomas: A clinical study. Mol Clin Oncol. Sep 2014;2(5):839-844. PMID 25054055
- Bujold A, Massey CA, Kim JJ, et al. Sequential phase I and II trials of stereotactic body radiotherapy for locally advanced hepatocellular carcinoma. J Clin Oncol. May 1 2013;31(13):1631-1639. PMID 23547075

- 120. Yoon SM, Lim YS, Park MJ, et al. Stereotactic body radiation therapy as an alternative treatment for small hepatocellular carcinoma. PLoS One. Nov 2013;8(11):e79854. PMID 24255719
- Jung J, Yoon SM, Kim SY, et al. Radiation-induced liver disease after stereotactic body radiotherapy for small hepatocellular carcinoma: clinical and dose-volumetric parameters. Radiat Oncol. Oct 27 2013;8:249. PMID 24160910
- 122. Ibarra RA, Rojas D, Snyder L, et al. Multicenter results of stereotactic body radiotherapy (SBRT) for non- resectable primary liver tumors. Acta Oncol. Jan 23 2012;51(5):575-583. PMID 22263926
- Price TR, Perkins SM, Sandrasegaran K, et al. Evaluation of response after stereotactic body radiotherapy for hepatocellular carcinoma. Cancer. Oct 24 2012;118 (12):3191-3198. PMID 22025126
- 124. Andolino DL, Johnson CS, Maluccio M, et al. Stereotactic body radiotherapy for primary hepatocellular carcinoma. Int J Radiat Oncol Biol Phys. Nov 15 2011;81(4):e447-453. PMID 21645977
- 125. Kwon JH, Bae SH, Kim JY, et al. Long-term effect of stereotactic body radiation therapy for primary hepatocellular carcinoma ineligible for local ablation therapy or surgical resection. Stereotactic radiotherapy for liver cancer. BMC Cancer. Sep 03 2010;10:475. PMID 20813065
- 126. Mahadevan A, Blanck O, Lanciano R, et al. Stereotactic Body Radiotherapy (SBRT) for liver metastasis - clinical outcomes from the international multi-institutional RSSearch(R) Patient Registry. Radiat Oncol. Feb 13 2018;13(1):26. PMID 29439707
- 127. Yuan ZY, Meng MB, Liu CL, et al. Stereotactic body radiation therapy using the CyberKnife((R)) system for patients with liver metastases. Onco Targets Ther. Jun 2014;7:915-923. PMID 24959080
- 128. Lanciano R, Lamond J, Yang J, et al. Stereotactic body radiation therapy for patients with heavily pretreated liver metastases and liver tumors. Front Oncol. May 2012;2:23. PMID 22645716
- 129. Chang DT, Swaminath A, Kozak M, et al. Stereotactic body radiotherapy for colorectal liver metastases: a pooled analysis. Cancer. Sep 1 2011;117(17):4060-4069. PMID 21432842
- 130. Mazloom A, Hezel AF, Katz AW. Stereotactic body radiation therapy as a bridge to transplantation and for recurrent disease in the transplanted liver of a patient with hepatocellular carcinoma. Case Rep Oncol. Jan 2014;7(1):18-22. PMID 24575010
- Sapisochin G, Barry A, Doherty M, et al. Stereotactic body radiotherapy vs TACE or RFA as a bridge to transplant in patients with hepatocellular carcinoma. An intention-to-treat analysis. J Hepatol. Jul 2017;67(1):92- 99. PMID 28257902
- 132. Mannina EM, Cardenes HR, Lasley FD, et al. Role of stereotactic body radiation therapy before orthotopic liver transplantation: retrospective evaluation of pathologic response and outcomes. Int J Radiat Oncol Biol Phys. Apr 01 2017;97(5):931-938. PMID 28333015
- 133. Jackson WC, Silva J, Hartman HE et al. Stereotactic Body Radiation Therapy for Localized Prostate Cancer: A Systematic Review and Meta-Analysis of Over 6,000 Patients Treated On Prospective Studies.. Int. J. Radiat. Oncol. Biol. Phys., 2019 Apr 9;104(4). PMID 30959121
- Kishan AU, Dang A, Katz AJ et al. Long-term Outcomes of Stereotactic Body Radiotherapy for Low-Risk and Intermediate-Risk Prostate Cancer. JAMA Netw Open, 2019 Feb 9;2(2). PMID 30735235
- Yu JB, Cramer LD, Herrin J, et al. Stereotactic body radiation therapy versus intensity-modulated radiation therapy for prostate cancer: comparison of toxicity. J Clin Oncol. Apr 20 2014;32(12):1195-1201. PMID 24616315
- 136. Katz A, Ferrer M, Suarez JF, et al. Comparison of quality of life after stereotactic body radiotherapy and surgery for early-stage prostate cancer. Radiat Oncol. Nov 20 2012;7:194. PMID 23164305
- 137. Miszczyk L, Namysl-Kaletka A, Napieralska A et al. Stereotactic Ablative Radiotherapy for Prostate Cancer-The Treatment Results of 500 Patients and Analysis of Failures.. Technol. Cancer Res. Treat., 2019 Aug 30;18:1533033819870815. PMID 31462169
- Zelefsky MJ, Pinitpatcharalert A, Kollmeier M et al. Early Tolerance and Tumor Control Outcomes with High-dose Ultrahypofractionated Radiation Therapy for Prostate Cancer.. Eur Urol Oncol, 2019 Nov 2. PMID 31668713
- Fuller DB, Falchook AD, Crabtree T et al. Phase 2 Multicenter Trial of Heterogeneous-dosing Stereotactic Body Radiotherapy for Low- and Intermediate-risk Prostate Cancer: 5-year Outcomes.. Eur Urol Oncol, 2019 Jun 4;1(6). PMID 31158102

- King CR, Brooks JD, Gill H, et al. Long-term outcomes from a prospective trial of stereotactic body radiotherapy for low-risk prostate cancer. Int J Radiat Oncol Biol Phys. Feb 1 2012;82(2):877-882. PMID 21300474
- 141. Freeman DE, King CR. Stereotactic body radiotherapy for low-risk prostate cancer: five-year outcomes. Radiat Oncol. Jan 10 2011;6:3. PMID 21219625
- 142. McBride SM, Wong DS, Dombrowski JJ, et al. Hypofractionated stereotactic body radiotherapy in low-risk prostate adenocarcinoma: Preliminary results of a multi-institutional phase 1 feasibility trial. Cancer. Dec 13 2011;118(15):3681-3690. PMID 22170628
- Boike TP, Lotan Y, Cho LC, et al. Phase I dose-escalation study of stereotactic body radiation therapy for low- and intermediate-risk prostate cancer. J Clin Oncol. May 20 2011;29(15):2020-2026. PMID 21464418
- Bolzicco G, Favretto MS, Satariano N, et al. A single-center study of 100 consecutive patients with localized prostate cancer treated with stereotactic body radiotherapy. BMC Urol. Oct 17 2013;13:49. PMID 24134138
- 145. Jabbari S, Weinberg VK, Kaprealian T, et al. Stereotactic body radiotherapy as monotherapy or post-external beam radiotherapy boost for prostate cancer: technique, early toxicity, and PSA response. Int J Radiat Oncol Biol Phys. Jan 1 2012;82(1):228-234. PMID 21183287
- 146. Katz AJ, Santoro M, Ashley R, et al. Stereotactic body radiotherapy for organ-confined prostate cancer. BMC Urol. Feb 01 2010;10:1. PMID 20122161
- 147. Katz AJ, Santoro M, Diblasio F, et al. Stereotactic body radiotherapy for localized prostate cancer: disease control and quality of life at 6 years. Radiat Oncol. May 13 2013;8:118. PMID 23668632
- Loi M, Wortel RC, Francolini G et al. Sexual Function in Patients Treated With Stereotactic Radiotherapy For Prostate Cancer: A Systematic Review of the Current Evidence.. J Sex Med, 2019 Jul 16;16(9). PMID 31303575
- Wiegner EA, King CR. Sexual function after stereotactic body radiotherapy for prostate cancer: results of a prospective clinical trial. Int J Radiat Oncol Biol Phys. Oct 1 2010;78(2):442-448. PMID 20137864
- Chen LN, Suy S, Wang H, et al. Patient-reported urinary incontinence following stereotactic body radiation therapy (SBRT) for clinically localized prostate cancer. Radiat Oncol. Jun 26 2014;9:148. PMID 24966110
- 151. Kim DW, Cho LC, Straka C, et al. Predictors of rectal tolerance observed in a dose-escalated phase 1-2 trial of stereotactic body radiation therapy for prostate cancer. Int J Radiat Oncol Biol Phys. Jul 1 2014;89(3):509-517. PMID 24929162
- 152. King CR, Collins S, Fuller D, et al. Health-related quality of life after stereotactic body radiation therapy for localized prostate cancer: results from a multi-institutional consortium of prospective trials. Int J Radiat Oncol Biol Phys. Dec 1 2013;87(5):939-945. PMID 24119836
- 153. De Bleser E, Jereczek-Fossa BA, Pasquier D et al. Metastasis-directed Therapy in Treating Nodal Oligorecurrent Prostate Cancer: A Multi-institutional Analysis Comparing the Outcome and Toxicity of Stereotactic Body Radiotherapy and Elective Nodal Radiotherapy.. Eur. Urol., 2019 Jul 25;76(6). PMID 31331782
- 154. Petrelli F, Comito T, Ghidini A et al. Stereotactic Body Radiation Therapy for Locally Advanced Pancreatic Cancer: A Systematic Review and Pooled Analysis of 19 Trials.. Int. J. Radiat. Oncol. Biol. Phys., 2017 Jan 10;97(2). PMID 28068239
- 155. Groot VP, van Santvoort HC, Rombouts SJ, et al. Systematic review on the treatment of isolated local recurrence of pancreatic cancer after surgery; re-resection, chemoradiotherapy and SBRT.. HPB (Oxford), 2017 Jan 10;19(2). PMID 28065427
- 156. Zhong J, Patel K, Switchenko J, et al. Outcomes for patients with locally advanced pancreatic adenocarcinoma treated with stereotactic body radiation therapy versus conventionally fractionated radiation. Cancer. Sep 15 2017;123(18):3486-3493. PMID 28493288
- 157. Goyal K, Einstein D, Ibarra RA, et al. Stereotactic body radiation therapy for nonresectable tumors of the pancreas. J Surg Res. May 15 2012;174(2):319-325. PMID 21937061
- Rwigema JC, Parikh SD, Heron DE, et al. Stereotactic body radiotherapy in the treatment of advanced adenocarcinoma of the pancreas. Am J Clin Oncol. Feb 2011;34(1):63-69. PMID 20308870

- 159. Taunk NK, Spratt DE, Bilsky M, et al. Spine radiosurgery in the management of renal cell carcinoma metastases. J Natl Compr Canc Netw. Jun 2015;13(6):801-809; quiz 809. PMID 26085394
- 160. Siva S, Pham D, Gill S, et al. A systematic review of stereotactic radiotherapy ablation for primary renal cell carcinoma. BJU Int. Dec 2012;110(11 Pt B):E737-743. PMID 23107102
- 161. Yamamoto T, Kadoya N, Takeda K, et al. Renal atrophy after stereotactic body radiotherapy for renal cell carcinoma. Radiat Oncol. May 26 2016;11:72. PMID 27229710
- Verma J, Jonasch E, Allen PK, et al. The impact of tyrosine kinase inhibitors on the multimodality treatment of brain metastases from renal cell carcinoma. Am J Clin Oncol. Dec 2013;36(6):620-624. PMID 22892430
- 163. Ranck MC, Golden DW, Corbin KS, et al. Stereotactic body radiotherapy for the treatment of oligometastatic renal cell carcinoma. Am J Clin Oncol. Dec 2013;36(6):589-595. PMID 22868242
- 164. Beitler JJ, Makara D, Silverman P, et al. Definitive, high-dose-per-fraction, conformal, stereotactic external radiation for renal cell carcinoma. Am J Clin Oncol. Dec 2004;27(6):646-648. PMID 15577450
- 165. Sohn S, Chung CK, Sohn MJ, et al. Stereotactic radiosurgery compared with external radiation therapy as a primary treatment in spine metastasis from renal cell carcinoma: a multicenter, matched-pair study. J Neurooncol. Aug 2014;119(1):121-128. PMID 24792488
- 166. Thibault I, Al-Omair A, Masucci GL, et al. Spine stereotactic body radiotherapy for renal cell cancer spinal metastases: analysis of outcomes and risk of vertebral compression fracture. J Neurosurg Spine. Nov 2014;21(5):711-718. PMID 25170656
- Balagamwala EH, Angelov L, Koyfman SA, et al. Single-fraction stereotactic body radiotherapy for spinal metastases from renal cell carcinoma. J Neurosurg Spine. Dec 2012;17(6):556-564. PMID 23020208
- 168. Zelefsky MJ, Greco C, Motzer R, et al. Tumor control outcomes after hypofractionated and singledose stereotactic image-guided intensity-modulated radiotherapy for extracranial metastases from renal cell carcinoma. Int J Radiat Oncol Biol Phys. Apr 01 2012;82(5):1744-1748. PMID 21596489
- 169. Wang XS, Rhines LD, Shiu AS, et al. Stereotactic body radiation therapy for management of spinal metastases in patients without spinal cord compression: a phase 1-2 trial. Lancet Oncol. Apr 2012;13(4):395-402. PMID 22285199
- Yamada Y, Bilsky MH, Lovelock DM, et al. High-dose, single-fraction image-guided intensitymodulated radiotherapy for metastatic spinal lesions. Int J Radiat Oncol Biol Phys. Jun 01 2008;71(2):484-490. PMID 18234445
- 171. Gerszten PC, Burton SA, Ozhasoglu C, et al. Stereotactic radiosurgery for spinal metastases from renal cell carcinoma. J Neurosurg Spine. Oct 2005;3(4):288-295. PMID 16266070
- 172. Alongi F, Arcangeli S, Filippi AR, et al. Review and uses of stereotactic body radiation therapy for oligometastases. Oncologist. 2012;17(8):1100-1107. PMID 22723509
- 173. Tree AC, Khoo VS, Eeles RA, et al. Stereotactic body radiotherapy for oligometastases. Lancet Oncol. Jan 2013;14(1):e28-37. PMID 23276369
- 174. Corbin KS, Hellman S, Weichselbaum RR. Extracranial oligometastases: a subset of metastases curable with stereotactic radiotherapy. J Clin Oncol. Apr 10 2013;31(11):1384-1390. PMID 23460715
- 175. Milano MT, Katz AW, Zhang H, et al. Oligometastases treated with stereotactic body radiotherapy: long-term follow-up of prospective study. Int J Radiat Oncol Biol Phys. Jul 1 2012;83(3):878-886. PMID 22172903
- 176. Long-term results of lung metastasectomy: prognostic analyses based on 5206 cases. The International Registry of Lung Metastases. J Thorac Cardiovasc Surg. Jan 1997;113(1):37-49. PMID 9011700
- 177. Siva S, MacManus M, Ball D. Stereotactic radiotherapy for pulmonary oligometastases: a systematic review. J Thorac Oncol. Jul 2010;5(7):1091-1099. PMID 20479693
- 178. Norihisa Y, Nagata Y, Takayama K, et al. Stereotactic body radiotherapy for oligometastatic lung tumors. Int J Radiat Oncol Biol Phys. Oct 1 2008;72(2):398-403. PMID 18374506
- Rusthoven KE, Kavanagh BD, Cardenes H, et al. Multi-institutional phase I/II trial of stereotactic body radiation therapy for liver metastases. J Clin Oncol. Apr 1 2009;27(10):1572-1578. PMID 19255321

- 180. Osti MF, Carnevale A, Valeriani M, et al. Clinical outcomes of single dose stereotactic radiotherapy for lung metastases. Clin Lung Cancer. Nov 2013;14(6):699-703. PMID 23886798
- 181. Ahmed KA, Barney BM, Macdonald OK, et al. Stereotactic body radiotherapy in the treatment of adrenal metastases. Am J Clin Oncol. Oct 2013;36(5):509-513. PMID 22781389
- 182. Scorsetti M, Alongi F, Filippi AR, et al. Long-term local control achieved after hypofractionated stereotactic body radiotherapy for adrenal gland metastases: A retrospective analysis of 34 patients. Acta Oncol. May 2012;51(5):618-623. PMID 22263925
- Casamassima F, Livi L, Masciullo S, et al. Stereotactic radiotherapy for adrenal gland metastases: university of Florence experience. Int J Radiat Oncol Biol Phys. Feb 1 2012;82(2):919-923. PMID 21300473
- 184. Holy R, Piroth M, Pinkawa M, et al. Stereotactic body radiation therapy (SBRT) for treatment of adrenal gland metastases from non-small cell lung cancer. Strahlenther Onkol. Apr 2011;187(4):245-251. PMID 21424513
- 185. Chawla S, Chen Y, Katz AW, et al. Stereotactic body radiotherapy for treatment of adrenal metastases. Int J Radiat Oncol Biol Phys. Sep 1 2009;75(1):71-75. PMID 19250766
- 186. Napieralska A, Miszczyk L, Tukiendorf A, et al. The results of treatment of prostate cancer bone metastases after CyberKnife radiosurgery. Ortop Traumatol Rehabil. Jul 3 2014;16(3):339-349. PMID 25058109

# Endnotes

<sup>1</sup> Based on BCBS Association MPRM 6.01.10 and expert opinion and AIM Specialty Health Guidelines