

Supplementary File S1. Overview of all included studies.

Authors – Year	Study Design – Level of Evidence	Patients No./ Male	Age years median (range)	Cranial Nerve Deficits at Presentation No. patients (percentage)	Tumor Origin No. patients (percentage)	Laterality No. patients (percentage)	Location No. patients (percentage)	Tumor Type No. patients (percentage)	Surgical Approach No. patients (percentage)	Extent of Resection No. patients (percentage)	Complications No. patients (percentage)	Stereotactic Radiosurgery No. patients (percentage)	Symptom Improvement No. patients (percentage)	Post-Operative Cranial Nerve Deficits No. patients (percentage)	Recurrence No. patients (percentage)	PFS months median (range)	OS months median (range)	Status No. patients (percentage)
Scott et al. – 1949 ¹	Case report – V	1 / 0 (0%)	50	IX, X, XI, XII	IX-X-XI	R	JF & HC	I, ID	SC + CL (C1-C3)	PTR	0 (0%)	0 (0%)	1 (100%)	IX, X, XI, XII	0 (0%)		36.0	1 Alive (100%)
Morelli et al. – 1966 ²	Case report – V	1 / 0 (0%)	22	XII	XII	R	HC	I, ID	SC + CL (C1)	GTR	0 (0%)	0 (0%)	0 (0%)	XII	0 (0%)		0.1	1 Dead (100%)
Strang et al. – 1967 ³	Case report – V	1 / 0 (0%)	51	IX, X, XI, XII	XII	R	HC	I-E, ID-ED	SC + CL (C1)	GTR	0 (0%)	0 (0%)	1 (100%)	XII	0 (0%)		3.0	1 Alive (100%)
Bartal et al. – 1973 ⁴	Case report – V	1 / 1 (100%)	36	X, XI, XII	XII	L	HC	I-E, ID-ED	SC	PTR	Hydrocephalus	0 (0%)	1 (100%)	XII	0 (0%)		12.0	1 Alive (100%)
Sumra et al. – 1978 ⁵	Case report – V	1 / 1 (100%)	46	0 (0%)	C2	R	C1-C2 F	E, ID-ED	CL (C2)	GTR	0 (0%)	0 (0%)	1 (100%)	0 (0%)	0 (0%)		1.0	1 Alive (100%)
Conrad et al. – 1979 ⁶	Case report – V	1 / 0 (0%)	46	0 (0%)	C2	L	C1-C2 F	E, ID	CL (C2)	GTR	0 (0%)	0 (0%)	1 (100%)	0 (0%)	0 (0%)		1.0	1 Alive (100%)
Fujiwara et al. – 1980 ⁷	Case report – V	1 / 0 (0%)	45	XII	XII	R	HC	I, ID	SC	GTR	0 (0%)	0 (0%)	1 (100%)	XII	0 (0%)		3.0	1 Alive (100%)
Ulse et al. – 1981 ⁸	Case report – V	1 / 0 (0%)	28	V, VII, IX, X, XI, XII	XII	L	FM	I, ID	SC	GTR	0 (0%)	0 (0%)	1 (100%)	XII	0 (0%)		4.0	1 Alive (100%)
Berger et al. – 1982 ⁹	Case report – V	1 / 0 (0%)	17	XII	XII	R	HC	I, ID	SC	GTR	0 (0%)	0 (0%)	1 (100%)	XII	0 (0%)		3.0	1 Alive (100%)
Dolan et al. – 1982 ¹⁰	Case report – V	1 / 0 (0%)	24	VII, IX, X, XI, XII	XII	L	HC	I-E, ID	SC	PTR	CSF leak	0 (0%)	1 (100%)	IX, X, XII	0 (0%)		3.0	1 Alive (100%)
Hakuba et al. – 1984 ¹¹	Case series – IV	2 / 1 (50%)	55	0 (0%)	2 C2 (100%)	1 L (50%) 1 R (50%)	2 C1-C3 F (100%)	2 I-E, ID-ED (100%)	2 CL (C2)	2 PTR (100%)	0 (0%)	0 (0%)	2 (100%)	0 (0%)	0 (0%)		21.0 (12-30)	2 Alive (100%)
Tuck et al. – 1984 ¹²	Case series – IV	2 / 0 (0%)	57 (52-62)	1 XI, XII (50%) 1 VIII, IX, X, XII (50%)	2 XII (100%)	1 L (50%) 1 R (50%)	2 HC (100%)	1 I, ID (50%) 1 I-E, ID-ED (50%)	2 SC (100%)	1 PTR (50%) 1 GTR (50%)	0 (0%)	0 (0%)	2 (100%)	1 XI, XII (50%) 1 XII (50%)	1 (50%)	36.0	30.0 (12-48)	2 Alive (100%)
Bettoni et al. – 1985 ¹³	Case report – V	1 / 0 (0%)	62	VII, XII	XII	L	HC	I, ED	SC	GTR	0 (0%)	0 (0%)	1 (100%)	XII	0 (0%)		24.0	1 Alive (100%)
Lesoin et al. – 1986 ¹⁴	Case report – V	1 / 1 (100%)	55	0 (0%)	C2	R	C1-C3 F	E, ED	CL (C2-C3)	PTR	C2 anesthesia	0 (0%)	1 (100%)	0 (0%)	0 (0%)		3.0	1 Alive (100%)
Shearman et al. – 1986 ¹⁵	Case report – V	1 / 1 (100%)	4	XI, XII	XII	L	JF	I-E, ED	SC	GTR	0 (0%)	0 (0%)	1 (100%)	XI, XII	1 (100%)	8.0	12.0	1 Alive (100%)
Solymosi et al. – 1987 ¹⁶	Case report – V	1 / 1 (100%)	48	VIII, IX, X, XII	XII	L	JF	I, ID-ED	SC	GTR	0 (0%)	0 (0%)	1 (100%)	XII	0 (0%)		3.0	1 Alive (100%)
Nakashima et al. – 1988 ¹⁷	Case report – V	1 / 1 (100%)	67	VIII, IX, X, XI, XII	XI	R	JF	I, ID-ED	SC-RS	PTR	0 (0%)	0 (0%)	1 (100%)	IX, X	0 (0%)		10.0	1 Alive (100%)
Crockard et al. – 1991 ¹⁸	Case series – IV	2 / 2 (100%)	39 (32-46)	0 (0%)	2 C1 (100%)	2 R (100%)	2 FM (100%)	2 I-E, ID (100%)	2 Transoral (100%)	2 GTR (100%)	2 Dysphagia (100%)	0 (0%)	1 (100%)	0 (0%)	0 (0%)		54.0 (36-72)	2 Alive (100%)
Kratimenos et al. – 1993 ¹⁹	Case series – IV	4 / 1 (25%)	30.5 (24-34)	0 (0%)	4 C1 (100%)	3 L (75%) 1 R (25%)	2 C1-C2 F (50%) 1 FM (25%)	4 E, ID-ED (100%)	4 FL (100%)	4 GTR (100%)	0 (0%)	0 (0%)	4 (100%)	0 (0%)	0 (0%)		3.0	4 Alive (100%)

							1 FM-C1 (25%)											
Krauss et al. – 1993 ²⁰	Case report – V	1 / 0 (0%)	49	V, VII, IX, X, XII	XII	R	HC	I, ID	SC-TC	PTR	Dysphagia, pneumonia	0 (0%)	1 (100%)	IX, X	1 (100%)	2.0	3.0	1 Dead (100%)
Kamitani et al. – 1994 ²¹	Case series – IV	2 / 1 (50%)	50.5 (48-53)	1 VII, VIII (50%) 1 XII (50%)	1 IX-X-XI (50%) 1 XII (50%)	2 L (100%)	1 JF (50%) 1 JF & HC (50%)	2 I-E, ID-ED (100%)	1 SC (50%) 1 SC + CL (C1-C2) (50%)	1 PTR (50%) 1 GTR (50%)	1 Hemiplegia (50%)	0 (0%)	1 (50%)	1 VII, VIII (50%) 1 IX, X, XI, XII (50%)	1 (50%)	24.0	14.5 (3-26)	2 Alive (100%)
Okura et al. – 1994 ²²	Case report – V	1 / 0 (0%)	59	XII	XII	R	HC	I-E, ID-ED	SC	GTR	0 (0%)	0 (0%)	1 (100%)	XI, XII	0 (0%)	2.0	6 Alive (30%)	
Smith et al. – 1995 ²³	Case report – V	1 / 1 (100%)	47	IX, X, XII	XII	L	HC	I-E, ID-ED	TC	GTR	0 (0%)	0 (0%)	1 (100%)	IX, X, XII	0 (0%)	3.0	1 Alive (100%)	
Kobayashi et al. – 1996 ²⁴	Case report – V	1 / 0 (0%)	46	0 (0%)	XII	R	HC	I, ID	SC	GTR	CSF leak	0 (0%)	1 (100%)	IX, X, XI, XII	0 (0%)	3.0	1 Alive (100%)	
Sato et al. – 1996 ²⁵	Case report – V	1 / 0 (0%)	59	XII	XII	R	HC	I-E, ID-ED	SC-TC + CL (C1)	PTR	CSF leak	0 (0%)	1 (100%)	XII	0 (0%)	1.0	1 Alive (100%)	
Sairyo et al. – 1997 ²⁶	Case report – V	1 / 1 (100%)	64	0 (0%)	C2	R	C1-C2 F	E, ED	CL (C1)	GTR	0 (0%)	0 (0%)	1 (100%)	0 (0%)	0 (0%)	3.0	1 Alive (100%)	
Bunc et al. – 1998 ²⁷	Case report – V	1 / 1 (100%)	53	IX, X, XII	XII	R	HC	I-E, ID-ED	SC-TC	GTR	Dysphagia	0 (0%)	1 (100%)	IX, X, XI, XII	0 (0%)	12.0	1 Alive (100%)	
Gilsbach et al. – 1998 ²⁸	Case report – V	1 / 1 (100%)	48	IX, XII	XII	R	JF & HC	I, ID	SC	GTR	0 (0%)	0 (0%)	1 (100%)	IX, XI, XII	0 (0%)	12.0	1 Alive (100%)	
Spinnato et al. – 1998 ²⁹	Case report – V	1 / 0 (0%)	49	0 (0%)	XII	R	FM & HC	I-E, ID-ED	SC-TC + CL (C1-C2)	GTR	0 (0%)	0 (0%)	1 (100%)	0 (0%)	0 (0%)	3.0	1 Alive (100%)	
Kachhara et al. – 1999 ³⁰	Case report – V	1 / 1 (100%)	24	XII	XII	R	HC	I-E, ID-ED	SC	PTR	0 (0%)	0 (0%)	1 (100%)	XII	0 (0%)	3.0	1 Alive (100%)	
Hoshi et al. – 2000 ³¹	Case series – IV	2 / 2 (100%)	55.5 (48-63)	1 IX, XII (50%) 1 VII, IX, X, XI, XII (50%)	2 XII (100%)	2 R (100%)	2 HC (100%)	2 I-E, ID-ED (100%)	2 SC (100%)	1 PTR (50%) 1 GTR (50%)	1 SAH (50%)	0 (0%)	2 (100%)	1 XII (50%) 1 IX, X (50%)	0 (0%)	1 (0.1-2)	1 Alive, 1 Dead (50%)	
Kalavakonda et al. – 2000 ³²	Case report – V	1 / 1 (100%)	52	0 (0%)	C1	L	FM-C1	E, ED	TC	GTR	0 (0%)	0 (0%)	1 (100%)	0 (0%)	0 (0%)	3.0	1 Alive (100%)	
Mariniello et al. – 2000 ³³	Case report – V	1 / 0 (0%)	20	0 (0%)	XII	R	HC	I-E, ED	SC	GTR	0 (0%)	0 (0%)	1 (100%)	IX, X, XI, XII	0 (0%)	24.0	1 Alive (100%)	
Kyoshima et al. – 2003 ³⁴	Case series – IV	2 / 0 (0%)	65 (57-73)	0 (0%)	2 C2 (100%)	1 L (50%) 1 R (50%)	2 C1-C2 F (100%)	2 E, ID-ED (100%)	2 CL (C1- C2) (100%)	2 GTR(100%)	0 (0%)	0 (0%)	2 (100%)	0 (0%)	0 (0%)	24.0	2 Alive (100%)	
Leal Filho et al. – 2003 ³⁵	Case series – IV	2 / 1 (50%)	51 (43-59)	1 IX, X (50%)	C1	2 R (100%)	2 FM-C1 (100%)	2 E, ID-ED (100%)	2 FL (100%)	2 GTR (100%)	0 (0%)	0 (0%)	2 (100%)	0 (0%)	0 (0%)	6.0	2 Alive (100%)	
Passacantilli et al. – 2003 ³⁶	Case report – V	1 / 1 (100%)	44	0 (0%)	XII	L	HC	I-ED	FL	PTR	0 (0%)	0 (0%)	1 (100%)	0 (0%)	0 (0%)	3.0	1 Alive (100%)	
Tatebayashi et al. – 2003 ³⁷	Case report – V	1 / 0 (0%)	46	XI	XI	R	JF	I, ID	SC + CL (C1)	GTR	0 (0%)	0 (0%)	1 (100%)	XI	0 (0%)	24.0	1 Alive (100%)	
Aihara et al. – 2004 ³⁸	Case report – V	1 / 0 (0%)	72	XII	XII	R	HC	I-E, ID-ED	FL	PTR	0 (0%)	0 (0%)	1 (100%)	XII	0 (0%)	3.0	1 Alive (100%)	
Ho et al. – 2004 ³⁹	Case report – V	1 / 1 (100%)	39	XII	XII	R	FM & HC	I-E, ID-ED	SC-TC	GTR	0 (0%)	0 (0%)	1 (100%)	XII	0 (0%)	12.0	1 Alive (100%)	
Kadri et al. – 2004 ⁴⁰	Case series – IV	6 / 3 (50%)	31 (23-42)	6 IX, X (100%) 4 XI, XII (66.7%) 2 VIII (33.3%) 1 V, VI, VII (16.7%)	3 X (50%) 3 IX-X-XI (50%)	4 L (66.7%) 2 R (33.3%)	6 JF (100%)	6 I-E, ID- ED (100%)	6 TC + SJ (83.3%) 1 TC (16.7%)	6 GTR (100%)	0 (0%)	0 (0%)	6 (100%)	6 IX, X (100%) 4 XI, XII (66.7%) 2 VIII (33.3%) 1 V, VI (16.7%)	0 (0%)	30.0 (2-66)	6 Alive (100%)	
Kim et al. – 2005 ⁴¹	Case report – V	1 / 0 (0%)	60	0 (0%)	C1	R	FM-C1	E	FL + CL (C1)	PTR	0 (0%)	1 (100%)	1 (100%)	0 (0%)	0 (0%)	2.0	1 Alive (100%)	
Takumi et al. – 2005 ⁴²	Case report – V	1 / 1 (100%)	35	0 (0%)	C1	R	FM-C1	E, ID	SC-RS	GTR	0 (0%)	0 (0%)	1 (100%)	0 (0%)	0 (0%)	48.0	1 Alive (100%)	
Sato et al. – 2006 ⁴³	Case report – V	1 / 0 (0%)	54	XII	XII	L	HC	I-E, ID-ED	SC	PTR	0 (0%)	0 (0%)	1 (100%)	0 (0%)	0 (0%)	24.0	1 Alive (100%)	
Ueda et al. – 2006 ⁴⁴	Case series – IV	3 / 0 (0%)	54 (50-79)	0 (0%)	3 C1 (100%)	3 R (100%)	3 FM-C1 (100%)	3 E, ID (100%)	3 SC-TC + CL (C1-C2) (100%)	3 GTR (100%)	1 CSF leak (33.3%)	0 (0%)	1 (100%)	0 (0%)	0 (0%)	79 (38-88)	3 Alive (100%)	
Kikkawa et al. – 2007 ⁴⁵	Case report – V	1 / 0 (0%)	36	VII, IX, X	XII	L	FM-C1	I, ID	SC + CL (C1)	GTR	0 (0%)	0 (0%)	1 (100%)	XII	0 (0%)	3.0	1 Alive (100%)	
Kim et al. – 2007 ⁴⁶	Case report – V	1 / 0 (0%)	68	XII	XII	L	HC	I, ID	SC-RS	GTR	0 (0%)	0 (0%)	1 (100%)	XII	0 (0%)	6.0	1 Alive (100%)	
Tucker et al. – 2007 ⁴⁷	Case report – V	1 / 0 (0%)	31	XII	XII	L	HC	I-E, ID-ED	SC	PTR	Dysphagia	0 (0%)	1 (100%)	XII	1 (100%)	15.0	27.0	1 Alive (100%)
Ciappetta et al. – 2008 ⁴⁸	Case report – V	1 / 0 (0%)	44	XI	C2	L	C1-C2 F	I-E, ID	CL (C1-C5)	GTR	0 (0%)	0 (0%)	1 (100%)	0 (0%)	0 (0%)	6.0	1 Alive (100%)	
Garg et al. – 2008 ⁴⁹	Case series – IV	1 /	35	XII	XII	R	HC	I-E, ID-ED	SC-RS	PTR	Hemiplegia	0 (0%)	1 (100%)	XII	1 (100%)	1.0	2.0	1 Dead

Kuo et al. – 2008 ⁵⁰	Case report – V	0 (0%) 1 / 0 (0%)	25	XII	XII	R	HC	I-E, ED	FL-SC	PTR	0 (0%)	0 (0%)	0 (0%)	XII	0 (0%)	6.0	(100%) 1 Alive (100%)	
Chibbaro et al. – 2009 ⁵¹	Case series – IV	16 / 3 (18.8%)	41 (16-71)	5 IX, X (31.3%) 3 IX, X, XI (18.2%) 2 X (12.5%) 1 V (6.3%) 1 V, X (6.3%) 1 VIII, IX, X, XI (6.3%)	7 IX-X-XI (43.7%) 7 IX (43.7%) 1 X (6.3%) 1 XI (6.3%)	9 R (56.3%) 7 L (43.7%)	16 JF (100%)	13 I (81.3%) 3 E (18.7%)	16 TC (100%)	13 GTR (81.3%) 3 PTR (18.7%)	4 Dysphagia (25%) 1 CSF leak (6.3%) 1 Aspiration pneumo (6.3%)	0 (0%)	16 (100%)	5 IX, X (31.3%) 2 IX, X, XI (12.5%)	0 (0%)	94 (24-252)	16 Alive (100%)	
Heiroth et al. – 2009 ⁵²	Case report – V	1 / 0 (0%)	23	XII	XII	R	HC	E, ED	FL	GTR	Hoarseness	0 (0%)	1 (100%)	X, XII	0 (0%)		1 Alive (100%)	
Ichimura et al. – 2009 ⁵³	Case series – IV	7 / 3 (42.9%)	50 (38-71)	3 IX, X, XII (42.9%) 2 XII (28.6%) 2 IX, X, XI, XII (28.6%)	7 XII (100%)	N/A	7 HC (100%)	6 I-E, ID-ED (85.7%) 1 E, ED (14.3%)	7 SC + CL (C1) (100%)	4 PTR (66.7%) 2 GTR (33.3%)	1 Venous thrombosis (14.3%)	3 (42.9%)	7 (100%)	7 XII (100%)	0 (0%)	6.0	6 Alive (85.7%) 1 Dead (14.3%)	
Mathiesen et al. – 2009 ⁵⁴	Case series – IV	2 / 1 (50%)	53	2 XII (100%)	2 XII (100%)	2 L (100%)	2 HC (100%)	2 I-E, ID-ED (100%)	2 RS + CL (C1) (100%)	2 GTR (100%)	1 CSF leak, dysphagi (50%)	0 (0%)	2 (100%)	1 IX, X, XII (50%)	0 (0%)	15.0 (6-24)	2 Alive (100%)	
Watanabe et al. – 2009 ⁵⁵	Case series – IV	9 / 6 (66.7%)	54 (22-68)	0 (0%)	5 C2 (55.6%) 4 C1 (44.4%)	N/A	9 C1-C2 F (55.6%)	9 E, ID-ED (100%)	9 SC (100%)	9 PTR (100%)	1 CSF leak (11.1%)	0 (0%)	9 (100%)	0 (0%)	2 (22.2%)	12.0	30.0 (7-180)	9 Alive (100%)
Edizer et al. – 2010 ⁵⁶	Case report – V	1 / 0 (0%)	34	0 (0%)	XII	R	FM	E, ED	CL (C1)	GTR	0 (0%)	0 (0%)	0 (0%)	XII	0 (0%)	3.0	1 Alive (100%)	
Ishikawa et al. – 2010 ⁵⁷	Case report – V	1 / 1 (100%)	54	X, XII	XII	L	HC	I, ID	SC-TC	PTR	0 (0%)	0 (0%)	0 (0%)	X, XII	0 (0%)	12.0	1 Alive (100%)	
Ji et al. – 2010 ⁵⁸	Case report – V	1 / 1 (100%)	44	0 (0%)	C1-C2	L	C1-C2 F	E, ID	CL (C1-C2)	GTR	0 (0%)	0 (0%)	1 (100%)	0 (0%)	0 (0%)	3.0	1 Alive (100%)	
Li et al. – 2010 ⁵⁹	Case report – V	1 / 0 (0%)	36	0 (0%)	XII	R	FM & HC	I, ID	SC	PTR	0 (0%)	0 (0%)	1 (100%)	XII	1 (100%)	20.0	24.0	1 Alive (100%)
Cavalcanti et al. – 2010 ⁶⁰	Case series – IV	36 / 19 (52.8%)	43 (17-68)	5 X (13.9%) 1 XII (2.8%) 1 VII, VIII (2.8%) 1 XI, XII (2.8%) 1 V, IX, X (2.8%) 1 VII,VIII,X (2.8%) 1 IX, XI, XI (2.8%) 1 VII, VIII, IX, X (2.8%) 1 VIII, IX, X, XII (2.8%) 1 IX, X, XI, XII (2.8%)	17 IX-X-XI (47.2%) 13 C1-C2 (36.1%) 6 XII (16.7%)	14 L (38.9%) 9 R (25%)	17 JF (47.2%) 13 C1-C2 F (36.1%) 6 HC (16.7%)	16 ED-ID (44.4%) 15 ID (41.7%) 5 ED (13.9%) 10 I (10 (27.8%) 4 I-E (11.1%) 2 E (5.6%)	20 FL (55.6%) 13 CL (C1-C2) (36.1%) 8 RS (22.2%)	25 GTR (69.4%) 11 PTR (30.6%)	8 Dysphagia (22.2%) 3 Aspiration pneumonia (8.3%) 3 CSF leak (8.3%) 1Hydrocephalus (2.8%) 1 Meningitis (2.8%)	8 (22.2%)	19 (52.8%)	7 X (19.4%) 3 XII (8.3%) 3 IX, X, XI (8.3%) 1 IX (2.8%) 1 VII,VIII (2.8%) 1 VII, IX, X (2.8%)	1 (2.8%)	12	25 (0-110)	35 Alive (97.2%) 1 Dead (2.8%)
Takami et al. – 2010 ⁶¹	Case series – IV	8 / 1 (12.5%)	49.5 (19-65)	0 (0%)	7 C2 (87.5%) 1 C1 (12.5%)	N/A	8 C1-C2 F (100%)	8 E, ID-ED (100%)	8 CL (C1-C2) (100%)	8 GTR (100%)	0 (0%)	0 (0%)	8 (100%)	0 (0%)	0 (0%)	3.0	8 Alive (100%)	
Gopalakrishnam et al. – 2011 ⁶²	Case report – V	1 / 1 (100%)	40	0 (0%)	C1	M	FM-C1 (100%)	I-E, ID-ED	SC	GTR	0 (0%)	0 (0%)	1 (100%)	0 (0%)	0 (0%)	1.0	1 Alive (100%)	
Ramzan et al. – 2011 ⁶³	Case report – V	1 / 0 (0%)	14	0 (0%)	C1-C2	L	FM-C2	I-E, ID-ED	SC + CL (C1-C3)	PTR	0 (0%)	0 (0%)	1 (100%)	0 (0%)	0 (0%)	3.0	1 Alive (100%)	
Nonaka et al. – 2011 ⁶⁴	Case series – IV	13 / 8 (61.5%)	44 (13-71)	6 XII (46.1%) 3 IX, X, XII (23.1%) 1 IX, X (7.7%)	13 XII (100%)	11 R (84.6%) 2 L (15.4%)	13 HC (100%)	7 I-E, ID-ED (53.8%) 5 I, ID (38.5%) 1 E, ED (7.7%)	13 ELITE (100%)	10 GTR (76.9%) 3 PTR (23.1%)	4 Hoarseness (30.8%) 3 Dysphagia (23.1%) 1 CSF leak (7.7%)	0 (0%)	13 (100%)	6 XII (46.1%) 4 X (30.8%) 3 IX, X (23.1%) 3 IX, X, XII (23.1%) 1 VII (7.7%)	1 (7.7%)	48	6 (9-168)	13 Alive (100%)
Wang et al. – 2011 ⁶⁵	Case series – IV	18 / 10 (55.6%)	47 (24-72)	0 (0%)	16 C2 (88.9%) 2 C1 (11.1%)	N/A	18 C1-C2 F (100%)	14 E, ID-ED (77.8%) 4 E, ED (22.2%)	18 FL (100%)	15 GTR (83.3%) 3 PTR (16.7%)	2 CSF leak (11.1%) 1 Infection wound (5.5%)	0 (0%)	12 (66.7%)	0 (0%)	1 (5.6%)	48	43 (3-110)	17 Alive (94.4%) 1 Dead (5.6%)
Zhang et al. – 2011 ⁶⁶	Case series – IV	3 / 1 (33.3%)	59 (58.61)	2 XII (66.7%) 1 IX, X, XII (33.3%)	3 XII (100%)	3 R (100%)	3 HC (100%)	3 E (100%)	3 Endoscopic Transoral (100%)	3 GTR (100%)	1 Dysphagia (33.3%)	0 (0%)	3 (100%)	2 IX, X, XII (66.7%) 1 XII (33.3%)	0 (0%)	6.0	3 Alive (100%)	
Helms et al. – 2012 ⁶⁷	Case report – V	1 / 0 (0%)	29	0 (0%)	C1	L	FM-C1	I-E, ID-ED	FL + CL (C1-C2)	GTR	0 (0%)	0 (0%)	1 (100%)	0 (0%)	0 (0%)	36.0	1 Alive (100%)	
Nakamizo et al. – 2012 ⁶⁸	Case report – V	1 / 1 (100%)	49	0 (0%)	C2	R	C1-C2 F	E, ED	CL (C1-C2)	GTR	0 (0%)	0 (0%)	1 (100%)	0 (0%)	0 (0%)	3.0	1 Alive (100%)	
Ohba et al. – 2012 ⁶⁹	Case report – V	1 / 1 (100%)	37	V, IX, X, XI, XII	XII	L	HC	I-E, ID-ED	SC	PTR	0 (0%)	0 (0%)	1 (100%)	V, IX, X, XI, XII	1 (100%)	24.0	108.0	1 Alive (100%)

Oyama et al. – 2012⁷⁰	Case report – V	1 / 1 (100%)	25	XII	XII	R	HC	I-E, ID-ED	TC	PTR	Dysphagia	1 (100%)	0 (0%)	XII	0 (0%)	25.0	37.0	1 Alive (100%)
Santarius et al. – 2012⁷¹	Case report – V	1 / 0 (0%)	9	VII	XII	L	HC	I-E, ID-ED	SC	GTR	Hemiparesis	0 (0%)	1 (100%)	XII	1 (100%)		12.0	1 Alive (100%)
Wan et al. – 2012⁷²	Case series – IV	8 / 4 (50%)	49 (31-58)	4 VII, VIII, IX, X, XI (50%) 2 IX, X, XII (25%) 1 X (12.5%) 1 VIII, IX, XII (12.5%)	8 IX-X-XI (100%)	N/A	8 JF (100%)	8 I-E, ID- ED (100%)	8 RS-SJ (100%)	7 GTR (87.5%) 1 PTR (12.5%)	2 CSF leak (25%) 1 Aspiration pneumonia (12.5%) 1 Dysphagia (12.5%)	1 (12.5%)	8 (100%)	4 VII, VIII, IX, X, XI (50%) 2 IX, X, XII (25%) 1 X (12.5%) 1 VIII, IX, XII (12.5%)	0 (0%)		38 (23-60)	1 Alive (100%)
Zhang et al. – 2012⁷³	Case series – IV	3 / 0 (0%)	42 (16-43)	1 X, XII (33.3%) 1 VII, VIII, XII (33.3%)	3 XII (100%)	2 L (66.7%) 1 R (33.3%)	JF & HC	3 I-E, ID- ED (100%)	3 Endo- scopic Tran- soral (100%)	3 GTR (100%)	0 (0%)	0 (0%)	3 (100%)	1 X (33.3%) 1 XII (33.3%)	0 (0%)		4.0 (2-6)	3 Alive (100%)
Baghel et al. – 2013⁷⁴	Case report – V	1 / 1 (100%)	40	XII	XII	L	HC	I-E, ID-ED	SC-RS + CL (C1)	PTR	0 (0%)	0 (0%)	1 (100%)	XII	0 (0%)		2.0	1 Alive (100%)
Chowdhury et al. – 2013⁷⁵	Case series – IV	14 / 7 (50%)	31 (10-53)	0 (0%)	11 C1 (84.6%) 2 C2 (15.4%)	8 L (57.1%) 6 R (43.9%)	11 FM-C1 (84.6%) 2 C1-C2 F (15.4%)	6 E, ID-ED (46.2%) 5 E, ID (38.5%) 3 E, ED (23.1%)	14 SC + CL (C1-C2 (100%)	14 GTR (100%)	2 CSF leak (15.4%) 1 Aspiration pneumonia (7.1%)	0 (0%)	14 (100%)	0 (0%)	0 (0%)		8.0 (3-12)	13 Alive (92.9%) 1 Dead (7.1%)
Xiao et al. – 2013⁷⁶	Case series – IV	11 / 3 (27.3%)	50 (31-59)	6 IX, XII (54.5%) 2 VII, IX, XII (18.2%) 2 VIII, IX, X, XII (18.2%) 1 XII (9.1%)	11 XI (100%)	7 R (63.6%) 4 L (36.4%)	11 HC (100%)	11 I-E (100%)	11 FL (100%)	10 GTR (90.9%) 1 PTR (9.1%)	2 Pneumonia (18.2%) 1 Meningitis (9.1%)	0 (0%)	11 (100%)	N/A	0 (0%)		14 (3-25)	11 Alive (100%)
Nowak et al. – 2014⁷⁷	Case series – IV	10 / 6 (60%)	38 (25-54)	2 IX, X, XI (20%) 2 VII, VIII, IX, X (20%) 1 VIII (10%) 1 XI (10%) 1 V, VII, VIII, IX (10%) 1 IX, X, XI, XII (10%) 1 VII, VIII, IX, X, XI (10%)	5 IX-X-XI (50%) 3 IX (30%) 1 X (10%) 1 XI (10%)	N/A	10 JF (100%)	8 I, ED (80%) 2 I, ID (20%)	8 SC-CL (C1) (80%) 2 RS (20%)	10 GTR (100%)	6 Paresis (60%)	0 (0%)	4 (40%)	5 VIII (50%) 5 X (50%) 4 XI (40%) 3 VII (30%) 3 IX (30%) 1 V (10%)	1 (10%)	40	28 (6-71)	10 Alive (100%)
Suri et al. – 2014⁷⁸	Case series – IV	14 / 8 (57.1%)	35 (15-63)	14 XII (100%) 8 IX, X (57.1%)	14 XII (100%)	9 R (69.2%) 4 L (30.8%) 1 B (7.1%)	14 HC (100%)	13 I, ID (92.9%) 1 I, ID-ED (7.1%)	9 RS (64.3%) 3 SC (21.4%) 2 FL (14.3%)	9 PTR (64.3%) 5 GTR (35.7%)	2 Infection wound (14.3%) 1 CSF leak (7.1%)	7 (50%)	14 (100%)	14 XII (100%)	0 (0%)		32 (3-59)	14 Alive (100%)
Yu et al. – 2014⁷⁹	Case series – IV	9 / 5 (55.6%)	52 (21-69)	0 (0%)	9 C2 (100%)	5 R (55.6%) 4 L (44.4%)	9 C1-C2 F (100%)	8 E, ID-ED (88.9%) 1 E, ED (11.1%)	9 SC + CL (C1-C2 (100%)	9 GTR (100%)	2 C2 deficit (22.2%)	0 (0%)	9 (100%)	0 (0%)	0 (0%)		34 (5-72)	9 Alive (100%)
Feldman et al. – 2015⁸⁰	Case report – V	1 / 1 (100%)	64	0 (0%)	C2	R	C1-C2 F	E, ID-ED	FL + CL (C1-C2)	GTR	0 (0%)	0 (0%)	1 (100%)	0 (0%)	1 (100%)	12.0	36.0	1 Alive (100%)
Hayashi et al. – 2015⁸¹	Case series – IV	8 / 5 (62.5%)	44 (38-72)	4 XII (50%) 3 X, XII (37.5%) 1 IX, X, XII (12.5%)	8 XII (100%)	5 L (62.5%) 3 R (37.5%)	8 HC (100%)	8 I, ID (100%)	6 TC (75%) 2 SC (25%)	8 PTR (100%)	0 (0%)	0 (0%)	8 (100%)	N/A	0 (0%)		6.0 (3-12)	1 Alive (100%)
Jiang et al. – 2015⁸²	Case series – IV	6 / 5 (83.3%)	54 (37-72)	0 (0%)	5 C1 (83.3%) 1 C2 (16.7%)	N/A	6 FM-C2 (100%)	6 E (100%)	6 CL (C1) (100%)	6 GTR (100%)	2 CSF leak (33.3%)	0 (0%)	5 (83.3%)	0 (0%)	0 (0%)		33.5 (24-42)	1 Alive (100%)
Oichi et al. – 2015⁸³	Case report – V	1 / 1 (100%)	64	0 (0%)	C2	L	C1-C2 F	E, ED	CL (C1)	GTR	0 (0%)	0 (0%)	1 (100%)	0 (0%)	0 (0%)		6.0	1 Alive (100%)
Puchalska-Niedbal et al. – 2015⁸⁴	Case report – V	1 / 0 (0%)	24	0 (0%)	C1	N/A	FM-C1	E, ID	SC + CL (C1-C2)	PTR	0 (0%)	0 (0%)	1 (100%)	0 (0%)	0 (0%)		2.0	1 Alive (100%)
Yu et al. – 2015⁸⁵	Case report – V	1 / 1 (100%)	61	XII	XII	L	HC	I-E, ID-ED	FL-SC	GTR	0 (0%)	0 (0%)	1 (100%)	XII	0 (0%)		24.0	1 Alive (100%)
Bhatoo et al. – 2016⁸⁶	Case report – V	1 /	47	IX, X, XII	XII	L	HC	I, E, ID	RS	GTR	0 (0%)	0 (0%)	1 (100%)	XII	0 (0%)		6.0	1 Alive

Liebelt et al. – 2016⁸⁷	Case report – V	0 (0%) 1 / 1 (100%)	58	0 (0%)	C1	R	FM-C1	I-E, ID-ED	SC + CL (C1)	PTR	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	3.0	(100%) 1 Alive (100%)
Yoon et al. – 2016⁸⁸	Case report – V	1 / 0 (0%)	32	0 (0%)	C2	L	C1-C2 F	I-E, ID-ED	SC + CL (C1)	GTR	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1.5	1 Alive (100%)
Inoue et al. – 2017⁸⁹	Case report – V	1 / 1 (100%)	61	XII	XII	R	HC	I-E, ID-ED	SC-RS	GTR	Hoarse, dys- phagia	0 (0%)	0 (0%)	XII	0 (0%)	12.0	1 Alive (100%)
Lee et al. – 2017⁹⁰	Case report – V	1 / 1 (100%)	57	0 (0%)	C2	L	C1-C2 F	E, ED	CL (C2-C3)	GTR	SAH	0 (0%)	0 (0%)	0 (0%)	0 (0%)	2.0	1 Alive (100%)
Pisani et al. – 2017⁹¹	Case report – V	1 / 0 (0%)	37	0 (0%)	C1	L	FM-C1	E, ED	SC	GTR	0 (0%)	0 (0%)	1 (100%)	0 (0%)	0 (0%)	6.0	1 Alive (100%)
Goel et al. – 2018⁹²	Case series – IV	50 / 36 (72%)	36 (14-70)	0 (0%)	50 C2 (100%)	5 B (10%)	50 C1-C2 (100%)	50 E, ID (100%)	50 CL (C1- C3) (100%)	50 PTR (100%)	N/A	0 (0%)	50 (100%)	0 (0%)	0 (0%)	68 (3-120)	50 Alive (100%)
Heda et al. – 2018⁹³	Case report – V	1 / 0 (0%)	40	XII	XII	L	JF & HC	E, ED	SC-RS	PTR	0 (0%)	0 (0%)	1 (100%)	XII	0 (0%)	3.0	1 Alive (100%)
Matsuda et al. – 2018⁹⁴	Case report – IV	2 / 2 (100%)	61.5 (53-70)	0 (0%)	2 C2 (100%)	2 R (100%)	C1-C2 F	1 E, ED (50%) 1 E, ID-ED (50%)	1 CL (C1-C2 (50%) 1SC+CL (C1-C2) (50%)	2 GTR (100%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	3.0	2 Alive (100%)
Park et al. – 2018⁹⁵	Case report – V	1 / 1 (100%)	54	0 (0%)	C2	R	C1-C2 F	E, ID	CL (C1)	PTR	0 (0%)	0 (0%)	1 (100%)	0 (0%)	0 (0%)	12.0	1 Alive (100%)
Jung et al. – 2019⁹⁶	Case report – V	1 / 1 (100%)	37	0 (0%)	C2	R	C1-C2 F	E, ID	CL (C2-C3)	GTR	0 (0%)	0 (0%)	1 (100%)	0 (0%)	0 (0%)	1.0	1 Alive (100%)
Di Pascuale et al. – 2020⁹⁷	Case report – V	1 / 1 (100%)	22	VIII, IX, X, XII	XII	L	HC	I-E, ED	RS	PTR	Dysphagia	0 (0%)	1 (100%)	0 (0%)	0 (0%)	12.0	1 Alive (100%)
Nakajima et al. – 2020⁹⁸	Case report – V	1 / 0 (0%)	50	0 (0%)	C2	R	C1-C2 F	E, ED	CL (C1-C2)	PTR	0 (0%)	0 (0%)	1 (100%)	0 (0%)	0 (0%)	36.0	1 Alive (100%)
Aftahy et al. – 2021⁹⁹	Case series – IV	9 / 2 (22.2%)	43 (20-71)	1 VII (11.1%) 1 VIII (11.1%) 1 X (11.1%)	5 IX (55.6%) 2 X (22.2%) 2 IX-X-XI (22.2%)	N/A	9 JF (100%)	4 I, ED (44.4%) 4 I (44.4%) 1 E (11.1%)	6 RS (66.7%) 3 ELITE (33.3%)	9 GTR (100%)	2Hydrocepha- lus (22.2%) 2 Hoarse, hear loss (22.2%)	0 (0%)	9 (100%)	N/A	0 (0%)	16.5 (3-84)	9 Alive (100%)
Fachniadin et al. – 2021¹⁰⁰	Case report – V	1 / 0 (0%)	53	IX, X, XII	XII	L	JF & HC	I, ID	SC-RS	PTR	0 (0%)	0 (0%)	1 (100%)	XI, XII	0 (0%)	1.0	1 Alive (100%)
Matsui et al. – 2021¹⁰¹	Case report – V	1 / 0 (0%)	54	0 (0%)	C1	R	FM-C1	I-E, ID-ED	SC + CL (C1)	PTR	0 (0%)	0 (0%)	1 (100%)	0 (0%)	0 (0%)	3.0	1 Alive (100%)

References correspond to **Supplementary File S1**.

Abbreviations: **B**, Bilateral; **CL**, Cervical laminectomy/laminoplasty; **E**, Extracranial; **ED**, extradural; **ELITE**, Extreme lateral infrajugular transcondylar-transtubercular exposure; **F**, Foramen; **FL**, Far-lateral; **FM**, Foramen magnum; **GTR**, Gross total resection (100%); **HC**, Hypoglossal canal; **I**, Intracranial; **ID**, Intradural; **JF**, Jugular foramen; **L**, Left; **M**, Midline; **N/A**, Not Available; **OS**, Overall Survival; **PFS**, Progression-free survival; **PTR**, Partial resection (<100%); **R**, Right; **RS**, Retrosigmoid; **SAH**, Subarachnoid hemorrhage; **SC**, Suboccipital craniectomy; **SJ**, Suprajugular; **TC**, Transcondylar.

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