

APPENDIX C

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*NOTE: All studies reporting a majority of patients with myelopathy at baseline are shaded in all of the above tables.

Table C1. Study characteristics for randomized controlled trials

Author	Year	Study Design	Country	Comparators	Sample Size	Study Duration (months)	Inclusion/Exclusion Criteria	Quality Assessment	Withdrawals n (%)	Notes
Anterior Discectomy and Fusion										
Abd-Alrahman	1999	RCT	Egypt *	Anterior discectomy and fusion	50	15.4†	<u>Inclusion</u> <ul style="list-style-type: none"> • one or two-level cervical disc disease • previous conservative treatment <u>Exclusion</u> <ul style="list-style-type: none"> • multi-level disease • re-operation 	Low	0 (0)	Post surgery, all patients wore soft collar for 1 month
				Discectomy	40					
Dowd	1999	RCT	USA	Anterior discectomy and fusion	40	54+	<u>Inclusion</u> <ul style="list-style-type: none"> • radiculopathy • single or two level cervical disc disease • cervical spondylosis diagnosis 	Low	17 (43)	All patients operated at single institution by same staff to achieve consistency
				Discectomy	44				11(25)	
Hauerberg	2008	RCT	Denmark	Anterior discectomy and fusion	40	24	<u>Inclusion</u> <ul style="list-style-type: none"> • cervical root compression • single level operation • duration of symptoms > 6 weeks <u>Exclusion</u> <ul style="list-style-type: none"> • cervical spine injury • myelopathy • root compression >2 levels • other neurologic disease • prior cervical spine surgery 	High	5 (13)	Operation performed by different surgeons; post surgery, no mobilization restrictions imposed
				Discectomy	46				4 (9)	
Martins	1976	RCT	USA	Anterior discectomy and fusion	25	12	<u>Inclusion</u> <ul style="list-style-type: none"> • symptoms of cervical disc disease and radiculopathy • one or two-level cervical disc disease 	High	None	Operation performed by different surgeons; post surgery, all patients fitted with stiff vertical collar
				Discectomy and foraminotomy	26					
Persson	1997, 2001‡	RCT	Sweden	Anterior discectomy and fusion	27	16	<u>Inclusion</u> <ul style="list-style-type: none"> • cervico brachial pain > 3 months • nerve root compression due to spondylotic spurs with or without bulging disc 	High	1 (4)	Operation performed by different surgeons
				Physiotherapy	27				0 (0)	
				Cervical collar	27				1 (4)	

Author	Year	Study Design	Country	Comparators	Sample Size	Study Duration (months)	Inclusion/Exclusion Criteria	Quality Assessment	Withdrawals n (%)	Notes
Rosenørn	1983	RCT	Denmark	Anterior discectomy and fusion	31	12	<u>Inclusion</u> • clinical evidence of herniated disc	High	2 (6)	Operation performed by different surgeons
				Discectomy	32		<u>Exclusion</u> • fractures, dislocations and narrowing of inter vertebral foramina and spinal cord			
Savolainen	1998	RCT	Finland*	Anterior discectomy and fusion	30	36-60	<u>Inclusion</u> • single-level radicular symptoms	High	3 (3) ^c	Post surgery, all patients wore soft collar for 2 months
				Discectomy	31		<u>Exclusion</u> • multilevel disease • patients requiring a posterior approach • prior cervical spine surgery			
				Anterior discectomy and fusion and plating	30					
van den Bent	1996	RCT	Netherlands	Anterior discectomy and fusion	42	24	<u>Inclusion</u> • radiculopathy • previous conservative treatment	High	3 (4) ^c	3 patients underwent assessment by phone due to long travelling distances
				Discectomy	39		<u>Exclusion</u> • spinal cord compression > grade 2 on the Nurick scale			
Wirth	2000	RCT	USA	Anterior discectomy and fusion	25	60+	<u>Inclusion</u> • radiculopathy • single level disease	Low	16 (64)	All operations performed by same surgeon at same institution
				Discectomy	25		<u>Exclusion</u> • myelopathy			
				Foraminotomy	22					
Xie	2007	RCT	Canada	Anterior discectomy and fusion	15	24	<u>Inclusion</u> • single-level radicular symptoms	High	0 (0)	
				Discectomy	15		<u>Exclusion</u> • cervical myelopathy • multi-level disease			
				Anterior discectomy and fusion with instrumentation	15					
Microdiscectomy and Fusion										
Barlöcher	2002	RCT	Switzerland	Microdiscectomy and fusion	30	12	<u>Inclusion</u> • radiculopathy • single level cervical disc disease • previous conservative treatment	High	0 (0)	Operations performed by different surgeons; post-surgery, all patients advised to wear soft collar for 3 weeks
				Microdiscectomy	33		<u>Exclusion</u> • cervical myelopathy • multi-level disease • acute trauma			
				Microdiscectomy with fusion using Polymethylmethacrylate	26					
				Microdiscectomy with fusion using titanium cage	36					

Author	Year	Study Design	Country	Comparators	Sample Size	Study Duration (months)	Inclusion/Exclusion Criteria	Quality Assessment	Withdrawals n (%)	Notes
Oktenoglu	2007	RCT	Turkey*	Microdiscectomy and fusion	9	12-18	<u>Inclusion</u> • symptoms of cervical disc disease and radiculopathy • one level disc disease • first cervical surgery • no response to at least 2 weeks conservative treatment	High	0 (0)	
				Microdiscectomy	11		<u>Exclusion</u> • multi-level disc disease • prior procedures to address cervical and /or radicular pain including epidural steroid injections		0 (0)	
Ruetten	2009	RCT	Germany*	Microdiscectomy and fusion	60	24	<u>Inclusion</u> • unilateral radiculopathy	High	12 (20)	All operations performed by two surgeons
				Full endoscopic anterior cervical discectomy	60		<u>Exclusion</u> • clear instability or deformities • previous operation at same segment		9 (15)	
Ruetten	2008	RCT	Germany*	Microdiscectomy and fusion	100	24	<u>Inclusion</u> • unilateral radiculopathy	Low	86 (86)	All operations performed by two surgeons
				Full endoscopic posterior foraminotomy	100		<u>Exclusion</u> • patients with instabilities or deformities • disc herniation		89 (89)	
Surgery versus Conservative Treatment										
Kadaňka	2011	RCT	Czech Republic	Surgery§	32	120	<u>Inclusion</u> • Signs and symptoms of cervical cord dysfunction • mono or multi segmental cord compression and/or myelopathy • JOA score ≥ 12	Low	10 (31)	
				Conservative treatment	32		<u>Exclusion</u> • Previous surgery		7 (22)	

RCT: randomized controlled trial; N: number

* All authors from listed country

† Mean length of follow-up

‡ Studies analyzing identical population

§ Surgery includes anterior discectomy and fusion, discectomy, laminoplasty and corpectomy; conservative methods include cervical collar use, anti-inflammatory medication and bed rest

Table C2. Patient characteristics for randomized controlled trials

Author	Year	Study Design	Intervention (N)	Extent Of Disease n (%)		Symptoms/ Diagnosis n (%)		Mean duration of symptoms (months ± SD)	Mean Age (years ± SD)	Females n(%)	Previous Surgery/ other n (%)	Employment Status (n, % employed)	Disability Coverage n (%)	Comments					
Anterior Discectomy and Fusion																			
Abd-Alrahman	1999	RCT	ADF	50	1-level*	70(78)	Radiculopathy Myelopathy	33 (66) 17 (34)	15.9 ± 18	49.7 ± 13.2	18(36)	NR	NR						
			Discectomy	40	2-levels*	20(22)	Radiculopathy Myelopathy	32 (80) 8 (20)	10.1 ± 6.8	40 ± 8.4	12(35)								
Dowd	1999	RCT	ADF	40	NR		Arm weakness Myelopathy	10 (25) 14 (35)	5.5	65	20(50)	NR	NR	13(33) (compensation claim)	Compensation claims and smoking history reported in study; less than 40% of patients in ADF group and less than 35% patients in discectomy group underwent preoperative therapy such as cervical traction, cervical collar, anti-inflammatory medications and muscle relaxants				
			Discectomy	44	NR		Arm weakness Myelopathy	1 (3) 12 (27)	3.75	50	26(60)					13(30)			
			ADF	40	1-level	86 (100)	Soft disc herniation	19(47.5)	24 (60) patients >12	45 (10)†	21(52.5)					7 (17.5)	NR	NR	Industrial injury 17.5% for intervention and 21.7% for discectomy
			Discectomy	46			Soft disc herniation	22(47.8)	23 (50) patients >12	46 (11)†	22(47.8)								
Martins	1976	RCT	ADF	25	NR		Neck, shoulder pain Paresthesia, hyperthesia Radicular pain Upper extremity weakness Myelopathy Spondylosis	21 (84) 18 (72) 23 (92) 20 (80) 1 (4) 23 (62)		48.8 ± 6.77		NR	NR	NR	NR				
			Discectomy with Foraminotomy	26	NR		Neck, shoulder pain Paresthesia, hyperthesia Radicular pain Upper extremity weakness Myelopathy Spondylosis	24 (92) 23 (88) 23 (88) 22 (85) 1 (4) 20 (80)		44 ± 7.24									
			ADF	27	1-level	27 (100)	Cervico brachial pain > 3 mo	27 (100)	34 (15)§	45 (47)§	11 (41)					100	19 (85)		
			Physiotherapy	27	NR		Cervico brachial pain > 3 mo	27 (100)	40 (31)§	48 (48)§	16 (59)					100	14 (78)		
			Cervical Collar	27	NR		Cervico brachial pain > 3 mo	27 (100)	28 (21)§	49 (50)§	10 (37)					96.2	12 (57)		
			ADF	31	NR		Symptoms of herniated disc * Pain, paresis, disturbance of sensation or reflexes indicating only 1 root being affected *	63 (100) 30 (48)		12* (1-48)¶	28-70*, ¶					14 (45)	NR	63(100)	NR
Rosenørn	1983	RCT	Discectomy	32	NR		>1 root affected *			9 (28)									

Author	Year	Study Design	Intervention (N)	Extent Of Disease n (%)		Symptoms/ Diagnosis n (%)	Mean duration of symptoms (months ± SD)	Mean Age (years ± SD)	Females n(%)	Previous Surgery/ other n (%)	Employment Status (n, % employed)	Disability Coverage n (%)	Comments
Savolainen	1998	RCT	ADF	30		Radiculopathy 30 (100) Soft disc prolapse 23(76.6)		47.9	8 (27)				
			Discectomy	31	1-level 91 (100)	Radiculopathy 31 (100) Soft disc prolapse 22(71)	NR	46	11 (35)	NR	NR	NR	
			ADF and plating	30		Radiculopathy 30 (100) Soft disc prolapse 22(73.3)		49.7	9 (30)				
van den Bent	1996	RCT	ADF	42		Brachialgia 42 (100) Severe neck pain before surgery 32 (76)	1- ≥12*, ¶	48	14 (33.3)		NR	NR	NR
			Discectomy	39	NR	Brachialgia 39 (100) Severe neck pain before surgery 21 (54)		47	14 (35.9)				
Wirth	2000	RCT	ADF	25		Weakness 11 (44) Numbness 21 (84) Herniated disc 25 (100)	1	41.7	11 (44)			2 (8)#	
			Discectomy	25	1-level 72(100)	Weakness 11 (44) Numbness 21 (84) Herniated disc 25 (100)	1.8	45	12 (48)	NR	NR	4(16)#	
			Foraminotomy	22		Weakness 9 (41) Numbness 16 (73) Herniated disc 22 (100)	1.3	43.8	13 (59)			3(14)#	
Xie	2007	RCT	ADF	15		Neck pain 11 (73) Arm pain 10 (66.6) Numbness 13 (86.6) Weakness 4 (26.6)	13 ± 17	43 ± 8	6 (40)		9 (60)**		
			Discectomy	15	1-level 45(100)	Neck pain 12 (100) Arm pain 7 (58.3) Numbness 7 (58.3) Weakness 3 (25)	10 ± 9	42 ± 8	7 (58.3)	NR	6 (50)**	NR	
			ADF with Instrumentation	15		Neck pain 14 (93.3) Arm pain 4 (26.6) Numbness 11 (73.3) Weakness 7 (46.6)	19 ± 24	42 ± 8	1 (6.6)		12 (80)**		
Microdiscectomy and Fusion													
Barlöcher	2002	RCT	MDF	30		Radicular pain 28 (93.3) Cervical pain 26 (86.6)		47.3 ± 11.5	12(40)	2 (7)			
			Microdiscectomy	33	1-level 125(100)	Radicular pain 33 (100) Cervical pain 25 (75.7)	8*	51.1 ± 12.5	14(41)	2 (6)	49 (39)*	NR	
			MDF with Polymethylmethacrylate	26		Radicular pain 26 (100) Cervical pain 26 (100)	0.5-72¶	52.2 ± 10.8	13(50)	0 (0)			
			MDF with titanium cage	36		Radicular pain 34 (94.4) Cervical Pain 35 (97.2)		50.5 ± 13.4	12(33)	4 (11)			
Oktenoglu	2007	RCT	MDF	9	1-level 20(100)	Radiculopathy 9 (100)	NR	40.2	2(22.2)	NR	NR	NR	
			Discectomy	11		Radiculopathy 11 (100)		39.9	7(63.6)				
Ruetten	2009	RCT	MDF	60	1-level 120(100)	Cervical soft disc herniations 60 (100)	0-4*, ¶	30-61*, ¶	77 (64.1)*	120 (100)*	NR	NR	
			Full endoscopic anterior cervical discectomy	60		Cervical soft disc herniations 60 (100)							
Ruetten	2008	RCT	MDF	100	1-level 200 (100)	Lateral cervical disc herniation 100 (100)	3.1*	43*	132(66)*	200 (100)*	NR	NR	171 (86%) patients received conservative treatment prior to interventions
			Full endoscopic posterior Foraminotomy	100		Lateral cervical disc herniation 100 (100)	0.2-8¶	(27-62)¶					

Author	Year	Study Design	Intervention (N)	Extent Of Disease n (%)	Symptoms/ Diagnosis n (%)	Mean duration of symptoms (months ± SD)	Mean Age (years ± SD)	Females n(%)	Previous Surgery/ other n (%)	Employment Status (n, % employed)	Disability Coverage n (%)	Comments	
Surgery versus Conservative Treatment													
Kadaňka	2011	RCT	Surgery††	32	1 (1,3)‡‡	Cervical Myelopathy	32 (100)	3 (0.3,12)‡‡	51 (41,65)‡‡	11 (34)	0 (0)	NR	NR
			Conservative Treatment	32	2 (1,3)‡‡	Cervical Myelopathy	32 (100)	1(0.3,6)‡‡	54.5 (47,65)‡‡	25 (78)	0 (0)		

ADF: anterior discectomy and fusion; MDF: microdiscectomy and fusion; N: number; NR: not reported; RCT: randomized controlled trial; SD: standard deviation

* Reported for entire patient population

† Median (IQR)

‡ Three studies evaluating identical study populations

§ Mean (Median)

|| Reported as patients with a sickness benefit

¶ Range

Workers' compensation claims

** Includes full- and part-time working status

†† Surgery includes anterior discectomy and fusion, discectomy, laminoplasty and corpectomy; conservative methods include cervical collar use, anti-inflammatory medication and bed rest

‡‡ Median (10th, 90th quantile)

Table C3. Treatment success for randomized controlled trials

Intervention	Author	Year	Study Design	Comparator(s)	Index	Time (months)	Measure	Intervention Outcome	Comparator Outcome	P-value	Comments
Anterior Discectomy and Fusion											
ADF	Abd-Alrahman	1999	RCT	Discectomy	Odom's Criteria	24	Excellent	20 (40)	24 (60)	NS	No statistically significant differences between groups
					Good		20 (40)	12 (30)			
					Satisfied		7 (14)	2 (5)			
					Poor		3 (6)	2 (5)			
ADF	Hauerberg	2007	RCT	Discectomy	Effect of operation*	3	Good	28 (71.8)	40 (87)	0.14	
					Poor		11 (28.2)	6 (13)			
						12	Good	28 (80)	34 (81)	1	
					Poor		7 (20)	8 (19)			
						24	Good	31 (86.1)	33 (76.7)	0.44	
					Poor		5 (13.9)	10 (23.3)			
ADF	Martins	1976	RCT	ACD	Results of operation†	1.5	Excellent	7 (28)	7 (27)	NS	
							Good	9 (36)	10 (38)	NS	
							Fair	7 (28)	7 (27)	NS	
							Poor	2 (8)	2 (8)	NS	
ADF	Ruetten	2009	RCT	Full endoscopic anterior cervical discectomy	Hilibrand Criteria	0	Excellent	0	0	NR	
					Good		0	0	NR		
					Fair		4(8.3)	5 (9.6)	NR		
					Poor		44 (91.6)	47 (90.3)	NR		
						3	Excellent	37 (77)	40 (78.4)	NR	
					Good		6 (12.5)	8 (15.7)	NR		
					Fair		3 (6.2)	2 (3.9)	NR		
					Poor		2 (4.16)	1 (2)	NR		
						6	Excellent	35 (72.9)	38 (74.5)	NR	
					Good		10 (20.8)	10 (19.6)	NR		
					Fair		1 (2)	2 (3.9)	NR		
					Poor		2(4.1)	1 (2)	NR		
						12	Excellent	34 (70.8)	39 (78)	NR	
					Good		9 (18.8)	10 (20)	NR		
					Fair		2 (4.1)	1 (2)	NR		
					Poor		3 (6.2)	1 (2)	NR		
						24	Excellent	36 (75)	37 (72.5)	NR	
					Good		7 (14.5)	11 (21.5)	NR		
					Fair		2 (4.2)	2 (3.9)	NR		
					Poor		3 (6.2)	1 (2)	NR		
ADF	Ruetten	2008	RCT	Full endoscopic posterior cervical foraminotomy	Hilibrand Criteria	0	Excellent	0	0	NR	
					Good		0	0	NR		
					Fair		7(7)	8 (8)	NR		
					Poor		93 (93)	92 (92)	NR		
						3	Excellent	84 (89.4)	83 (85.6)	NR	
					Good		7 (7.4)	12 (12.4)	NR		
					Fair		2 (2.1)	1(1)	NR		
					Poor		1 (1.1)	1 (1)	NR		
						6	Excellent	81 (88)	80 (81.6)	NR	No significant difference among 3 groups at 6 months for each level of success; no significant difference among 3 groups in those with good success at 48 months
					Good		7 (7.6)	15 (15.3)	NR		
					Fair		3 (3.3)	2 (2)	NR		
					Poor		1 (1.1)	1 (1)	NR		
						12	Excellent	78 (86.7)	80 (82.5)	NR	
					Good		7 (7.8)	14 (14.4)	NR		
					Fair		3 (3.3)	1 (1)	NR		
					Poor		2 (2.2)	2 (2.1)	NR		
						24	Excellent	76 (88.4)	79 (88.8)	NR	
					Good		5 (5.8)	7 (7.9)	NR		
					Fair		3 (3.5)	1 (1.1)	NR		
					Poor		2 (2.3)	2 (2.2)	NR		

Intervention	Author	Year	Study Design	Comparator(s)	Index	Time (months)	Measure	Intervention Outcome	Comparator Outcome	P-value	Comments	
ADF	Savolainen	1998	RCT	Discectomy	Clinical outcome /Rate of success†	6	n (%)	21(70)	21 (67)	NR		
					Good		n (%)	6(20)	5 (17)	NR		
					Fair		n (%)	3 (10)	5 (16)	NR		
					48§	Good	n (%)	23 (82)	23 (76)	NR		
						Fair	n (%)	4 (14)	7 (24)	NR		
						Poor	n (%)	1 (4)	0 (0)	NR		
				ADF with plating	6	n (%)	21(70)	23 (77)	NR			
						Good	n (%)	6(20)	6 (20)	NR		
						Fair	n (%)	3 (10)	1 (3)	NR		
					48§	Good	n (%)	23 (82)	22 (73)	NR		
						Fair	n (%)	4 (14)	7 (23)	NR		
						Poor	n (%)	1 (4)	1 (4)	NR		
ADF	van den Bent	1996	RCT	Discectomy	Odom's Criteria	24	n (%)	28 (70)	30 (77)	NS	Good outcome at 6 weeks and 4 months was almost 70% for both groups	
					Good							
Microdiscectomy and Fusion												
Microdiscectomy with fusion	Barlöcher	2002	RCT	Microdiscectomy	Odom's Criteria	6	n (%)	20 (66.6)	24 (72.7)	NR		
					excellent/good							12
					satisfied/poor	6	n (%)	6 (20)	8 (24.5)	NR		
					Microdiscectomy with polymethylmethacrylate							excellent/good
						satisfied/poor	12	n (%)	10 (33.3)	2 (8.4)		NR
					Microdiscectomy with titanium cage	excellent/good						
				satisfied/poor		10	n (%)	6 (20)	3 (12.5)	NR		
				excellent/good	6							n (%)
				satisfied/poor		10	n (%)	10 (33.3)	3 (8.4)	NR		
				excellent/good	12							n (%)
				satisfied/poor		12	n (%)	6 (20)	2 (5.6)	NR		

ADF: anterior discectomy and fusion; N: number; NR: not reported; NS: not significant; RCT: randomized controlled trial

* Subjective categorization of surgical results, dichotomized into Good (full recovery or improved) and Poor (unchanged or worse) effect of the interventions

† Excellent: All preoperative symptoms relieved, abnormal signs unchanged or improved; Good: minimum persistence of pre-operative symptoms, abnormal signs unchanged or improved;

Fair: Definite relief of some pre-operative symptoms, others unchanged or slightly improved; Poor: Signs and symptoms unchanged

‡ Outcome assessment based on scale developed by Jennett, 1975: good = no symptoms; fair = some benefit from surgery but still with some complaints; poor = no benefit or worse than the preoperative state

§ Mean length of follow-up

|| Good categorization includes patients assessed with "good" and "excellent" based on Odom's criteria

Table C4. Pain outcomes for randomized controlled trials

Intervention	Author	Year	Study Design	Comparator(s)	Index	Time (months)	Measure	Intervention Outcome	Comparator Outcome	P-value	Comments
Anterior Discectomy and Fusion											
ADF	Abd-Alrahman	1999	RCT	Discectomy	VAS score						
					Arm	15.4*	NR	NR	NR	NS	No data provided on VAS scores
					Neck	15.4*	NR	NR	NR	NS	
ADF	Dowd	1999	RCT	Discectomy	Subjective pain evaluation (% with improved pain relief)						
						1.3	n (%)	37 (92.5)	40 (90.9)	NR	
						2.5	n (%)	35 (100)	32 (96.8)	NR	
ADF	Hauerberg	2007	RCT	Discectomy	Subjective assessment of pain†						
					Overall Pain	0	Median (IQR)	7 (2)	6 (3)	0.14	
					Arm	3	Median (IQR)	0 (5)	1 (4)	0.73	
					Arm	12	Median (IQR)	2 (5)	2 (5)	0.85	
					Arm	24	Median (IQR)	2 (4)	3 (5)	0.46	
					Neck	3	Median (IQR)	4 (6)	4 (5)	0.26	
					Neck	12	Median (IQR)	3 (6)	3 (6)	1	
					Neck	24	Median (IQR)	4 (6)	3 (6)	0.48	
ADF	Persson	1997,2001‡	RCT		VAS score [§]						
				Physiotherapy		0	Mean (SD)	47 (25.5)	50 (20.7)	NS	
				Physiotherapy		4	Mean (SD)	27 (23)	41 (28.6)	NS	
				Physiotherapy		16	Mean (SD)	30 (28.1)	39 (25.8)	NS	
				Cervical collar		0	Mean (SD)	47 (25.5)	49 (19.9)	NS	
				Cervical collar		4	Mean (SD)	27 (23)	48 (23.2)	<0.01	
				Cervical collar		16	Mean (SD)	30 (28.1)	35 (23.6)	NS	
ADF	van den Bent	1996	RCT	Discectomy	Neck Pain						
						0	n (%)	21(53.8)	32(76.1)	0.06	
						1.5	n(%)	30(78)	18(43)	0.04	
						4	n(%)	25(65)	18(43)	NS	
						24	n(%)	23(58)	24(60)	NS	
ADF	Wirth	2000	RCT		Complete relief of pain						
				Discectomy		1st post-operative day	n (%)	16(64)	18(72)	NR	
				Discectomy		2	n (%)	19(76)	18(72)	NR	
				Discectomy		ADF: 69 Discectomy: 56	n (%)	7(44)	9 (69)	NR	
				Foraminotomy		1st post-operative day	n (%)	16(64)	9(41)	NR	
				Foraminotomy		2	n (%)	19(76)	17(77)	NR	
				Foraminotomy		ADF: 69 Foraminotomy:53	n (%)	7(44)	7 (50)	NR	

Intervention	Author	Year	Study Design	Comparator(s)	Index	Time (months)	Measure	Intervention Outcome	Comparator Outcome	P-value	Comments			
ADF	Xie	2007	RCT	Discectomy	Arm pain relief	12	n (%)	14(93)	11(92)	0.36	ADF with instrumentation values also reported in the study			
					Neck pain relief	12	n (%)	12(80)	10(83)	0.33				
				Discectomy	Repeated analysis of variance for clinical outcome tools									
				ADF with Instrumentation	MC Gill Pain Scores¶			F-Statistic	Associated p-value					
					Mc Gill PRI	Treatment with time interaction	0.44	0.95						
					Mc Gill NWC	Treatment with time interaction	0.45	0.94						
					Mc Gill PPI	Treatment with time interaction	1.3	0.67						
Microdiscectomy and Fusion														
MDF	Barlöcher	2002	RCT	Microdiscectomy	Patients with cervical pain	0	n (%)	26 (86.6)	25 (75.7)	p<0.02	Significant difference between microdiscectomy, polymethylmethacrylate and titanium cage			
					Improvement in VAS: Neck	2	%	20	45.5	NS				
					Improvement in VAS: Neck	6	%	53.4	53.6	NS				
								Improvement in VAS: Neck	12	%	50	64	NS	Improvement reported for all patients
				Microdiscectomy with polymethylmethacrylate	Patients with cervical pain	0	n (%)	26 (86.6)	26 (100)	NS				
					Improvement in VAS: Neck	2	%	20	27	NS				
					Improvement in VAS: Neck	6	%	53.4	58.4	NS				
								Improvement in VAS: Neck	12	%	50	62.5	NS	
				Microdiscectomy with titanium cage	Patients with cervical pain	0	n (%)	26(86.6)	35 (97.2)	NS				
					Improvement in VAS: Neck	2	%	20	47.3	NS				
					Improvement in VAS: Neck	6	%	53.4	72.3	NS				
								Improvement in VAS: Neck	12	%	50	72.3	NS	

Intervention	Author	Year	Study Design	Comparator(s)	Index	Time (months)	Measure	Intervention Outcome	Comparator Outcome	P-value	Comments				
MDF	Barlöcher (Cont. from previous page)	2002	RCT	Microdiscectomy	Patients with radicular pain	0	n (%)	28 (93.3)	33(100)	NS	At 12 months, Microdiscectomy significant compared with titanium cage				
					Improvement in VAS: Arm	2	%	66.7	78.8	NS					
					Improvement in VAS: Arm	6	%	76.7	78.8	NS					
					Improvement in VAS: Arm	12	%	86.7	81.9	<0.05					
				Microdiscectomy with polymethylmethacrylate	Patients with radicular pain	0	n (%)	28 (93.3)	26 (100)	NS					
					Improvement in VAS: Arm	2	%	66.7	88.5	NS					
					Improvement in VAS: Arm	6	%	76.7	79.2	NS					
					Improvement in VAS: Arm	12	%	86.7	87.5	NS					
				Microdiscectomy with titanium cage	Patients with radicular pain	0	n (%)	28 (93.3)	34(94.4)	NS					
					Improvement in VAS: Arm	2	%	66.7	86.2	NS					
					Improvement in VAS: Arm	6	%	76.7	91.7	NS					
					Improvement in VAS: Arm	12	%	86.7	97.3	NS					
MDF	Oktenoglu	2007	RCT	Microdiscectomy	VAS score						Difference in pre and post operative vas scores within groups was significant for arm pain in both groups and neck pain in fusion group				
					Arm	0	Mean	8	8.2	NS					
					Arm	13.9*	Mean	3.1	3.3	NS					
					Neck	0	Mean	3.2	3.2	NS					
					Neck	13.9*	Mean	2	2.8	NS					
MDF	Ruetten	2009	RCT	Full endoscopic anterior cervical discectomy	VAS score [#]										
					Arm	0	Mean	79	82	NR					
					Arm	3	Mean	13	10	NR					
					Arm	6	Mean	11	8	NR					
					Arm	12	Mean	8	11	NR					
					Arm	24	Mean	10	8	NR					
					Neck	0	Mean	13	18	NR					
					Neck	3	Mean	17	16	NR					
					Neck	6	Mean	15	12	NR					
					Neck	12	Mean	16	14	NR					
					Neck	24	Mean	14	15	NR					
					German Version of NASS Score										
					Pain	0	Mean	4.4	4.2	NR					
					Pain	3	Mean	1.6	1.3	NR					
					Pain	6	Mean	1.4	1.5	NR					
Pain	12	Mean	1.7	1.4	NR										
Pain	24	Mean	1.6	1.5	NR										

Intervention	Author	Year	Study Design	Comparator(s)	Index	Time (months)	Measure	Intervention Outcome	Comparator Outcome	P-value	Comments
MDF	Ruetten	2008	RCT	Full endoscopic posterior foraminotomy	VAS score [#]						
					Arm	0	Mean	81	84	NR	
					Arm	3	Mean	10	11	NR	
					Arm	6	Mean	8	9	NR	
					Arm	12	Mean	7	8	NR	
					Arm	24	Mean	8	7	NR	
					Neck	0	Mean	15	17	NR	
					Neck	3	Mean	19	15	NR	
					Neck	6	Mean	19	17	NR	
					Neck	12	Mean	16	14	NR	
					Neck	24	Mean	17	16	NR	
					German Version of NASS Score						
					Pain	0	Mean	4.3	4.1	NR	
					Pain	3	Mean	1.5	1.4	NR	
					Pain	6	Mean	1.8	1.6	NR	
					Pain	12	Mean	1.7	1.8	NR	
					Pain	24	Mean	1.5	1.4	NR	

ADF: anterior discectomy and fusion; MDF: microdiscectomy and fusion; NASS: North American Spine Society; NR: not reported; NS: not significant;
RCT: randomized controlled trial; VAS: Visual Analog Scale

* Mean length of follow-up

† 11 point scale where 0 = no pain at anytime; 10 = most painful condition

‡ Studies evaluated identical populations

§ Measured using 100 mm straight line where patient marked pain

|| Measured as patients reporting radicular pain relief

¶ PRI = Pain Rating Index, NWC = Number of words chosen, PPI = Present pain intensity

VAS score units NR

Table C5. Functional outcomes for randomized controlled trials

Intervention	Author	Year	Study Design	Comparator(s)	Index	Time (months)	Measure	Intervention Outcome	Comparator Outcome	P-value	Comments
Anterior Discectomy and Fusion											
ADF	Persson	1997, 2001*	RCT		Subjective assessment of disability (compared to baseline)†						Information on muscle strength comparison between the groups is available in the study
				Physiotherapy	Restored	16	n (%)	2 (8)	3 (11)	NR	
				Physiotherapy	Unchanged	16	n (%)	11 (42)	4 (15)	NR	
				Physiotherapy	Improved	16	n (%)	5 (19)	11 (41)	NR	
				Physiotherapy	Worse	16	n (%)	8 (31)	9 (33)	NR	
				Cervical Collar	Restored	16	n (%)	2 (8)	2 (8)	NR	
				Cervical Collar	Unchanged	16	n (%)	11 (42)	9 (35)	NR	
				Cervical Collar	Improved	16	n (%)	5 (19)	9 (35)	NR	
				Cervical Collar	Worse	16	n (%)	8 (31)	6 (23)	NR	
					Disability Rating Index score						
				Physiotherapy	Running	0	mean (SD)	56 (32)	31 (35)	<0.05	
				Physiotherapy	Running	3.5-4	mean (SD)	NR	NR	<0.05	No data provided on DRI scores at follow-up
				Physiotherapy	Running	16	mean (SD)	NR	NR	<0.05	
				Cervical Collar	Running	0	mean (SD)	56 (32)	63 (39)	NR	
				Cervical Collar	Running	3.5-4	mean (SD)	NR	NR	NR	
				Cervical Collar	Running	16	mean (SD)	NR	NR	NR	
				Physiotherapy	Dressing	0	mean (SD)	18 (25)	11 (17)	NR	
				Physiotherapy	Dressing	3.5-4	mean (SD)	NR	NR	NS	No data provided on DRI scores at follow-up
				Physiotherapy	Dressing	16	mean (SD)	NR	NR	NS	
				Cervical Collar	Dressing	0	mean (SD)	18 (25)	9 (11)	NR	
				Cervical Collar	Dressing	3.5-4	mean (SD)	NR	NR	<0.05	Surgery significantly better than Cervical Collar, data NR
				Cervical Collar	Dressing	16	mean (SD)	NR	NR	NR	
				Physiotherapy	Heavy work	0	mean (SD)	77 (18)	65 (33)	NR	
				Physiotherapy	Heavy work	3.5-4	mean (SD)	NR	NR	NS	
				Physiotherapy	Heavy work	16	mean (SD)	NR	NR	<0.05	Surgery significantly better than Physiotherapy, data NR
				Cervical Collar	Heavy work	0	mean (SD)	77 (18)	71 (32)	NR	
				Cervical Collar	Heavy work	3.5-4	mean (SD)	NR	NR	<0.05	Surgery significantly better than Cervical Collar, data NR
				Cervical Collar	Heavy work	16	mean (SD)	NR	NR	<0.05	
Surgery versus Conservative Treatment											
Surgery‡	Kadaňka	2011	RCT	Conservative treatment	mJOA	0	median (10%, 90% quantile)	14 (12, 16)	15 (13, 16)	0.263	
						144§	median (5%, 95% quantile)	14 (9.2, 16.9)	15 (12.2, 18)	0.114	
					10 m Walk time (seconds)	0	median (10%, 90% quantile)	8 (6, 10)	7 (6, 8)	0.102	
						144§	median (5%, 95% quantile)	7.3 (5.1, 25.7)	7.1 (5.1, 12.5)	0.207	

ADF: anterior discectomy and fusion; DRI: Disability Rating Index; M: meter; mJOA: modified Japanese Orthopaedic Association [score]; N: number; NR: not reported; NS: not significant; RCT: randomized controlled trial; SD: standard deviation;

* Studies analyzing identical populations

† No definition for scales in subjective evaluation provided

‡ Surgery includes anterior discectomy and fusion, discectomy, laminoplasty and corpectomy; conservative methods include cervical collar use, anti-inflammatory medication and bed rest

§ Median length of follow-up

Table C6. Quality of life for randomized controlled trials

Intervention	Author	Year	Study Design	Comparator(s)	Scale	Component	Time (months)	Measure	Intervention Outcome	Comparator Outcome	P-value	Comments															
Anterior Discectomy and Fusion																											
ADF	Persson	1997, 2001*	RCT	Physiotherapy	Sickness Impact profile	Overall Sickness Impact profile	0		NR	NR	NS	Physiotherapy group was better than cervical collar group at 4 months															
							4		NR	NR	NR																
							16		NR	NR	NS																
							0		NR	NR	NS																
							4		NR	NR	<0.05																
							16		NR	NR	NS																
				Cervical collar	Mood Adjective Check List	Overall score	0		NR	NR	NS																
							4		NR	NR	NS																
							16		NR	NR	NS																
							0		NR	NR	NS																
							4		NR	NR	NS																
							16		NR	NR	NS																
ADF	Xie	2007	RCT	Discectomy		Repeated analysis of variance for clinical outcome tools						Total SF-36 scores significantly increased (p-value, NR) over year 1 for all groups, with no statistical differences noted among treatment arms (p-value, NR)															
													ADF with Instrumentation														
																										F-Statistic	Associated p-value
																								SF-36 Total	Treatment with time interaction	0.15	1
																								Bodily Pain	Treatment with time interaction	0.82	0.63
																								Role Physical	Treatment with time interaction	0.39	0.97
																								Role emotional	Treatment with time interaction	0.89	0.56
																								Vitality	Treatment with time interaction	0.56	0.87
																								Physical Function	Treatment with time interaction	0.6	0.84
																								Social Function	Treatment with time interaction	0.42	0.95
																								Mental Health	Treatment with time interaction	0.5	0.91
																								General Health	Treatment with time interaction	0.72	0.73

Intervention	Author	Year	Study Design	Comparator(s)	Scale	Component	Time (months)	Measure	Intervention Outcome	Comparator Outcome	P-value	Comments
Surgery versus Conservative Treatment												
Surgery	Kadaňka	2011	RCT	Conservative methods	Subjective evaluation of clinical status†		144‡	n (%)	10 (45.5)	14 (56)	0.47	
					Evaluation of daily activities†§							
					Expert 1		144‡	n (%)	11 (50)	11 (44)	0.68	Agreement between experts was 86.4% for patients with surgery and 80% for patients without surgery
					Expert 2			n (%)	14 (63.6)	14 (56)	0.59	

ADF: anterior discectomy and fusion; N: number; NR: not reported; NS: not significant; RCT: randomized controlled trial;

* Studies evaluated identical patient populations

† Proportion of patients with worsened final state as compared to initial scoring, with a decrease of at least 1 point in the following semi-quantitative scale:

+3 = excellent; +2 = very good; +1 = slightly better; 0 = no change; -1 = slightly worse; -2 = much worse; -3 = poor

‡ Median length of follow-up

§ Evaluation of video recording of patients performing different activities, such as buttoning a shirt and walking up and down stairs

Table C7. Employment status for randomized controlled trials

Intervention	Author	Year	Study Design	Comparator(s)	Work Status Outcome	Time (months)	Measures	Intervention Outcome	Comparator Outcome	P-value	Comments					
Anterior Discectomy and Fusion																
ADF	Dowd	1999	RCT	Discectomy	Return to work	1.3	n (%)	4 (10.8)	10 (22.7)	NS						
						2.5	n (%)	10 (30.3)	12 (37.5)							
ADF	Hauerberg	2007	RCT	Discectomy	Absent from work	0	n (%)	31(77.5)	30(65.2)	0.18 0.16 0.22						
						3	n (%)	13 (33.3)	23 (50)							
						12	n (%)	11 (27.5)	21 (46)							
						24	n (%)	11 (27.5)	20 (43.5)							
ADF	Rosenørn	1983	RCT	Discectomy	Return to work	0.5	n (%)	0 (0)	5 (16)	p<0.05	At 3, 4,6 and 9 weeks statistically significant difference reported					
						3	n(%)	15 (48)	23 (72)	NS						
						12	n(%)	24 (77)	30 (94)	NS						
										Clinical Condition with respect to work status*		3	n(%)	8(23)	17(53.1)	NR
												Excellent	n(%)	11(35.4)	11(34.3)	NR
												Good	n(%)	12(38.7)	4(12.5)	NR
												Fair	n(%)	0 (0)	0 (0)	NR
												Poor	n(%)	12(41.3)	22(70.9)	NR
												Excellent	n(%)	8(27.5)	5(16.1)	NR
												Good	n(%)	2(6.8)	2(6.4)	NR
					Fair	n(%)	7(24.1)	2(6.4)	NR							
					Poor	n(%)			NR							
ADF	Wirth	2000	RCT	Discectomy	Return to work	2	n (%)	23 (91)	22 (88)	NR	No statistical differences reported among 3 groups at 2 months and latest follow-up					
						ADF: 69		n (%)	13 (81)	12 (92)		NR				
				Foraminotomy	Return to work	2	n (%)	23 (91)	20 (91)	NR						
						ADF: 69		n (%)	13 (81)	11 (79)		NR				
		Foraminotomy: 53														
ADF	Xie	2007	RCT	Discectomy	Return to work	0	n (%)	9(60)	6(50)	NR						
						6	n (%)	12 (80)	9 (75)	NR						
						24	n (%)	12 (80)	10 (83)	NR						
				Discectomy with instrumentation	Return to work	0	n (%)	9 (60)	12(80)	NR						
						6	n (%)	12 (80)	13 (87)	NR						
						24	n (%)	12 (80)	13 (87)	0.83						
Microdiscectomy and Fusion																
MDF	Barlöcher	2002	RCT	Microdiscectomy only	Work incapacity	6	n (%)	8 (27.2)	6 (18.1)	NR	Microdiscectomy only was significant compared with titanium cage					
						12	n (%)	5 (16.7)	4 (12.1)	NR						
				Microdiscectomy with polymethylmethacrylate	Work incapacity	6	n (%)	8 (27.2)	2 (8.3)	NR						
						12	n (%)	5 (16.7)	1 (4.2)	NR						
				Microdiscectomy with titanium cage	Work incapacity	6	n (%)	8 (27.2)	2 (5.5)	p<0.05						
						12	n (%)	5 (16.7)	1 (2.8)	NR						

ADF: anterior discectomy and fusion; MDF: microdiscectomy and fusion; N: number; NR: not reported; NS: not significant; RCT: randomized controlled trials

* Excellent = returned to previous occupations, all symptoms disappeared; Good = returned to previous occupations, minor symptoms exist; Fair = returned to an occupation, symptoms exist and some had to change to easier occupation; Poor = no occupation, symptoms unchanged or worse

Table C8. Operative outcomes and perioperative complications for randomized controlled trials

Intervention	Author	Year	Study Design	Comparator(s)	Measure or Harm Category	Measure	Intervention Outcome	Comparator Outcome	P-value	Comments
Anterior Discectomy and Fusion										
ADF	Abd-Alrahman	1999	RCT	Discectomy	Procedure Duration (mins)	mean (SD)	140 (34)	110 (29)	NS	
					Operative Levels					
					1 level	n (%)	38 (76)	32(80)	NR	
					2 levels	n (%)	12 (24)	8(20)	NR	
					Length of Stay (days)	mean (SD)	4.8 (1.4)	4.2 (0.8)	NS	
					Hematoma	n (%)	2 (2.2)*		NR	
ADF	Dowd	1999	RCT	Discectomy	Procedure Duration (min)	NR	131	102	<0.001	
					Operative levels					
					1 level	n (%)	20 (50)	26 (59)	NR	
					2 levels	n (%)	20 (50)	18 (41)	NR	
					Length of Stay (days)	NR	5	3.6	<0.005	
					Pain	n (%)	20(50)	34 (77.2)	<0.01	Subjective resolution of pain on the morning following surgery
					Medical complication†	n (%)	10 (25)	4 (9)	<0.05	
					Weakness	n (%)	1(2.5)	2(4.5)	NR	
					Numbness	n (%)	2(5)	1(2.2)	NR	
					Hoarseness	n (%)	2 (5)	0 (0)	NR	
ADF	Hauerberg	2008	RCT	Discectomy	Procedure Duration	median (IQR)	60 (15)	55 (15)	0.05	
					Perioperative blood loss	median (IQR)	25 (45)	10 (50)	0.22	
					Operative levels					
					1 level	n (%)	40(100)	46 (100)	0.62	
					Hoarseness	n (%)	5 (12.5)	1 (2.2)	0.092	
					Dysphagia	n (%)	7 (17.5)	7 (15.2)	1	
ADF	Martins	1976	RCT	Discectomy and Foraminotomy	Procedure Duration	NR	NR	NR	NR	Discectomy took less time than ADF, data NR
					Operative levels					
					1 level	n (%)	17 (68)	18 (69)	NR	
					2 levels	n (%)	8 (32)	8 (31)	NR	
					Length of Stay (days)	NR	NR	NR	NR	Length of stay similar in both groups, data NR
					Infection	n (%)	0 (0)	1(4)	NR	Staphylococcus aureus infection at discectomy site
ADF	Rosenørn	1983	RCT	Discectomy	Operative levels					
					1 level	n (%)	40 (63.4)*		NR	
					2 levels	n (%)	23 (36)*		NR	
ADF	Savolainen	1998	RCT	Discectomy	Wound infection	n (%)	1 (3.3)	0 (0)	NR	
				ADF with plating	Wound infection	n (%)	1 (3.3)	1 (3)	NR	
ADF	van den Bent	1996	RCT	Discectomy	Neck Pain	n (%)	7 (17)	13 (33)	0.12	
					Operative levels					
					1 level	n (%)	38 (90)	33 (85)	NR	
					2 levels	n (%)	4 (10)	6 (15)	NR	

Intervention	Author	Year	Study Design	Comparator(s)	Measure or Harm Category	Measure	Intervention Outcome	Comparator Outcome	P-value	Comments	
ADF	Wirth	2000	RCT	Discectomy	Anesthesia time (min)	mean (SD)	120 (21)	98 (20)	NR	Anesthesia time significantly different among 3 groups (p<0.005)	
					Operative levels						
					1 level	n(%)	25 (100)	25 (100)	NR		
					Length of Stay (days)	mean (SD)	4.5 (1.6)	3.9 (1.8)	NR		
					New numbness	n(%)	1 (4)	2 (8)	NR		
					New weakness	n(%)	2(8)	2(8)	NR		
				Foraminotomy	Anesthesia time (min)	mean (SD)	120 (21)	139 (53)	NR		
					Operative levels						
					1 level	n (%)	25 (100)	22(100)	NR		
					Length of Stay (days)	mean (SD)	4.5 (1.6)	4.3 (1.9)	NR		
					New numbness	n(%)	1 (4)	2 (9)	NR		
					New weakness	n(%)	2(8)	3(14)	NR		
ADF	Xie	2007	RCT	Discectomy	Length of Stay (days)	Mean (SD)	3 (1*)		0.4	No significant difference in length of stay among 3 groups No significant difference among 3 groups in hoarseness (p=0.48) Donor site infection No significant differences among the 3 groups in dysphagia (p=0.66)	
					Hoarseness	n (%)	3 (20)	1 (8)	NR		
					Infection	n (%)	2 (13)	0 (0)	NR		
					Dysphagia	n (%)	2 (13)	3 (25)	NR		
					Donor site pain	n (%)	12(80)	NR	NR		
					Mortality	n (%)	0 (0)	0 (0)	NR		
				ADF with Instrumentation	Length of Stay (days)	Mean (SD)	3 (1)*		0.4		
					Hoarseness	n (%)	3 (20)	1 (7)	NR		
					Infection	n (%)	2 (13)	0 (0)	NR		
					Dysphagia	n (%)	2 (13)	2 (13)	NR		
					Donor site pain	n (%)	12(80)	7(47)	0.06		
					Mortality	n (%)	0 (0)	0 (0)	NR		

Intervention	Author	Year	Study Design	Comparator(s)	Measure or Harm Category	Measure	Intervention Outcome	Comparator Outcome	P-value	Comments
Microdiscectomy and Fusion										
MDF	Barlöcher	2002	RCT	Microdiscectomy	Procedure Duration (min)	mean (SD)	99.8 (9.8)	82.6 (11.2)	<0.001	
					Blood Loss (mL)	mean (SD)	70.7 (17.8)	49.7 (12.6)	<0.001	
					Operative levels					
					1 level	n (%)	30 (100)	33 (100)	NR	
					Length of Stay (days)	mean (SD)	7.5 (1.8)	7.6 (2.1)	NS	
					Nerve damage					
					Laryngeal nerve palsy	n (%)	1 (3.3)	1 (3)	NR	
					Ulnar nerve palsy	n (%)	1 (3.3)	0 (0)	NR	
					Hematoma	n (%)	2 (6.6)	0 (0)	NR	
				MDF with Polymethylmethacrylate	Procedure Duration (min)	mean (SD)	99.8 (9.8)	89 (11.6)	<0.05	
				Blood Loss (mL)	mean (SD)	70.7 (17.8)	58.3 (17.6)	NS		
				Operative levels						
				1 level	n (%)	30 (100)	26 (100)	NS		
				Length of Stay (days)	mean (SD)	7.5 (1.8)	6.8 (1.3)	NS		
				Nerve damage						
				Laryngeal nerve palsy	n (%)	1 (3.3)	0 (0)	NR		
				Ulnar nerve palsy	n (%)	2 (6.6)	0 (0)	NR		
				Hematoma	n (%)	2 (6.6)	0 (0)	NR		
MDF with Titanium Cage	Procedure Duration (min)	mean (SD)	99.8 (9.8)	75.8 (14.8)	<0.05					
Blood Loss	mean (SD)	70.7 (17.8)	62.8 (14.9)	NS						
Operative levels										
1 level	n (%)	30 (100)	36 (100)	NR						
Length of Stay (days)	mean (SD)	7.5 (1.8)	7 (1.1)	NS						
Nerve damage										
Laryngeal nerve palsy	n (%)	1 (3.3)	0 (0)	NR						
Ulnar nerve palsy	n (%)	1 (3.3)	0 (0)	NR						
Hematoma	n (%)	2 (6.6)	0 (0)	NR						

Intervention	Author	Year	Study Design	Comparator(s)	Measure or Harm Category	Measure	Intervention Outcome	Comparator Outcome	P-value	Comments
MDF	Ruetten	2009	RCT	Full endoscopic cervical posterior foraminotomy	Procedure duration (min)	mean	62	32	<0.001	
					Blood loss (mL)	NR	<10	No measurable blood loss	NR	
					Dysphagia	n (%)	5 (8.3)	2 (3.3)	NR	
					Surface hematoma	n (%)	2 (3.3)	0 (0)	NR	
MDF	Ruetten	2008	RCT	Full endoscopic anterior cervical decompression	Procedure duration (min)	mean	68	28	<0.001	
					Operative levels					
					1 level	n (%)	100 (100)	100 (100)	NR	
					Blood loss (mL)	NR	<10	No measurable blood loss	NR	
					Dysphagia	n (%)	3 (3)	0 (0)	NR	
Surface hematoma	n (%)	1 (1)	0 (0)	NR						

ADF: anterior discectomy and fusion; IQR: interquartile range; MDF: microdiscectomy and fusion; N: number; NR: not reported; NS: not significant; RCT: randomized controlled trial; SD: standard deviation

* Reported for entire patient population

† Medical complications include atelectasis, urinary tract infection and leukocytosis

Table C9. Long-term complications and adverse events for randomized controlled trials

Intervention	Author	Year	Study Design	Comparator(s)	Time (months)	Harm Category	Measure	Intervention Outcome	Comparator Outcome	P-value	Comments	
Anterior Discectomy and Fusion												
ADF	Abd-Alrahman	1999	RCT	Discectomy	6	Reoperation	n (%)		2 (6)*	N/A	Chronic hip pain reported	
						Chronic Pain	n (%)		2 (6)*	N/A		
						Pseudarthrosis	n (%)	2 (4)	0	NR		
ADF	Dowd	1999	RCT	Discectomy	54†	Reoperation	n (%)	1 (2.5)	2 (5)	NR		
						Chronic pain	n (%)	5 (21.7)	4 (12)	NS		
ADF	Hauerberg	2008	RCT	Discectomy	24	Reoperation	n (%)	6 (15)	9 (19.6)	NS		
						Adjacent disc degeneration	n (%)	5 (13.9)	2 (4.8)	0.35		
						Mortality	n (%)	2(5)	0(0)	NR		
ADF	Persson	1997, 2001‡	RCT	Physiotherapy	16	Reoperation	n (%)	8 (29)	5 (18.5)	NR		
						Paresthesia						
						4	Improved	n (%)	14 (52)	12 (45)	NS	
							Unchanged	n (%)	9 (33)	14 (51)	NS	
							Worse	n (%)	4 (15)	1 (4)	NS	
						16	Improved	n (%)	15 (58)	18 (67)	NS	
							Unchanged	n (%)	6 (23)	6 (22)	NS	
							Worse	n (%)	5 (19)	3 (11)	NS	
						Sensory Loss						
						4	Improved	n (%)	11(41)	4(15)	<0.05	
							Unchanged	n (%)	15(55)	21(78)	NS	
							Worse	n (%)	1(4)	2(7)	NS	
				16	Improved	n (%)	7(27)	4(14)	NS			
					Unchanged	n (%)	18(69)	18(67)	NS			
					Worse	n (%)	1(4)	5(19)	NS			
				Cervical Collar								
				16	Reoperation	n (%)	8 (29)	5 (19.2)	NR			
					Paresthesia							
					4	Improved	n (%)	14 (52)	10(37)	NS		
				Unchanged		n (%)	9 (33)	13 (48)	NS			
				Worse		n (%)	4 (15)	4 (15)	NS			
16	Improved	n (%)	15 (58)	18 (67)	NS							
	Unchanged	n (%)	6 (23)	6 (22)	NS							
	Worse	n (%)	5 (19)	3 (11)	NS							
Sensory Loss												
4	Improved	n (%)	11(41)	4(15)	NS	Improvement in sensory loss was greater in surgery group than other two groups, p<0.05						
	Unchanged	n (%)	15(55)	21(78)	NS							
	Worse	n (%)	1(4)	2(7)	NS							
16	Improved	n (%)	7(27)	4(15)	NS							
	Unchanged	n (%)	18(69)	20(77)	NS							
	Worse	n (%)	1(4)	2(8)	NS							
ADF	Rosenørn	1983	RCT	Discectomy	12	Reoperation	n (%)		1 (2)*		Reoperation due to sub fascial hematoma	
ADF	Savolainen	1998	RCT	Discectomy	NR	Procedure Revision	n (%)	1(3.3)	1 (3.2)	NR		
				ADF with plating	NR	Procedure Revision	n (%)	1(3.3)	1 (3.3)	NR		

Intervention	Author	Year	Study Design	Comparator(s)	Time (months)	Harm Category	Measure	Intervention Outcome	Comparator Outcome	P-value	Comments
ADF	Van den Bent	1996	RCT	Discectomy	24	Migration of polymethylmethacrylate occurred in 9 patients	n(%)	9(23)	N/A	N/A	
ADF	Wirth	2000	RCT	Discectomy	42*	Reoperation (same level)	n (%)	2 (8)	1 (4)	NR	
				Foraminotomy		Reoperation (same level)	n (%)	2 (8)	4 (18)	NR	
ADF	Xie	2007	RCT	Discectomy	24	Adjacent segment disease	n (%)	5(33.3)	2(16.6)	NR	
				ADF with instrumentation	24	Adjacent segment disease	n (%)	5(33.3)	5(33.3)	NR	
Microdiscectomy and Fusion											
MDF	Barlöcher	2002	RCT	Microdiscectomy	NR	Reoperation	n (%)	1(3.3)	2(0.6)	NR	
					0	Neurological deficit (% improved)	n (%)	22(73.3)	28(84.8)	NR	
					2		n (%)	19 (63.4)	15 (45.5)	NS	
					6		n (%)	21 (70)	21 (63.7)	NS	
					12		n (%)	23 (76.7)	24 (72.8)	NS	
				MDF with Polymethylmethacrylate	NR	Reoperation	n (%)	1(3.3)	0 (0)	NR	
					0	Neurological deficit (% improved)	n (%)	22(73.3)	20(76.9)	NR	
					2		n (%)	19 (63.4)	15 (63.4)	NS	
					6		n (%)	21 (70)	20 (83.4)	NS	
					12		n (%)	23 (76.7)	19 (79.2)	NS	
				MDF with Titanium cage	NR	Reoperation	n (%)	1(3.3)	0 (0)	NR	
					0	Neurological deficit (% improved)	n (%)	22(73.3)	28(77.7)	NR	
					2		n (%)	19 (63.4)	23 (63.9)	NS	
					6		n (%)	21 (70)	26 (72.3)	NS	
					12		n (%)	23 (76.7)	29 (80.6)	NS	
MDF	Ruetten	2009	RCT	Full endoscopic anterior cervical discectomy	NR	Reoperation	n (%)	3 (5)	4 (6)	NS	
					17	Mortality	n (%)		1(0.8)*	N/A	
MDF	Ruetten	2008	RCT	Full endoscopic posterior cervical foraminotomy	NR	Reoperation	n (%)	3 (3)	3 (3)	NS	
Surgery versus Conservative Treatment											
Surgery	Kadaňka	2011	RCT	Conservative treatment	120	Mortality	n (%)	10(31.2)	7(21.8)	NR	
						Mortality Rate	%	30	20	0.2	Kaplan Meier curve

ADF: anterior discectomy and fusion; MDF: microdiscectomy and fusion; N: number; N/A: not available; NR: not reported; NS: not significant; RCT: randomized controlled trial

* Reported for entire patient population

† Mean length of follow-up

‡ Studies evaluated identical patient populations

Table C10. Study characteristics for comparative cohorts

Author	Year	Study Design	Country	Comparators	Sample Size	Study Duration	Inclusion/Exclusion Criteria	Quality Assessment	Patient Withdrawals n(%)	Notes	
Anterior Decompression and Fusion											
Mayer	2002	Prospective comparative cohort	USA*	Anterior decompression and fusion, followed by interdisciplinary treatment	52	12 months	<u>Inclusion</u> <ul style="list-style-type: none"> • AF: disabled workers compensation patients with cervical spinal disorders, undergoing 1- or 2-level surgery for DDD • Interdisciplinary arm: DDD at ≥1 level with chronic pain and disability for ≥4 months; surgery ruled out • all patients completed treatment program 	Fair	NR	Patients in control arm selected from larger cohort (n=625) and matched by other compensable body parts involved in work-related injuries; detailed information provided on interdisciplinary treatment	
				Interdisciplinary treatment	150				NR		
Nagata	1996	Retrospective comparative cohort	Japan*	Anterior decompression and fusion	77	12 - 54 months	<u>Inclusion</u> <ul style="list-style-type: none"> • AF: 1- or 2-level condition • LMN: narrow spinal canal or ≥3 levels of focus 	Fair	---	Primary analysis evaluated patients by age, regardless of surgical approach	
				Posterior decompression by expansive laminectomy	96				---		
Hasegawa	2007	Retrospective comparative cohort	Japan	Anterior decompression and fusion	424	Minimum of 12 months	<u>Inclusion</u> <ul style="list-style-type: none"> • deterioration of motor function • appearance of new sensory disturbance between post-op day 0 and 2 months 	Fair	---	Multicenter	
				Laminoplasty	345				<u>Exclusion</u> <ul style="list-style-type: none"> • pain without change in motor or sensory function • deterioration of lower extremity function, including tetraparesis 		---
				Laminectomy	88						---
Hasegawa	2002	Retrospective comparative cohort	Japan*	Anterior decompression and fusion	35	Minimum of 12 months	<u>Inclusion</u> <ul style="list-style-type: none"> • cervical myelopathy w/documented spondylosis and stenosis • AF: 1- or 2-level disease • LMP: ≥3 level disease • LMN: ≥3 level disease, stable spine 	Fair	---		
				Laminoplasty	29				---		
				Laminectomy	26				---		
Kawakami	2000	Retrospective comparative cohort	Japan	Anterior decompression and fusion	60	24 months	<u>Inclusion</u> <ul style="list-style-type: none"> • cervical myelopathy due to spondylosis and disc herniation <u>Exclusion</u> <ul style="list-style-type: none"> • myelopathy with OPLL or ossification of ligament flavum • clinical radiculopathy • tumor, trauma, other spinal lesions 	Fair	---	Single center study	
				Laminoplasty	76				---		

Author	Year	Study Design	Country	Comparators	Sample Size	Study Duration	Inclusion/Exclusion Criteria	Quality Assessment	Patient Withdrawals n(%)	Notes
Koakutsu	2010	Prospective comparative cohort	Japan	Anterior decompression and fusion	30	12 months	<u>Inclusion</u> • cervical myelopathy caused by soft disc herniation • duration of disease <1 year <u>Exclusion</u> • prior cervical injury or surgery • other neuromuscular disease	Good	5 (17)	Patients chose to discontinue post-operative observation; multicenter study
				Laminoplasty	30				5 (17)	
Anterior Discectomy and Fusion										
Tominaga	2002	Retrospective comparative cohort	Japan*	Anterior decompression and fusion (discectomy or corpectomy)	35	NR	<u>Inclusion</u> • patients with cervical spondylosis and/or OPLL who presented with myelopathy	Fair	---	
				Posterior laminoplasty w/ fusion	12				---	
Korinth	2006	Retrospective comparative cohort	Germany	Anterior discectomy and fusion	154	72 months	<u>Inclusion</u> • radicular symptoms <u>Exclusion</u> • myelopathy/myelopathic symptoms • neoplasms or fractures • congenital deformities • recurrent cervical disc disease	Fair	71/363 (19.6%) patients excluded due to death, lack of follow-up or refusal of cooperation	
				Posterior foraminotomy	209					
Stieber	2005	Retrospective comparative cohort	USA	Anterior discectomy and fusion - Outpatient	30	0.75 months	<u>Inclusion</u> • 1- or 2-level ADF, performed at C4/5 or below • cervical disc herniation refractory to ≥3 months conservative management • for outpatient procedures: C4/5 through C6/7, absence of myelopathy, est. surgical time < 2 hours, without a subjectively large neck size, no revision surgery	Poor	*complete data available on 26 (87%) of patients	
				Anterior discectomy and fusion - Inpatient (1)	30					
				Anterior discectomy and fusion - Inpatient (2)	30					
Microdiscectomy and Fusion										
Liu	2009	Retrospective comparative cohort	USA	Anterior microdiscectomy and fusion - Outpatient	45	2.1 months	No definitive selection criteria described	Poor	---	Procedures done by 2 surgeons
				Anterior microdiscectomy and fusion - Inpatient	64				---	

Author	Year	Study Design	Country	Comparators	Sample Size	Study Duration	Inclusion/Exclusion Criteria	Quality Assessment	Patient Withdrawals n(%)	Notes
Silvers	1996	Retrospective comparative cohort	USA	Microdiscectomy and fusion - Outpatient	50	12 months	<u>Inclusion</u> • herniated cervical disc • pain or weakness associated with cervical radiculopathy • failed conservative treatment	Fair	---	
				Microdiscectomy and fusion - Inpatient	53		<u>Exclusion</u> • ≥2 vertebral levels of involvement			
Anterior Corpectomy and Fusion										
Gandhoke	2011	Retrospective comparative cohort	USA	Anterior corpectomy and fusion	31	15 months	<u>Inclusion</u> • ACF: degenerative cervical spinal canal stenosis or OPLL w/ anterior compression of C4/C5 levels • LMP: multi-level cervical spinal canal stenosis due to degenerative spondylosis or OPLL of C4/C5 levels	Poor	0(0)	Procedures done by single surgeon
				Laminoplasty	31		<u>Exclusion</u> • ACF: prior anterior procedure of C4/C5 • LMP: prior posterior procedure of C4-C5 • traumatic fracture • kyphosis • neurological disease such as polio or MS • posterior cervical fusion			
Hirai	2011	Prospective comparative cohort	Japan	Anterior corpectomy and fusion	45	60 months	<u>Inclusion</u> • patients with CSM	Good	6 (13)	Withdrawals were patients lost to follow-up; single center study with 4 surgeons
				Laminoplasty	50		<u>Exclusion</u> • disc herniation • OPLL • radiculopathy • history of previous cervical surgery • cervical injury			
Iwasaki	2007	Retrospective comparative cohort	Japan	Anterior decompression and fusion (subtotal corpectomy with total discectomy)	27	72 months	No definitive selection criteria applied	Poor	---	2 hospitals
				Laminoplasty	66					
Kristof	2009	Retrospective comparative cohort	Germany	Anterior corpectomy and fusion	42	24 months	<u>Exclusion</u> • combined anterior and posterior procedures • OPLL	Good	---	
				Posterior laminectomy and fusion	61		• posttraumatic myelopathy due to degenerative cervical stenosis			

Author	Year	Study Design	Country	Comparators	Sample Size	Study Duration	Inclusion/Exclusion Criteria	Quality Assessment	Patient Withdrawals n(%)	Notes
Laminectomy and Fusion										
Highsmith	2011	Retrospective comparative cohort	USA*	Laminectomy and fusion	30	Minimum of 12 months	<u>Inclusion</u> • cervical stenotic myelopathy	Fair	---	
				Laminoplasty	26		<u>Exclusion</u> • kyphosis or spondylolisthesis > 2 mm		---	
Woods	2011	Retrospective comparative cohort	USA	Laminectomy and fusion (posterior)	82	24 months	<u>Inclusion</u> • documented findings of progressive myelopathy/myeloradiculopathy in patients w/failure of non-operative measures • cord compression of ≥3 cervical levels	Fair	22 patient records excluded for incomplete data	
				Laminoplasty (posterior)	39		<u>Exclusion</u> • axial neck pain alone • fracture or tumor • cervical instability • previous history of cervical surgery			
Anterior Spinal Fusion										
Yoshida	1998	Retrospective comparative cohort	Japan*	Anterior spinal fusion	44	3 months	<u>Inclusion</u> • patients with cervical disc herniation • LMP: developmental spinal canal stenosis	Poor	---	No description provided of conservative treatment program
				Laminoplasty	32				---	
				Conservative treatment	15				---	
Shamji	2009	Retrospective comparative cohort	USA	Anterior spinal fusion	6,091	NR	<u>Inclusion</u> • multilevel cervical fusion surgery between 4 and 8 levels	Fair	---	Data from Nationwide Inpatient Sample (NIS), 2003-2005
				Posterior spinal fusion	2,457		<u>Exclusion</u> • congenital spinal deformity • infection • inflammatory spinal disease • neoplasia • pregnancy • trauma or previous cervical fusion		---	
Shamji	2008	Retrospective comparative cohort	USA	Anterior spinal fusion without myelopathy	77,491	NR	<u>Inclusion</u> • patients with myelopathy: cervical spondylosis or intervertebral disc disorder	Fair	---	Data from Nationwide Inpatient Sample (NIS), 1988-2003
				Anterior spinal fusion with myelopathy	13,952		<u>Inclusion</u> • patients without myelopathy: degeneration of intervertebral disc, spinal stenosis, cervicocranial syndrome, brachial neuritis or radiculitis, OPLL		---	
				Posterior spinal fusion without myelopathy	2,795		<u>Exclusion</u> • congenital spinal disorder		---	
				Posterior spinal fusion with myelopathy	2,535		<u>Exclusion</u> • infection or inflammatory spinal disorder • neoplasia • trauma or previous cervical fusion		---	

ACF: anterior corpectomy and fusion; ADF: anterior discectomy and fusion; AF: anterior decompression and fusion; ASF: anterior spinal fusion; CSM: cervical spondylotic myelopathy; DDD: degenerative disc disease; LMN: laminectomy; LMP: laminoplasty; MDF: microdiscectomy and fusion; N: number; NR: not reported; NS: not significant; OPLL: ossified posterior longitudinal ligament; SD: standard deviation; VAS: visual analog scale

* All authors from listed country

Table C11. Patient characteristics for comparative cohorts

Author	Year	Study Design	Intervention (N)	Extent of Disease n (%)		Symptoms/ Diagnosis n (%)		Mean duration of symptoms (months ± SD)	Mean Age (years ± SD)	Females n (%)	Race	Previous Surgery/other	Disability Coverage	Employment Status	Comments		
Anterior Decompression and Fusion																	
Mayer	2002	Prosp. comparative cohort	AF + Interdisciplinary treatment	52	1- or 2-level	52 (100)	DDD	52 (100)	25.0 ± 14.8	45.4 ± 7.8	12 (23)	White: 39 (74.5) Black: 7 (13.7) Hispanic: 6 (11.8) Other: 0 (0) White: 115 (76.5) Black: 14 (9.4) Hispanic: 19 (12.8) Other: 2 (1.3)	52 (100)	NR	NR	Significant differences between age, gender, length of disability, attorney retention	
			Interdisciplinary treatment	150	≥ 1 level	150 (100)	DDD	150 (100)	15.7 ± 15.6	41.3 ± 10.2	62 (41)		26 (17.6)				
Nagata	1996	Retrospective comparative cohort	AF	77	1- or 2-level	77 (100)	Myelopathy	77 (100)	NR	NR	NR	NR	NR	NR	NR	NR	
			Laminoplasty (posterior)	96	Narrow spinal canal or ≥ 3 levels	96 (100)	Myelopathy	96 (100)									
Hasegawa	2007	Retrospective comparative cohort	AF	424	NR	Described for entire group: CSM 587 (68) OPLL 143 (17) Cervical disc hernia 117 (14) Calcification/ossification of ligamentum flavum 10 (1.2)	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	
			Laminoplasty	345	NR												
			Laminectomy	88	NR												
Hasegawa	2002	Retrospective comparative cohort	AF, ≥ 70 years	10	1- or 2-level	35 (100)	All patients diagnosed with spondylotic myelopathy by MRI/CT	NR	NR	NR	NR	NR	NR	NR	NR	NR	
			AF, ≤ 60 years	25	≥ 3 levels	29 (100)											13.1 ± 16.0
			Laminoplasty, ≥ 70 years	13													39.5 ± 83.9
			Laminoplasty, ≤ 60 years	16													39.7 ± 53.4
			Laminectomy, ≥ 70 years	17													71.4 ± 90.7
Laminectomy, ≤ 60 years	9	43.6 ± 72.2 32.1 ± 42.1															
Kawakami	2000	Retrospective comparative cohort	AF	60	1 level	46 (77)	Spondylosis	9 (15)	16.8 ± 36.0	51.1	15 (25)	NR	NR	NR	NR	NR	
			Laminoplasty	76	2 levels	14 (23)	Disc herniation	51 (85)	24.0 ± 27.6	61.5	24 (32)						
Koakutsu	2010	Prosp. comparative cohort	AF	25	NR	Myelopathy w/ disc herniation	25 (100)	<12 months	51 ± 9	10 (40)	NR	0(0)	NR	NR	NR	NR	
			Laminoplasty	25	NR		25 (100)										55 ± 13
Anterior Discectomy and Fusion																	
Tominaga	2002	Retrospective comparative cohort	ADF	35	NR	Myelopathy	35 (100)	NR	60.2 (32-77)*	18 (38)	NR	NR	NR	NR	NR	NR	
			Posterior laminoplasty w/ fusion	12	NR	Myelopathy	12 (100)										
Korinth	2006	Retrospective comparative cohort	ADF	154	1- level	154 (100)	Radiculopathy	154 (100)	6.3 ± 9.6	45.9 ± 8.2	51 (41)	NR	NR	NR	NR	Duration of symptoms significantly different between groups (p<0.000); data available on pre-operative neurological status	
			Myelopathy	0 (0)	3.5 ± 4.8	46.9 ± 10.4	70 (41)										
			Posterior foraminotomy	209				1- level	209 (100)	Radiculopathy	209 (100)						
Myelopathy	0 (0)																
Stieber	2005	Retrospective comparative cohort	ADF - Outpatient	30	1- or 2-level	30 (100)	Myelopathy	0 (0)	≥3 months	43.2	12 (40)	NR	NR	NR	NR	NR	
			ADF - Inpatient (1)	30	1- or 2-level	30 (100)	Myelopathy	4 (13)		43.6	17 (57)						
			ADF - Inpatient (2)	30	1- or 2-level	30 (100)	Myelopathy	3 (12)		44.9	18 (60)						3 (10)

Author	Year	Study Design	Intervention (N)	Extent of Disease n (%)		Symptoms/ Diagnosis n (%)		Mean duration of symptoms (months ± SD)	Mean Age (years ± SD)	Females n (%)	Race	Previous Surgery/other	Disability Coverage	Employment Status	Comments	
Microdiscectomy and Fusion																
Liu	2009	Retrospective comparative cohort	Anterior MDF and fusion - Outpatient	45	1- level	45 (100)	Radiculopathy	27 (60)	NR	48.7 (23-64)*	14 (31)	NR	NR	NR	Average major medical comorbidities for inpatients (1.9/patient) greater than outpatient (1.4/patient, p-value, NR)	
						Myelopathy	11 (24)									
						Combination	7 (16)									
			Anterior MDF and fusion - Inpatient	64	1- level	64 (100)	Radiculopathy	27 (42)								
						Myelopathy	26 (41)		56.1 (22-89)*	27 (42)		8 (12.5)				
						Combination	9 (14)									
Silvers	1996	Retrospective comparative cohort	MDF - Outpatient	50	1- or 2-level	50 (100)	Neck pain	40 (80)	5.5+	45.9 ± 1.5	25 (50)	NR	NR	18 (36) workers' comp. cases	44 (88) employed	Authors report that inpatients were not significantly different to inpatients with respect to baseline demographics (p>0.05)
						Arm pain	37 (74)									
			MDF - Inpatient	53	1- or 2-level	53 (100)	Muscle weakness/atrophy	25 (50)								
							NR	NR	NR	NR			NR	42 (79) employed		
Anterior Corpectomy and Fusion																
Gandhoke	2011	Retrospective comparative cohort	ACF	31	≥ 2 levels	31 (100)	OPLL	9 (29)	NR	53	13 (42)	NR	NR	NR	NR	
						Degenerative spondylosis	22 (71)									
			Laminoplasty	31	≥ 3 levels	31 (100)	OPLL	NR								
						Degenerative spondylosis	NR		62	7(23)						
Hirai	2011	Prosp. comparative cohort	ACF	39	NR		Spondylosis	39 (100)	11.8 ± 7.6	59.2 ± 10.7	12 (30.8)	NR	NR	NR	NR	
			Laminoplasty	47	NR		Spondylosis	47 (100)	10.0 ± 7.3	61.2 ± 10.1	11 (23.4)					
Iwasaki	2007	Retrospective comparative cohort	AF (corpectomy/ discectomy)	27	NR		Myelopathy	27 (100)	NR	58 (41-74)*	12 (44)	Asian (100%)	NR	NR	NR	
			Laminoplasty	66	NR		Myelopathy	66 (100)								57 (41-75)*
Kristof	2009	Retrospective comparative cohort	ACF	42	≥ 2 levels	42 (100)	Spondylotic myelopathy	42 (100)	0.5-192*	62.5 ± 10.6	11 (26)	NR	NR	NR	NR	Patients in the anterior corpectomy arm were significantly younger (p=0.012)
			Posterior laminectomy and fusion	61	≥ 2 levels	61 (100)	Spondylotic myelopathy	61 (100)	1-120*	66 ± 12.4	15 (25)					
Laminectomy and Fusion																
Highsmith	2011	Retrospective comparative cohort	Laminectomy with fusion	26	NR		Myelopathy	26 (100)	NR	58 (42-81)*	NR	NR	NR	NR	NR	
			Laminoplasty	30	NR		Myelopathy	30 (100)								61 (44-81)*
Woods	2011	Retrospective comparative cohort	Laminectomy with fusion (posterior)	82	≥ 3 levels	82 (100)	Myelopathy	82 (100)	16 ± 11.2	64 ± 10.7	32 (39)	NR	NR	NR	NR	0(0)‡
						Myeloradiculopathy	29 (35)									
			Laminoplasty (posterior)	39	≥ 3 levels	39 (100)	Myelopathy	39 (100)								
						Myeloradiculopathy	13 (33)	14 ± 8.3	60 ± 12.5	14 (36)						

Author	Year	Study Design	Intervention (N)	Extent of Disease n (%)	Symptoms/ Diagnosis n (%)	Mean duration of symptoms (months ± SD)	Mean Age (years ± SD)	Females n (%)	Race	Previous Surgery/o ther	Disability Coverage	Employment Status	Comments
Anterior Spinal Fusion													
Yoshida	1998	Retrospective comparative cohort	Anterior spinal fusion	44	NR	Myelopathy	44 (100)	15.6	50.3	NR	NR	NR	NR
			Laminoplasty	32	NR	Myelopathy	32 (100)	10.5	56				
			Conservative treatment	15	NR	Myelopathy Radiculopathy	7 (47) 8 (53)	NR	53				
Shamji	2009	Retrospective comparative cohort	Anterior spinal fusion	6,091	NR	Myelopathy	2,302 (37.8)	55 ± 11	3,120 (51)	NR	NR	NR	Significant differences between age, gender, race, presence of myelopathy, Deyo co-morbidity score, hospital payer
			Posterior spinal fusion	2,457	NR	Myelopathy	1,457 (59.3)	61 ± 12	1,079 (44)				
Shamji	2008	Retrospective comparative cohort	Anterior spinal fusion without myelopathy	77,491	NR	Myelopathy	0 (0)	48 ± 11	40,202 (51.6)	NR	NR	NR	Significant differences among groups with respect to age, sex, co-morbidity score, and race; no data available on presence of spondylosis, nor number of levels fused or cervical spine alignment
			Anterior spinal fusion with myelopathy	13,952	NR	Myelopathy	13,952 (100)	56 ± 13	6,264 (44.9)				
			Posterior spinal fusion without myelopathy	2,795	NR	Myelopathy	0 (0)	54 ± 15	1,243 (44.5)				
			Posterior spinal fusion with myelopathy	2,535	NR	Myelopathy	2,535 (100)	62 ± 13	953 (37.6)				

ACF: anterior corpectomy and fusion; ADF: anterior discectomy and fusion; AF: anterior decompression and fusion; ASF: anterior spinal fusion; CSM: cervical spondylotic myelopathy; CT: computed tomography; DDD: degenerative disc disease; LMN: laminectomy; LMP: laminoplasty; MDF: microdiscectomy and fusion; MRI: magnetic resonance imaging; N: number; NR: not reported; OPLL: ossified posterior longitudinal ligament; SD: standard deviation; VAS: visual analog scale

* range
‡ any previous cervical spine surgery
† median

Table C12. Treatment success for comparative cohorts

Intervention	Author	Year	Study Design	Comparator(s)	Index	Time (months)	Measure	Intervention Outcome	Comparator Outcome	P-value	Comments
Anterior Decompression and Fusion											
AF	Nagata	1996	Retrospective comparative cohort	LMP (posterior)	Recovery rate, based on Hirabayashi (%)	12 - 54	mean (SD)	61 (27)	58 (22)	NS	
AF, ≤ 60 yrs	Hasegawa	2002	Retrospective comparative cohort	LMP, ≤ 60 yrs	Recovery rate, based on Hirabayashi (%)	36	mean (SD)	47.9 (32.0)	3.8 (46.3)	NR	Older vs. younger: p=0.844
AF, ≤ 60 yrs	Hasegawa	2002	Retrospective comparative cohort	LMN, ≤ 60 yrs	Recovery rate, based on Hirabayashi (%)	36	mean (SD)	47.9 (32.0)	16.3 (69.7)	NR	Among 3 procedures: p=0.954
AF, ≥ 70 years	Hasegawa	2002	Retrospective comparative cohort	LMP, ≥ 70 years	Recovery rate, based on Hirabayashi (%)	27	mean (SD)	21.9 (40.2)	37.4 (31.5)	NR	
AF, ≥ 70 years	Hasegawa	2002	Retrospective comparative cohort	LMN, ≥ 70 years	Recovery rate, based on Hirabayashi (%)	27	mean (SD)	21.9 (40.2)	34.6 (32.7)	NR	
AF	Kawakami	2000	Retrospective comparative cohort	LMP	Recovery rate, based on Hirabayashi (%)	AF: 70* LMP: 61*	mean	Spondylosis: 49.0	Spondylosis: 58.6	NS	Analysis of recovery rate by pre-operative characteristics, as well as post-operative alignment
							mean	Herniation: 71.1	Herniation: 71.9	NS	
AF	Koakutsu	2010	Prospective comparative cohort	LMP	Recovery rate, based on Hirabayashi (%)	12	mean (SD)	73.2 (20.6)	66.8 (25.3)	NS	Sub-group analysis in LMN: herniation reduction and associated recovery rate
Anterior Discectomy and Fusion											
ADF	Tominaga	2002	Retrospective comparative cohort	Posterior LMP with fusion	Recovery rate, based on Hirabayashi (%)	NR	mean (SD)	54.0 (24.8)	45.5 (18.2)	NS	
ADF	Korinth	2006	Retrospective comparative cohort	Posterior foraminotomy	Odom's Criteria						
						Excellent	72*	n (%)	71 (57.3)	100 (59.5)	NR
						Good	72*	n (%)	45 (36.3)	43 (25.6)	NR
						Fair	72*	n (%)	7 (5.6)	13 (7.7)	NR
						Poor	72*	n (%)	1 (0.8)	12 (7.2)	<0.05
Success Rate (Excellent + Good)	72*	n (%)	116 (93.6)	142 (85.1)	<0.05						
Microdiscectomy and Fusion											
MDF - Outpatient	Liu	2009	Retrospective comparative cohort	MDF - Inpatient	Excellent Outcome†	2.1*	n (%)	40 (88.9)	50 (78.1)	NS	
						Good	2.1*	n (%)	5 (11.1)	14 (21.9)	NS
						Fair	2.1*	n (%)	0 (0)	0 (0)	NS
						Poor	2.1*	n (%)	0 (0)	0 (0)	NS

Intervention	Author	Year	Study Design	Comparator(s)	Index	Time (months)	Measure	Intervention Outcome	Comparator Outcome	P-value	Comments
Anterior Corpectomy and Fusion											
ACF	Hirai	2011	Prosp. comparative cohort	LMP	Recovery rate, based on Hirabayashi (%)	12	mean (SD)	59.9 (27.4)	49.5 (25.8)	NS	
						24	mean (SD)	63.5 (28.6)	50.4 (27.3)	<0.05	
						36	mean (SD)	74.1 (25.4)	52.5 (27.3)	<0.05	
						60	mean (SD)	72.9 (28.3)	50.2 (26.6)	<0.05	
ACF	Iwasaki	2007	Retrosp. comparative cohort	LMP	Recovery rate (%)‡	ACF: 72* LMP: 122*	mean (range)	51 (0-92)	55 (-21 - 100)	NR	Sub-group analysis based on occupying ratio of OPLL, sagittal shape of ossification and cervical alignment available
Laminectomy and Fusion											
LMN with fusion	Highsmith	2011	Retrosp. comparative cohort	LMP	Odom's Criteria						
						Excellent	LMN: 41* LMP: 42*	n (%)	7 (27)	8 (27)	NR
						Good	LMN: 41* LMP: 42*	n (%)	14 (54)	15 (50)	NR
						Fair	LMN: 41* LMP: 42*	n (%)	5 (19)	6 (20)	NR
						Poor	LMN: 41* LMP: 42*	n (%)	0 (0)	1 (3)	NR
Anterior Spinal Fusion											
ASF	Yoshida	1998	Retrosp. comparative cohort	LMP	Recovery rate, based on Hirabayashi (%)	3	mean	68.8	67.9	NS	Recovery rate for conservative arm: 5 (62.5) for patients with myelopathy; full recovery for patients with radiculopathy (no definition provided); sub-group analysis available for patients with developmental canal stenosis

ACF: anterior corpectomy and fusion; ADF: anterior decompression and fusion; AF: anterior decompression and fusion; ASF: anterior spinal fusion;
LMN: laminectomy; LMP: laminoplasty; MDF: microdiscectomy and fusion; N: number; NR: not reported; NS: not significant; OPLL: ossified posterior longitudinal ligament;
SD: standard deviation; VAS: Visual Analog Scale

* Mean follow-up length

† Subjective outcome scale: Excellent = complete resolution of symptoms; Good = partial resolution of symptoms with non-debilitating residual symptoms;
Fair = no improvement in symptoms; Poor = exacerbation of symptoms

‡ No definition provided

Table C13. Pain outcomes for comparative cohorts

Intervention	Author	Year	Study Design	Comparator(s)	Index	Time (months)	Measure	Intervention Outcome	Comparator Outcome	P-value	Comments					
Anterior Decompression and Fusion																
AF + Interdisciplinary treatment	Mayer	2002	Prosp. comparative cohort	Interdisciplinary treatment	VAS score	0	mean (SD)	7.0 (2.2)	6.6 (2.1)	0.26						
						12	mean (SD)	4.9 (2.0)	6.0 (8.2)	0.35						
					Million VAS	0	mean (SD)	88.8 (22.9)	85.9 (23.5)	0.45						
						12	mean (SD)	64.9 (29.0)	58.5 (29.6)	0.21						
					VAS score	0	> 5 (%)	83.7	74.5	0.19						
						12	> 5 (%)	44.7	34.8	0.24						
					Million VAS	0	>70 (%)	83.7	73.6	0.15						
						12	>70 (%)	48.9	38.8	0.23						
AF	Kawakami	2000	Retrospective comparative cohort	LMP	Presence of axial symptom: neck pain	0	n (%)	8 (13)	8 (11)	NS						
						AF: 70* LMP: 61*	n (%)	6 (10)	4 (5)	NR						
AF	Koakutsu	2010	Prosp. comparative cohort	LMP	Neck Pain†	0	12	n (%)	19 (79)	12 (50)	Significantly more frequent neck pain in LMP vs. ADF patients (p=0.037)					
						1	12	n (%)	5 (20)	12 (50)						
						2	12	n (%)	0 (0)	0 (0)						
						3	12	n (%)	0 (0)	0 (0)						
						4	12	n (%)	0 (0)	0 (0)						
						4	12	n (%)	0 (0)	0 (0)						
						Donor site pain†										
						0	12	n (%)	15 (62.5)	N/A						
						1	12	n (%)	9 (37.5)	N/A						
						2	12	n (%)	0 (0)	N/A						
						3	12	n (%)	0 (0)	N/A						
						4	12	n (%)	0 (0)	N/A						
Anterior Discectomy and Fusion																
ADF - Outpatient	Stieber	2005	Retrospective comparative cohort	ADF - Inpatient	Presence of donor site pain	NR	n (%)	0 (0)	4 (7)	NR						

Intervention	Author	Year	Study Design	Comparator(s)	Index	Time (months)	Measure	Intervention Outcome	Comparator Outcome	P-value	Comments		
Microdiscectomy and Fusion													
MDF - Outpatient	Silvers	1996	Retrospective comparative cohort	MDF - Inpatient	VAS Successful Outcome†								
						Arm	Outpatient: 15* Inpatient: 19*	n (%)	40 (80)	37 (70)	>0.05	Sub-group analysis available in patients employed pre-operatively, # of surgical levels	
						Neck	Outpatient: 15* Inpatient: 19*	n (%)	39 (78)	36 (68)	>0.05		
Anterior Corpectomy and Fusion													
ACF	Kristof	2009	Retrospective comparative cohort	Posterior LMN and fusion	VAS - Neck	0	median (range)	4 (0-10)	3.5 (0-8)	0.76	Subgroup analysis including patients undergoing LMN with a follow-up of > 1 year		
					Change in VAS-Neck	ACF: 197§ LMN: 67§	median (range)	1.0 (-8 - 9)	0.5 (-8 - 8)	0.95			
Laminectomy and Fusion													
LMN with fusion	Highsmith	2011	Retrospective comparative cohort	LMP	VAS - Neck	0	mean (SD)	5.8 (3.2)	3.2 (2.8)	<0.01	Significant decrease in pain for fusion patients (p<0.01); for laminoplasty patients, increase in pain was NS (p=0.50)		
						LMN: 41* LMP: 42*	mean (SD)	3.0 (2.3)	3.4 (2.6)	0.28			
Posterior LMN with fusion	Woods	2011	Retrospective comparative cohort	Posterior LMP	Neck pain	Post-operative	n (%)	NR	12 (39)	NR			
									24	n (%)	2 (2)	3 (8)	0.07
					Subjective Pain Improvement								
					Good + Very good	≥ 6 months	n (%)	60 (73)	23 (59)	0.14			

ACF: anterior corpectomy and fusion; ADF: anterior decompression and fusion; AF: anterior decompression and fusion; LMN: laminectomy; LMP: laminoplasty; MDF: microdiscectomy and fusion; N: number; N/A: not available; NR: not reported; NS: not significant; SD: standard deviation; VAS: visual analog scale

* Mean follow-up length

† Authors' scale: 0 = no pain; 1 = occasional mild pain requiring no analgesics; 2 = incessant mild pain or occasional intense pain requiring analgesics; 3 = incessant intense pain; 4 = unbearable pain - analgesics not effective

‡ Defined as a score of 0-4 out of 10 points: 0 = no pain; 1-3 = sporadic mild pain with little discomfort; 4 = discontinuous but occasionally distressing pain

§ Median length of follow-up

|| Subjective evaluation based on a 6-point scale: 1 = very poor; 2 = poor; 3 = fair; 4 = good; 5 = very good;

A positive response is recorded for patients with stated improvement of good (4) or very good (5)

Table C14. Functional outcomes for comparative cohorts

Intervention	Author	Year	Study Design	Comparator(s)	Index	Time (months)	Measure	Intervention Outcome	Comparator Outcome	P-value	Comments
Anterior Decompression and Fusion											
AF + Interdisciplinary treatment	Mayer	2002	Prosp. comparative cohort	Interdisciplinary treatment	Physical cumulative score*	0	mean (SD)	42.2 (13.9)	46.3 (15.3)	0.1	
						12	mean (SD)	73.7 (12.2)	74.3 (16.4)	0.81	
						0	<60 (%)	93.9	83.4	0.07	
						12	<60 (%)	14.9	14.4	0.94	
AF, ≤ 60 yrs	Hasegawa	2002	Retrosp. comparative cohort	LMP, ≤ 60 yrs	JOA score	0	mean (SD)	10.9 (2.1)	10.3 (2.5)	NR	Older vs. younger groups, pre- and post-JOA: NS
					36	mean (SD)	13.9 (2.2)	11.1 (2.5)	NR		
AF, ≤ 60 yrs	Hasegawa	2002	Retrosp. comparative cohort	LMN, ≤ 60 yrs	JOA score	0	mean (SD)	10.9 (2.1)	9.6 (3.4)	NR	Among 3 procedures, pre- and post-JOA scores: NS
						36	mean (SD)	13.9 (2.2)	12.5 (2.2)	NR	
AF, ≥ 70 years	Hasegawa	2002	Retrosp. comparative cohort	LMP, ≥ 70 years	JOA score	0	mean (SD)	10.4 (3.1)	10.1 (3.0)	NR	P-values available for pre- and post- analyses
						27	mean (SD)	12.1 (3.0)	13.0 (2.1)	NR	
AF, ≥ 70 years	Hasegawa	2002	Retrosp. comparative cohort	LMN, ≥ 70 years	JOA score	0	mean (SD)	10.4 (3.1)	9.0 (2.9)	NR	
						27	mean (SD)	12.1 (3.0)	11.6 (3.0)	NR	
AF	Koakutsu	2010	Prosp. comparative cohort	LMP	JOA score	0	mean (SD)	9.1 (3.0)	9.3 (2.6)	NS	
						12	mean (SD)	15.2 (1.4)	14.4 (2.5)	NS	
Anterior Discectomy and Fusion											
ADF	Tominaga	2002	Retrosp. comparative cohort	Posterior LMP with fusion	JOA score	0	mean	9.8	9.8	NR	
											post-operative: NR
Microdiscectomy and Fusion											
MDF - Outpatient	Silvers	1996	Retrosp. comparative cohort	MDF - Inpatient	Resolution of muscle weakness/ atrophy - Successful Outcome†	Outpatient: 15‡ Inpatient: 19‡	n (%)	47 (94)	51 (96)	>0.05	Sub-group analysis available in patients employed pre-operatively, number of surgical levels

Anterior Corpectomy and Fusion												
ACF	Gandhoke	2011	Retrospective comparative cohort	LMP	Nurick grade	0	mean	1.10	2.61	<0.001		
						12	mean	0.74	NR	0.065		
						18	mean	NR	1.19			
ACF	Hirai	2011	Prospective comparative cohort	LMP	JOA score	0	mean (SD)	9.9 (3.1)	9.7 (2.9)	NS	Data available for individual JOA functions	
						12	mean (SD)	14.0 (2.6)	13.3 (2.5)	NS		
						24	mean (SD)	14.8 (2.0)	13.5 (2.5)	<0.05		
						36	mean (SD)	15.0 (2.3)	13.5 (2.6)	<0.05		
						60	mean (SD)	14.9 (2.3)	13.1 (2.9)	<0.05		
ACF	Iwasaki	2007	Retrospective comparative cohort	LMP	JOA score	0	mean (range)	9.5 (4.5-14)	9.2 (0-15)	NR	Sub-group analysis based on occupying ratio of OPLL, sagittal shape of ossification and cervical alignment available	
						ADF: 72‡ LMP: 122‡	mean (range)	13.2 (9-16.5)	13.7 (8-17)	NR		
						Neurologic Outcome§						
						Excellent/Good	ADF: 72‡ LMP: 122‡	n (%)	15 (56)	43 (65)		NR
						Fair	ADF: 72‡ LMP: 122‡	n (%)	10 (37)	10 (15)		NR
Poor	ADF: 72‡ LMP: 122‡	n (%)	2 (7)	13 (20)	NR							
ACF	Kristof	2009	Retrospective comparative cohort	Posterior LMN with fusion	Nurick Grade	0	median (range)	3 (0-5)	3 (1-5)	0.24	Subgroup analysis including patients undergoing LMN with a follow-up of > 1 year	
						Change in Nurick Grade	ACF: 197 LMN: 67	median (range)	0 (-2 - 3)	0 (-2 - 2)		0.5
Laminectomy and Fusion												
LMN with fusion	Highsmith	2011	Retrospective comparative cohort	LMP	mJOA score	0	mean (SD)	12.4 (2.7)	11.6 (2.6)	NR	Within each arm, difference between pre- and post-scores was significant (p<0.01)	
						LMN: 41‡ LMP: 42‡	mean (SD)	15.2 (1.9)	14.4 (2.3)	NR		
						Nurick Grade	0	mean (SD)	2.2 (1.3)	2.9 (1.2)		NR
Posterior LMN with fusion	Woods	2011	Retrospective comparative cohort	Posterior LMP	Subjective Gait Improvement¶	Good + Very good	≥ 6 months	n (%)	58 (71)	26 (67)	0.7	Within each arm, difference between pre- and post-scores was significant (p<0.01)
						LMN: 41‡ LMP: 42‡	mean (SD)	0.8 (1.0)	1.5 (1.1)	NR		
						LMN: 41‡ LMP: 42‡	mean change (SD)	1.4 (1.0)	1.4 (1.0)	NR		

Anterior Spinal Fusion

ASF	Yoshida	1998	Retrospective comparative cohort	LMP	JOA score	0	mean (SD)	10.6 (9.5)	8.5 (5.6)	<0.05	No data provided for conservative treatment arm; sub-group analysis of herniated disc regression available for LMP and conservative treatment arms
						3	mean (SD)	14.9 (2.6)	14.4 (5.6)	NS	

ACF: anterior corpectomy and fusion; ADF: anterior decompression and fusion; AF: anterior decompression and fusion; ASF: anterior spinal fusion; JOA: Japanese Orthopaedic Association [score]; LMN: laminectomy; LMP: laminoplasty; MDF: microdiscectomy and fusion; mJOA: modified Japanese Orthopaedic Association [score]; N: number; NR: not reported; NS: not significant; SD: standard deviation; VAS: visual analog scale

* Based on physical and functional capacity measures, avg. normal subject score = 100

† Evaluation based on surgeon's physical exam, successful outcome based on conversion of a score of 3-4 to 1-2, based on the following scale:

1= none; 2 = mild; 3 = significant but not completely debilitating; 4 = debilitating

‡ Mean length of follow-up

§ Based on recovery rate: excellent, >75%; good, 50-74%, fair, 25-50%, poor, <25%

|| Median length of follow-up

¶ Subjective evaluation based on a 6-point scale: 1 = very poor; 2 = poor; 3 = fair; 4 = good; 5 = very good

A positive response is recorded for patients with stated improvement of good (4) or very good (5)

Table C15. Quality of life for comparative cohorts

Intervention	Author	Year	Study Design	Comparator(s)	Scale	Component	Time (months)	Measure	Intervention Outcome	Comparator Outcome	P-value	Comments
Anterior Decompression and Fusion												
AF + Interdisciplinary treatment	Mayer	2002	Prosp. comparative cohort	Interdisciplinary treatment	Beck Depression Inventory	--	0	mean (SD)	17.7 (9.3)	14.5 (10.8)	0.06	
							12	mean (SD)	10.7 (8.4)	7.5 (8.4)	0.03	
							0	>10 (%)	79.6	57.6	0.006	
							12	>10 (%)	46.8	25.0	0.007	
Microdiscectomy and Fusion												
MDF - Outpatient	Silvers	1996	Retrospective comparative cohort	MDF - Inpatient	Performance of ADLs - Successful Outcome*	---	Outpatient: 15† Inpatient: 19†	n (%)	32 (64)	37 (70)	>0.05	Sub-group analysis available in patients employed pre-operatively, number of surgical levels

ADL: activities of daily living; AF: anterior fusion; MDF: microdiscectomy and fusion; N: number; SD: standard deviation

* Subjective assessment based on scoring 1 or 2 on the following scale: 1 = excellent - no limitations; 2 = good - one or more minor limitations but most activity or work can be accomplished; 3 = fair - one or more limitations that interfere seriously with work; 4 = poor - incapacitated, unable to work at all

† Mean length of follow-up

Table C16. Employment status for comparative cohorts

Intervention	Author	Year	Study Design	Comparator(s)	Work Status Outcome	Time (months)	Measures	Intervention Outcome	Comparator Outcome	P-value	Comments
Anterior Decompression and Fusion											
AF + Interdisciplinary treatment	Mayer	2002	Prosp. comparative cohort	Interdisciplinary treatment	Return to work	12	n (%)	42 (81.3)	136 (90.8)	0.08	
							OR (95% CI)	2.3 (0.9, 5.8)			
					Work retention	12	n (%)	39 (75)	127 (84.7)	0.13	
							OR (95% CI)	1.8 (0.8, 4.2)			
					Work return, permanent modified work	12	n (%)	5 (10.4)	10 (6.9)	0.43	
							OR (95% CI)	6 (0.2, 2.0)			
					Recurrent lost time injury	12	n (%)	2 (3.8)	6 (4.0)	0.96	
							OR (95% CI)	1.0 (0.2,5.3)			
Microdiscectomy and Fusion											
MDF - Outpatient	Silvers	1996	Retrospective comparative cohort	MDF - Inpatient	Ability to work - Successful outcome*	Outpatient: 15† Inpatient: 19†	n (%)	29 (65)	29 (68)	>0.05	Evaluated only in patients who were working pre- operatively

AF: anterior fusion; CI: confidence interval; MDF: microdiscectomy and fusion; N: number; OR: odds ratio

* Subjective assessment based on scoring 1 or 2 on the following scale: 1 = excellent - no limitations; 2 = good - one or more minor limitations but most activity or work can be accomplished;
3 = fair - one or more limitations that interfere seriously with work; 4 = poor - incapacitated, unable to work at all

† Mean length of follow-up

Table C17. Operative outcomes and perioperative complications for comparative cohorts

Intervention	Author	Year	Study Design	Comparator(s)	Measure or Harm Category	Measure	Intervention Outcome	Comparator Outcome	P-value	Comments
Anterior Decompression and Fusion										
AF	Hasegawa	2007	Retrospective comparative cohort	LMP (a) LMN (b)	Nerve Damage	n(%)	22(5)	(a) 21(6) (b) 6(7)	NS	Upper extremity palsy
AF	Koakutsu	2010	Prospective comparative cohort	LMP	Procedure Duration (min)	mean (SD)	122 (24)	122 (24)	NS	
					Perioperative Blood Loss (mL)	mean (SD)	128 (107)	63 (48)	0.0084	
Anterior Discectomy and Fusion										
ADF	Korinth	2006	Retrospective comparative cohort	Posterior foraminotomy	Procedure Duration (min)	mean (SD)	112 (26.9)	94 (30.8)	<0.001	
					Operative Levels - 1 level	n (%)	124 (100)	168 (100)	NR	
					Length of Stay (days)	mean (SD)	4.6 (2.3)	4.5 (2.0)	NS	
					Hematoma	n (%)	1 (0.8)	0 (0)	NR	
					Nerve Damage	n (%)	1 (0.8)	1 (0.6)	NR	
					Infection	n (%)	0 (0)	1 (0.6)	NR	Wound infection
					Hoarseness	n (%)	2 (1.6)	0 (0)	NR	
					Dysphagia	n (%)	2 (1.6)	0 (0)	NR	
					Procedure Revision	n (%)	NR	1 (0.6)	NR	
ADF - Outpatient	Stieber	2005	Retrospective comparative cohort	ADF - Inpatient (groups #1 and #2)	Operative Levels					Inpatients: 4 patients had increased LOS due to minor complications (no data provided); 4 patients re-admitted for early complications; Outpatients: no admissions for surgical complications
					1 level	n(%)	13 (43)	#1: 12 (40) #2: 15 (50)	NR	
					2 levels	n(%)	17 (57)	#1: 18 (60) #2: 15 (50)	NR	
					Dysphagia	n(%)	3 (10)	3 (5)	NR	
Microdiscectomy and Fusion										
MDF - Outpatient	Liu	2009	Retrospective comparative cohort	MDF - Inpatient	Operative Levels - 1 level	n (%)	45 (100)	64 (100)	NR	
					Hematoma	n (%)	0 (0)	1 (1.6)	NR	
					Dysphagia	n (%)	0 (0)	1 (1.6)	NR	
					CSF leak	n (%)	0 (0)	1 (1.6)	NR	
MDF - Outpatient	Silvers	1996	Retrospective comparative cohort	MDF - Inpatient	Operative Levels					
					1 level	n (%)	31 (62)	36 (68)	NR	
					2 levels	n (%)	19 (38)	17 (32)	NR	
					Length of Stay (days)	mean (SD)	1.6 (0.1)	Hours: 6	NR	
					Nerve Damage	n (%)	1 (2)	0 (0)	NR	Vocal cord paralysis
					Infection	n (%)	0 (0)	1 (1.9)	NR	Superficial wound infection

Intervention	Author	Year	Study Design	Comparator(s)	Measure or Harm Category	Measure	Intervention Outcome	Comparator Outcome	P-value	Comments
Anterior Corpectomy and Fusion										
ACF	Gandhoke	2011	Retrospective comparative cohort	LMP	Perioperative Blood Loss	mean (mL)	278	171	0.195	
					Operative Levels	mean no.	2.74	3.87	<0.001	
					Length of Stay	mean (days)	3.8	3.8	0.12	
					Nerve Damage	n(%)	2(6%)	2(6%)	1	Deltoid paresis; 1 patient also had C5 nerve root paresis
					Infection	n(%)	0(0)	2(6)	NR	Wound infections in 2 of 3 patients requiring procedure revisions
					Procedure Revision Mortality	n(%) n(%)	0(0) 0(0)	3(10) 0(0)	0.24 ---	
ACF	Hirai	2011	Prosp. comparative cohort	LMP	Procedure Duration (min)	mean (SD)	211 (55.3)	149 (38.7)	<0.005	Authors note that no intraoperative complications occurred
					Perioperative Blood Loss (mL)	mean (SD)	340 (287)	188 (92.1)	<0.005	
					Operative Levels	mean (SD) n (%)	2.18 (0.83)	C3-C7: 27 (57) C3-C6: 20 (43)	NR	
					Nerve Damage	n(%)	3 (8)	3 (6)	NR	ACF: meralgia (2), C5 palsy (1)
					Dysphagia	n(%)	3 (8)	0 (0)	NR	LMP: C5 palsy (3) Dysphagia and laryngeal edema
ACF	Iwasaki	2007	Retrospective comparative cohort	LMP	Procedure Duration (min)	mean (range)	302 (167-470)	177 (90-395)	NR	
					Perioperative Blood Loss (g)	mean (range)	513 (70-1730)	464 (40-1800)	NR	
					Operative Levels	mean (range)	3 (2-5)	NR	NR	
					Nerve Damage	n(%)	2 (7)	11 (17)	NR	ACF: motor weakness in LLE (1), C5 palsy (1); LMP: transient motor paresis in upper extremity (6), persistent neuropathic arm pain (5)
					Hematoma	n(%)	0 (0)	1 (2)	NR	
Procedure Revision	n(%)	1 (4)	1 (2)	NR						

Intervention	Author	Year	Study Design	Comparator(s)	Measure or Harm Category	Measure	Intervention Outcome	Comparator Outcome	P-value	Comments
ACF	Kristof	2009	Retrospective comparative cohort	Posterior LMN with fusion	Procedure Duration (min)	mean (SD)	229.2 (60.1)	183.8 (46.6)	<0.001	Radiculopathy Anterior: wound infection(1) and pneumonia (1) leading to sepsis; Posterior: wound infection (4) and pneumonia (3)
					Perioperative Blood Loss (mL)	mean (SD)	743.3 (748.9)	839.8 (876.6)	0.37	
					Operative Levels	median (range)	2 (2-3)	3 (1-5)	NR	
					Nerve Damage	n (%)	5 (11.9)	12 (19.6)	0.23	
					Infection	n (%)	2 (4.7)	7 (11)	NS	
					Hoarseness, dysphagia Hardware failure	n (%) n (%)	3 (7.1) 7 (16.6)	0 (0) 4 (6.5)	NR 0.11	
Laminectomy and Fusion										
LMN with fusion	Highsmith	2011	Retrospective comparative cohort	LMP	Operative Levels	mean (range)	5.3 (3-8)	4.0 (3-5)	<0.01	Wound infections; 4/6 patients had comorbid condition affecting wound healing (e.g. diabetes)
					Length of Stay	mean (range)	4.4 (2-11)	4.9 (2-15)	0.46	
					Infection	n (%)	4 (15)	2 (7)	NR	
					Hematoma	n (%)	1	0	NR	
					CSF leak	n (%)	0	1	NR	
Re-operation	n (%)	8 (31)	4 (13)	NR						

Intervention	Author	Year	Study Design	Comparator(s)	Measure or Harm Category	Measure	Intervention Outcome	Comparator Outcome	P-value	Comments
Anterior Spinal Fusion										
ASF	Shamji	2009	Retrospective comparative cohort	Posterior spinal fusion	Length of Stay (days)	mean	2.61	5.98	<0.001	Data available on respiratory and cardiac complications, procedural complications, vascular injury, and wound complications; no data available on infection type; OR analysis describes odds of perioperative morbidity with posterior approach vs. anterior
					Hematoma	n (%)	49 (0.8)	52 (2.1)	<0.001	
						OR (95% CI)	2.27 (1.48, 3.48)		<0.001	
					Transfusion	n (%)	84 (1.4)	177 (7.2)	<0.001	
						OR (95% CI)	4.92 (3.69, 6.56)		<0.001	
					Infection	n (%)	8 (0.1)	24 (1.0)	<0.001	
						OR (95% CI)	6.72 (2.72, 16.33)		<0.001	
					Hoarseness	n (%)	22 (0.4)	8 (0.3)	0.8	
						OR (95% CI)	0.79 (0.33, 1.88)		0.6	
					Dysphagia	n (%)	221 (3.6)	46 (1.9)	<0.001	
						OR (95% CI)	0.41 (0.29, 0.58)		<0.001	
					CSF leak	n (%)	3 (0.05)	2 (0.08)	0.6	
						OR (95% CI)	0.50 (0.06, 3.77)		0.5	
					Mortality	n (%)	20 (0.3)	17 (0.7)	0.02	
						OR (95% CI)	0.67 (0.31, 1.40)		0.3	
ASF	Shamji	2008	Retrospective comparative cohort	Posterior spinal fusion	Length of Stay (days), without myelopathy	mean	2.0	4.4	<0.001	Data available on OR of higher perioperative morbidity compared with patients without myelopathy undergoing anterior fusion
					Length of Stay (days), with myelopathy	mean	3.4	5.8		
					Transfusion, without myelopathy	n (%)	263 (0.3)	93 (3.3)	<0.001	
					Transfusion, with myelopathy	n (%)	142 (1.0)	143 (5.6)		
					Thrombosis, without myelopathy	n (%)	15 (0.02)	4 (0.1)	<0.001	
					Thrombosis, with myelopathy	n (%)	8 (0.06)	3 (0.1)		
					Infection, without myelopathy	n (%)	15 (0.02)	10 (0.4)	<0.001	
					Infection, with myelopathy	n (%)	14 (0.1)	14 (0.6)		
					Pneumonia, without myelopathy	n (%)	108 (0.1)	29 (1.0)	<0.001	
					Pneumonia, with myelopathy	n (%)	87 (0.6)	28 (1.1)		
					Mortality, without myelopathy	n (%)	39 (0.05)	10 (0.4)	<0.001	
					Mortality, with myelopathy	n (%)	73 (0.5)	17 (0.7)		

ACF: anterior corpectomy and fusion; ADF: anterior decompression and fusion; AF: anterior decompression and fusion; ASF: anterior spinal fusion; CI: confidence interval; CSF: cerebrospinal fluid; LLE: left lower extremity; LMN: laminectomy; LMP: laminoplasty; LOS: length of stay; MDF: microdiscectomy and fusion; N: number; NR: not reported; NS: not significant; OR: odds ratio; SD: standard deviation; VAS: visual analog scale

Table C18. Long-term complications and adverse events for comparative cohorts

Intervention	Author	Year	Study Design	Comparator(s)	Time (months)	Harm Category	Measure	Intervention Outcome	Comparator Outcome	P-value	Comments
Anterior Decompression and Fusion											
AF + Interdisciplinary treatment	Mayer	2002	Prosp. comparative cohort	Interdisciplinary treatment	12	New surgery to original injury area	n(%)	0 (0)	6 (3.7)	0.17	
							OR (95% CI)	0.7 (0.7, 0.8)			
AF, ≤ 60 yrs	Hasegawa	2002	Retrosp. comparative cohort	LMP, ≤ 60 yrs	36	Myelopathy	n(%)	1 (4)	1 (6)	NR	
						Radiculopathy	n(%)	0(0)	1 (6)	NR	
						Mortality	n(%)	0(0)	0(0)	NR	
AF, ≤ 60 yrs	Hasegawa	2002	Retrosp. comparative cohort	LMN, ≤ 60 yrs	36	Myelopathy	n(%)	1 (4)	0(0)	NR	
						Radiculopathy	n(%)	0(0)	1 (11)	NR	
						Mortality	n(%)	0(0)	0(0)	NR	
AF, ≥ 70 years	Hasegawa	2002	Retrosp. comparative cohort	LMP, ≥ 70 years	27	Myelopathy	n(%)	2 (20)	2 (15)	NR	
						Radiculopathy	n(%)	1 (10)	0(0)	NR	
						Mortality	n(%)	0(0)	0(0)	NR	
AF, ≥ 70 years	Hasegawa	2002	Retrosp. comparative cohort	LMN, ≥ 70 years	27	Myelopathy	n(%)	2 (20)	0(0)	NR	
						Radiculopathy	n(%)	1 (10)	1 (6)	NR	
						Mortality	n(%)	0(0)	0(0)	NR	
AF	Kawakami	2000	Retrosp. comparative cohort	LMP	ADF: 70* LMP: 61 *	Reoperation	n(%)	0 (0)	0 (0)	NR	
						Late-term neurological decline	n(%)	0 (0)	0 (0)	NR	
						Adjacent segment disease	n(%)	15 (25)	NR	NR	
AF	Koakutsu	2010	Prosp. comparative cohort	LMP	12	Reoperation	n(%)	0 (0)	0 (0)	NR	
					12	Pseudarthrosis	n(%)	0 (0)	NR	NR	

Intervention	Author	Year	Study Design	Comparator(s)	Time (months)	Harm Category	Measure	Intervention Outcome	Comparator Outcome	P-value	Comments
Anterior Discectomy and Fusion											
ADF	Korinth	2006	Retrosp. comparative cohort	Posterior foraminotomy	72*	Reoperation	n(%)	3 (2.4)	11 (6.5)	NR	
						Late-term neurological decline	n(%)	0 (0)	0 (0)	NR	
Microdiscectomy and Fusion											
MDF - Outpatient	Liu	2009	Retrosp. comparative cohort	MDF - Inpatient	2.1*	Reoperation	n(%)	0 (0)	1 (1.6)	NR	No other permanent procedure-related morbidities reported during follow-up
						Mortality	n(%)	0 (0)	0 (0)	NR	
MDF - Outpatient	Silvers	1996	Retrosp. comparative cohort	MDF - Inpatient	Outpatient: 15* Inpatient: 19*	Reoperation	n (%)	2 (4)	5 (9.4)	NR	
						Pseudarthrosis	n (%)	2 (4)	1 (1.9)	NR	
						Mortality	n (%)	0 (0)	0 (0)	NR	
Anterior Corpectomy and Fusion											
ACF	Gandhoke	2011	Retrospective comparative cohort	LMP	ACF: 12* LMP: 18*	Paresthesia	n(%)	1(3)	0(0)	NR	Data provided on patient w/post-op paresis that only partially resolved by follow-up
						Mortality	n(%)	0(0)	3(10)	NR	
ACF	Hirai	2011	Prosp. comparative cohort	LMP	12	Reoperation	n(%)	1 (3)	0(0)	NR	
						Pseudarthrosis	n(%)	1 (3)	0(0)	NR	
ACF	Iwasaki	2007	Retrosp. comparative cohort	LMP	ADF: 72* LMP: 122*	Reoperation	n(%)	6 (22)	4 (6)	NR	
						Late-term neurological decline	n(%)	2 (7)	0 (0)	NR	
						Pseudarthrosis	n(%)	2 (7)	0 (0)	NR	
ACF	Kristof	2009	Retrosp. comparative cohort	Posterior LMN with fusion	ACF: 197+ LMN: 67+	Reoperation	n(%)	7 (16.6)	4 (6.5)	0.11	
						Radiculopathy	n (%)	0 (0)	4 (6.5)	NR	
						Mortality	n(%)	2 (4.7)	1 (1.6)	0.67	

Intervention	Author	Year	Study Design	Comparator(s)	Time (months)	Harm Category	Measure	Intervention Outcome	Comparator Outcome	P-value	Comments
Laminectomy and Fusion											
LMN with fusion	Highsmith	2011	Retrospective comparative cohort	LMP	LMN: 41* LMP: 42*	Reoperation	n(%)	1 (4)	0 (0)	NR	
						Pseudarthrosis	n(%)	2 (8)	0 (0)	NR	
Posterior LMN with fusion	Woods	2011	Retrospective comparative cohort	Posterior LMP	24	Reoperation	n (%)	2 (2)	2 (5)	0.07	
						Chronic Pain	n (%)	2 (2)	3 (8)	0.07	Data available on stenosis and kyphosis
						Persistent radiculopathy	n (%)	0 (0)	1 (3)	NR	
						Dysphagia	n (%)	1 (1)	0 (0)	NR	
						Infection	n (%)	1 (1)	0 (0)	NR	
						Pseudarthrosis	n (%)	1 (1)	0 (0)	NR	
Anterior Spinal Fusion											
ASF	Yoshida	1998	Retrospective comparative cohort	LMP	3	Reoperation	n (%)	0 (0)	0 (0)	NR	No data provided for conservative treatment arm
						Adjacent segment disease	n (%)	8 (18)	0(0)	NR	

ACF: anterior corpectomy and fusion; ADF: anterior decompression and fusion; AF: anterior decompression and fusion; ASF: anterior spinal fusion; CI: confidence interval; LMN: laminectomy; LMP: laminoplasty; MDF: microdiscectomy and fusion; N: number; NR: not reported; OR: odds ratio; SD: standard deviation; VAS: visual analog scale

* Mean length of follow-up

† Median length of follow-up

Table C19. Sub-group analysis for randomized controlled trials

Intervention	Author	Year	Sample Size	Comparator(s)	Subgroups Analysed	Summary
Anterior Discectomy and Fusion	Martins	1976	51	Discectomy	Single level surgery Two level surgery	<ul style="list-style-type: none"> • Single-level surgery, excellent/good* results: 82% vs. 66% for fusion vs. discectomy (p-value NR) • Two-level surgery, excellent/good* results: 26% vs. 63% for fusion vs. discectomy (p-value NR)
Anterior Discectomy and Fusion	Persson	2001	81	Physiotherapy Cervical Collar	Smokers Non-Smokers	<p>At 3.5 months, less pain[†] reported in non-smokers vs smokers in surgery group (p<0.05)</p> <p>In entire population, less pain after treatment reported by non-smokers compared to smokers (p = 0.03).</p>
Anterior Discectomy and Fusion	Rosenørn	1983	63	Discectomy	Males Females	<p><u>At 3 months:</u></p> <ul style="list-style-type: none"> • Males, excellent/good clinical condition[‡] : 76% vs. 91% for fusion vs. discectomy (p-value NR) • Females, excellent/good clinical condition : 43% vs. 78% for fusion vs. discectomy (p-value NR) <p><u>At 12 months:</u></p> <ul style="list-style-type: none"> • Males, excellent/good clinical condition[‡] : 94% vs. 86% for fusion vs. discectomy (p-value NR) • Females, excellent/good clinical conditions: 38% vs. 89% for fusion vs. discectomy (p-value NR) <p>Difference between males vs females in fusion group significant at 3 and 12 months. (p<0.005)</p>

NR=Not reported

* Excellent = all preoperative symptoms relieved, abnormal signs unchanged or improved; Good = minimum persistence of pre-operative symptoms, abnormal signs unchanged or improved

† Pain measured on 100 mm VAS scale

‡ Excellent = returned to previous occupations, all symptoms disappeared; Good = returned to previous occupations, minor symptoms exist

Table C20. Sub-group analysis for comparative cohorts

Intervention	Author	Year	Sample Size	Comparator(s)	Subgroups Analyzed	Summary
Microdiscectomy and Fusion	Silvers	1996	103	None	Outpatient vs. Inpatient	<p><u>Operative Details:</u> Mean Length of stay (hours): 1.6 vs. 6 for outpatient vs. inpatient (p-value NR) Nerve Damage: 2% vs. 0% for outpatient vs. inpatient (p-value NR) Infection: 0% vs. 1.9% for outpatient vs. inpatient (p-value NR)</p> <p><u>Functional Outcomes:</u> Resolution of muscle weakness/ atrophy - Successful Outcome*: 94% vs. 96% for outpatient vs. inpatient (p>0.05)</p> <p><u>Pain Outcomes (VAS)</u> Successful Outcome[†]: • Arm pain relief: 80% vs. 70% outpatient vs. inpatient (p>0.05) • Neck pain relief: 78% vs. 68% outpatient vs. inpatient (p>0.05)</p> <p><u>Performance of ADLs -</u> Successful Outcome[‡]: 64% vs. 70% outpatient vs. inpatient (p>0.05)</p> <p><u>Adverse Events:</u> Reoperation: 4% vs. 9.4% for outpatient vs. inpatient (p-value NR) Rates of non-union (pseudarthrosis): 4% vs. 1.9% outpatient vs. inpatient (p-value NR)</p> <p><u>Ability to work:</u> Successful outcome[‡]: 65% vs. 68% for outpatient vs. inpatient (p<0.05)</p>
					Outpatient vs. Inpatient: Patients employed prior to intervention	<p><u>Functional Outcomes:</u> Resolution of muscle weakness/ atrophy - Successful Outcome*: 93% vs. 100% for outpatient vs. inpatient (p>0.05)</p> <p><u>Pain Outcomes (VAS)</u> % Successful Outcome[†]: • Arm pain relief: 77% vs. 69% for outpatient vs. inpatient (p>0.05) • Neck pain relief: 77% vs. 67% for outpatient vs. inpatient (p>0.05)</p> <p><u>Performance of ADLs :</u> Successful outcome[‡]: 64% vs. 74% for outpatient vs. inpatient (p>0.05)</p> <p><u>Ability to work:</u> Successful outcome[‡]: 65% vs. 68% for outpatient vs. inpatient (p>0.05)</p>
					Outpatient vs. Inpatient : Patients with Single level Surgery	<p><u>Functional Outcomes:</u> Resolution of muscle weakness/ atrophy - Successful Outcome*: 97% vs. 97% for outpatient vs. inpatient (p>0.05)</p> <p><u>Pain Outcomes (VAS)</u> % Successful Outcome[†]: Arm pain relief: 84% vs. 67% for outpatient vs. inpatient (p>0.05) Neck pain relief: 84% vs. 67% for outpatient vs. inpatient (p>0.05)</p> <p><u>Performance of ADLs :</u> Successful outcome[‡]: 65% vs. 64% for outpatient vs. inpatient (p>0.05)</p> <p><u>Ability to work:</u> Successful outcome[‡]: 66% vs. 63% for outpatient vs. inpatient (p>0.05)</p>

Intervention	Author	Year	Sample Size	Comparator(s)	Subgroups Analyzed	Summary
Microdiscectomy and Fusion	Silvers (Continued from previous page)	1996	103	None	Outpatient vs. Inpatient : Patients with Two-level Surgery	<p><u>Functional Outcomes:</u> Resolution of muscle weakness/ atrophy - Successful Outcome*: 88% vs. 93% for outpatient vs. inpatient (p-value NS)</p> <p><u>Pain Outcomes (VAS)</u> % Successful Outcome[†]: Arm pain relief: 74% vs. 77% for outpatient vs. inpatient (p-value NS) Neck pain relief: 68% vs. 71% for outpatient vs. inpatient (p>0.05)</p> <p><u>Performance of ADLs :</u> Successful outcome[‡]: 63% vs. 82% for outpatient vs. inpatient (p>0.05)</p> <p><u>Ability to work:</u> Subjective outcome[‡]: 64% vs. 79% for outpatient vs. inpatient (p>0.05)</p>
Microdiscectomy and Fusion	Liu	2009	109	None	Outpatient vs. Inpatient	<p><u>Operative Details:</u> Hematoma: 0% vs. 1.6% for outpatient vs. inpatient (p-value NR) Dysphagia: 0% vs. 1.6% for outpatient vs. inpatient (p-value NR) CSF leak : 0% vs. 1.6% for outpatient vs. inpatient (p-value NR)</p> <p><u>Adverse Events:</u> Reoperation: 0% vs. 1.6% for outpatient vs. inpatient (p-value NR)</p> <p><u>Treatment Success:</u> • Excellent Outcome: 88.9% vs. 78.1% for outpatient vs. inpatient (p-value NS) • Good Outcome: 11.1% vs. 21.9% for outpatient vs. inpatient (p-value NS)</p>
Anterior Discectomy and Fusion	Stieber	2005	90	None	Out-patient Inpatient	<p><u>Operative Details:</u> Dysphagia: 10% vs. 5% for outpatient vs. inpatient (p-value NR)</p> <p><u>Presence of donor site pain:</u> 0% vs. 7% for outpatient vs. inpatient (p-value NR)</p>
Anterior Spinal Fusion	Shamji	2009	8,548	Anterior Spinal Fusion Posterior Spinal Fusion	Anterior Spinal Fusion Posterior Spinal Fusion	<p><u>Operative Details:</u> Length of stay (mean no. of days): 2.6 vs. 5.9 for Anterior versus Posterior fusion (p<0.001) Hematoma: 0.8% vs. 2.1% for Anterior vs. Posterior fusion (p<0.001) OR = 2.27 (p<0.001) Transfusion: 1.4% vs. 7.2% for Anterior vs. Posterior fusion (p<0.001) OR = 4.92 (p<0.001) Infection: 0.1% vs. 1.0% for Anterior vs. Posterior fusion (p<0.001) OR = 6.72 (p<0.001) Hoarseness: 0.4% vs. 0.3% Anterior vs. Posterior fusion (p = 0.8) OR = 0.79 (p = 0.6) Dysphagia: 3.6% vs. 1.9% Anterior vs. Posterior fusion (p<0.001) OR = 0.41 (p<0.001) CSF leak: 0.05% vs. 0.08% Anterior vs. Posterior fusion (p = 0.6) OR = 0.5 (p = 0.50) Mortality: 0.3% vs. 0.7% Anterior vs. Posterior fusion (p = 0.02) OR = 0.67 (p = 0.3)</p>

Intervention	Author	Year	Sample Size	Comparator(s)	Subgroups Analyzed	Summary
Anterior Spinal Fusion	Shamji	2008	96,773	Anterior Spinal Fusion Posterior Spinal Fusion	Anterior Spinal Fusion Posterior Spinal Fusion	<p><u>Operative Details:</u> Length of Stay (mean no. of days), without myelopathy: 2.0 vs. 4.4 for Anterior vs. Posterior fusion (p<0.001) Length of Stay (mean no. of days), with myelopathy: 3.4 vs. 5.8 for Anterior vs. Posterior fusion (p<0.001)</p> <p>Transfusion, without myelopathy: 0.3% vs. 3.3% for Anterior vs. Posterior fusion (p<0.001) Transfusion, with myelopathy: 1% vs. 5.6% for Anterior vs. Posterior fusion (p<0.001)</p> <p>Thrombosis, without myelopathy: 0.02% vs. 0.1% for Anterior vs. Posterior fusion(p<0.001) Thrombosis, with myelopathy: 0.06% vs. 0.1% for Anterior vs. Posterior fusion(p<0.001)</p> <p>Infection, without myelopathy: 0.02% vs. 0.4% for Anterior vs. Posterior fusion(p<0.001) Infection, with myelopathy: 0.1% vs. 0.6% for Anterior vs. Posterior fusion(p<0.001)</p> <p>Pneumonia, without myelopathy: 0.1% vs. 1% for Anterior vs. Posterior fusion(p<0.001)</p>
Anterior Corpectomy and Fusion	Kristof	2009	103	Posterior Laminectomy and Fusion	Anterior Corpectomy and Fusion Posterior Laminectomy and Fusion	<p><u>Operative Details:</u> Procedure Duration (mean no. of minutes): 229.2 vs. 183.8 for Anterior vs. Posterior Fusion (p<0.001) Perioperative Blood loss (mean mL): 743.3 vs. 839.8 for Anterior vs. Posterior Fusion (p = 0.37) Operative levels (median): 2 vs.3 for Anterior vs. Posterior Fusion (p-value NR) Nerve Damage: 11.9% vs. 19.6% for Anterior vs. Posterior Fusion (p = 0.23) Infection: 4.7% vs. 11% for Anterior vs. Posterior Fusion (p-value NS) Hoarseness: 7.1% vs. 0% for Anterior vs. Posterior Fusion (p-value NR) Hardware failure: 16.6% vs. 6.5% for Anterior vs. Posterior Fusion (p = 0.11)</p> <p><u>Functional Outcomes:</u> Nurick Grade (Median): 3 vs. 3 for Anterior vs. Posterior Fusion (p = 0.24) Change in Nurick Grade (Median): 0 vs. 0 for Anterior vs. Posterior Fusion (p = 0.5)</p> <p><u>Pain Outcomes:</u> VAS • Neck pain (median): 4 vs. 3.5 for Anterior vs. Posterior Fusion (p = 0.76) • Change in VAS neck (median): 1 vs. 0.5 for Anterior vs. Posterior Fusion (p = 0.95)</p> <p><u>Adverse Events:</u> Reoperation: 16.6% vs. 6.5% for Anterior vs. Posterior Fusion (p = 0.11) Radiculopathy: 0% vs. 6.5% for Anterior vs. Posterior Fusion (p-value NR) Mortality: 4.7% vs. 1.6% for Anterior vs. Posterior Fusion (p = 0.67)</p>

Intervention	Author	Year	Sample Size	Comparator(s)	Subgroups Analyzed	Summary
Anterior Decompression and Fusion	Tominaga	2002	47	Anterior Decompression and Fusion Posterior Laminoplasty and Fusion	Anterior Decompression and Fusion Posterior Laminoplasty and Fusion	<u>Functional Outcomes:</u> <ul style="list-style-type: none"> • JOA Score at baseline (mean): 9.8 vs. 9.8 for Anterior vs. Posterior Fusion (p-value NR) • JOA Score post operation: 13.3 vs. 13 for Anterior vs. Posterior Fusion (p-value NR) <u>Treatment Success:</u> Recovery Rate based on Hirabayashi(%) (mean): 54.4 vs. 45.5 for Anterior vs. Posterior Fusion (p-value NS)

ADL: activities of daily living; CSF: cerebrospinal fluid; JOA: Japanese Orthopaedic Association [score]; NR: not reported; OR: odds ratio; VAS: Visual Analog Scale

* Evaluation based on surgeon's physical exam, successful outcome based on conversion of a score of 3-4 to 1-2, based on the following scale:

1= none; 2 = mild; 3 = significant but not completely debilitating; 4 = debilitating

† Defined as a score of 0-4 out of 10 points: 0 = no pain; 1-3 = sporadic mild pain with little discomfort; 4 = discontinuous but occasionally distressing pain

‡ Subjective assessment based on scoring 1 or 2 on the following scale: 1 = excellent - no limitations; 2 = good - one or more minor limitations but most activity or work can be accomplished;

3 = fair - one or more limitations that interfere seriously with work; 4 = poor - incapacitated, unable to work at all

Table C21. Study characteristics for case series

Author	Year	Country	Intervention	Sub-group Analysis	Sample Size	Study Duration (months)	Patient Population	Patient Withdrawals n(%)	Notes
Anterior Decompression and Fusion									
Belanger	2005	USA*	Anterior decompression and fusion	N/A	65	48 (24-184)†	<ul style="list-style-type: none"> • Ossification of the posterior longitudinal ligament • Discectomy with foraminotomy, hemi-corpectomy or subtotal corpectomy at 1 to 5 levels 	4 (6.2)	Patients excluded for lack of minimum follow-up (2 years)
Bindal	2007	USA*	Anterior decompression and fusion	Multivariate analysis	93	20 (12-31)†	<ul style="list-style-type: none"> • 1-level degenerative disease 	0 (0)	One arm of controlled cohort examining 2 kinds of graft plates
Faldini	2010	Italy*	Anterior decompression and fusion	N/A	51	Minimum of 120 (120-180)†	<ul style="list-style-type: none"> • Single-level disease • Absence of degenerative changes at adjacent levels 	NR	
Hilibrand	2001	USA	Anterior decompression and fusion	Smoking status	190	68 (24-183)†	<ul style="list-style-type: none"> • Cervical radiculopathy or myelopathy due to degenerative spondylosis or herniated nucleus pulposus 	0 (0)	
Javid	2001	Sweden	Anterior decompression and fusion	1) Gender 2) Surgery level	94	26 (12-56)†	<ul style="list-style-type: none"> • Discogenic and spondylotic radiculopathy • Whiplash injury in 24/81 (29.6%) patients 	13 (13.8)	Withdrawals due to missing data
Matsumoto	2009	Japan	Anterior decompression and fusion	1) Age 2) Gender 3) Surgery level 4) Smoking status	68	144	<ul style="list-style-type: none"> • 1- or 2-level surgery for disc herniation or spondylosis 	4 (5.9)	Patients who underwent a revision procedure were excluded
Riley	2005	USA	Anterior decompression and fusion	Surgery level	668	24	<ul style="list-style-type: none"> • Radiculopathy and/or myelopathy 	358 (53.6)	Withdrawals due to inadequate follow-up data (135), presence of baseline dysphagia (79), and no data (144)
Xu	2009	NR	Anterior decompression and fusion (trephination with strut grafting)	N/A	168	>120 (120-288)†	<ul style="list-style-type: none"> • Cervical spondylotic myelopathy 	61 (36.3)	Withdrawals due to death (19) and lost-to-follow-up (42)

Author	Year	Country	Intervention	Sub-group Analysis	Sample Size	Study Duration (months)	Patient Population	Patient Withdrawals n(%)	Notes
Anterior Cervical Fusion									
Papavero	2002	Germany	Anterior cervical fusion	Radiculopathy	78	Minimum of 24 (44)‡	• Degenerative disc disease with radiculopathy, myelopathy or anterior horn cell syndrome, refractory to conservative treatment	0 (0)	
Robertson	2005	USA*	Anterior cervical fusion	N/A	202	24	• Symptomatic 1-level herniated disc or spondylosis • Intractable radiculopathy and/or myelopathy	44 (21.8)	Withdrawals due to pseudarthrosis (13), previous fusion (13) and no 24-month x-rays (18)
Takayasu	1998	Japan	Anterior cervical fusion	N/A	60	33 (6-55)†	• Cervical myelopathy and/or radiculopathy due to spondylosis or soft disc herniation	NR	
Yang	2009	NR	Anterior cervical fusion	N/A	165	29 (24-108)†	• Cervical spondylotic radiculopathy/myelopathy or disc herniation	0 (0)	
Anterior Discectomy and Fusion									
Barsa	2007	Czech Republic*	Anterior discectomy and fusion	N/A	100	43 (24-62)†	• Cervical myelopathy and/or radiculopathy due to disc herniation, osteophyte formation or posterior longitudinal ligament hypertrophy	0 (0)	
Cabraja	2011	Germany*	Anterior discectomy and fusion	N/A	127	97 (81-110)†	• Radiculopathy and neck pain, without benefit from conservative treatment • 1-level procedure	77 (60.6)	Withdrawals due to lost-to-follow-up (21), refusal to participate (24) and missing data (32)
Carr	2011	USA*	Anterior discectomy and fusion	N/A	122	39 (7-59)†	• Intractable neck pain and radiculopathy caused by spondylosis and/or disc herniation, foraminal and/or central stenosis, spondylolisthesis and myelopathy • ≥ 6 weeks unsuccessful conservative treatment • 1 to 3 level surgery	43 (35.2)	Patients part of a larger randomized, controlled trial; withdrawals: lost-to-follow up (13), with minimal pain at baseline (30)
Epstein	2000	USA*	Anterior discectomy and fusion	Surgery level	178	82 (31-118)†	• Degenerative disc disease and spondylosis	0 (0)	

Author	Year	Country	Intervention	Sub-group Analysis	Sample Size	Study Duration (months)	Patient Population	Patient Withdrawals n(%)	Notes
Faldini	2012	Italy*	Anterior discectomy and fusion	N/A	143	Minimum of 120	<ul style="list-style-type: none"> • 1-level disc disease between C4 and C7 • Intractable pain, worsening of radiculopathy, and myelopathy 	36 (25.2)	Patient overlap with Faldini, 2010; Faldini, 2011
Faldini	2011	Italy*	Anterior discectomy and fusion	N/A	143	Minimum of 120 (120-180)†	<ul style="list-style-type: none"> • 1-level disc disease between C4 and C7 • Intractable neck pain >12 weeks, refractory to non-operative treatment • Pain associated with radiculopathy/myelopathy <12 weeks 	36 (25.2)	Patients lost-to-follow-up; no separate outcomes of interest reported in this study
Garvey	2002	USA	Anterior discectomy and fusion	1-2 level surgery vs. ≥3 levels	87	53	<ul style="list-style-type: none"> • Dominant mechanical neck pain, defined as neck pain > arm pain 	NR	
Geisler	1998	USA, Germany	Anterior discectomy and fusion	Surgery level	402	46 (18-113)†	<ul style="list-style-type: none"> • Cervical radiculopathy, myelopathy or myeloradiculopathy • Herniated disc, posterior osteophyte or cervical stenosis 	0 (0)	
Goldberg	2002	USA*	Anterior discectomy and fusion	Workers' compensation status	80	48 (24-84)†	<ul style="list-style-type: none"> • Radiculopathy and/or myelopathy refractory to conservative treatment for ≥2 months • Herniated nucleus pulposus or spondylosis/stenosis 	0 (0)	
Gore	1998	USA	Anterior discectomy and fusion	N/A	68	253 (234-296)†	<ul style="list-style-type: none"> • Retrospective review: no specific criteria applied 	18 (26.4)	14 patients died, and 4 lost to follow-up
Hamburger	2001	Germany*	Anterior discectomy and fusion	Duration of symptoms	319	146 (120-180)†	<ul style="list-style-type: none"> • Pure radicular symptoms 	70 (21.9)	Withdrawals due to death (12) and lost-to-follow-up (58)
Hwang	2005	Taiwan*	Anterior discectomy and fusion	1) 1- vs. 2- vs. 3-level surgery 2) Clinical presentation 3) Pathology	78	25 (18-35)†	<ul style="list-style-type: none"> • Degenerative disc disease due to disc herniation or significant spondylotic change 	NR	
Jagannathan	2008	USA	Anterior discectomy and fusion	N/A	196	22 (12-124)†	<ul style="list-style-type: none"> • 1-level procedure for degenerative disc disease with spondylosis and/or disc protrusion 	26 (13.3)	Withdrawals due to lost-to-follow-up

Author	Year	Country	Intervention	Sub-group Analysis	Sample Size	Study Duration (months)	Patient Population	Patient Withdrawals n(%)	Notes
Jensen	2009	USA*	Anterior discectomy and fusion	Smoking status	144	19 (6-54)†	• Cervical myelopathy or radiculopathy	8 (5.6)	Withdrawals due to lost-to-follow-up
Kaiser	2002	USA*	Anterior discectomy and fusion	N/A	251	16 (9-40)†	• Cervical spondylosis and/or disc herniation • Radiculopathy and/or myelopathy	18 (7.2)	Withdrawals due to lost-to-follow-up
Kienapfel	2004	Germany*	Anterior discectomy and fusion	N/A	108	84‡ (36-144)†	• Radiculopathy, myelopathy or myeloradiculopathy and diagnosis of herniated disc, posterior osteophyte or cervical stenosis	54 (50.0)	Withdrawals from lost-to-follow-up (24), unwillingness to participate (8), death (5) and claustrophobia (17)
Kim	2009	South Korea*	Anterior discectomy and fusion	1- vs. 2-level surgery	54	20 (12-40)†	• Symptomatic 1- or 2-level cervical disc disease	0(0)	
Maldonado	2011	Spain*	Anterior discectomy and fusion	N/A	105	36	• Single-level degenerative disc disease • Intractable radiculopathy and/or myelopathy	NR	
Riina	2009	USA	Anterior discectomy and fusion	N/A	486	24	• 1-level disease with radiculopathy and/or myelopathy, refractory to non-operative treatment	113 (23.3)	No data on withdrawals; post-hoc analysis of data from 2 RCTs
Samartzis	2005	USA*	Anterior discectomy and fusion	1) Smoking status 2) Work-related injury	66	17 (5-60)†	• Radiculopathy, myelopathy or myeloradiculopathy from herniated nucleus pulposus or spondylosis • Failed conservative therapy	0 (0)	
Schmieder	2006	Germany*	Anterior discectomy and fusion	N/A	54	24	• Degenerative disc disease with or without posterior osteophytes	0 (0)	
Shin	2010	South Korea	Anterior discectomy and fusion	1) Age 2) Duration of symptoms	70	33 (10-51)†	• Cervical myelopathy • 1- or 2-level disease	0 (0)	
Silber	2003	USA	Anterior discectomy and fusion	N/A	187	48 (24-72)†	• 1-level fusion procedure	53 (28.3)	Withdrawals due to incomplete questionnaires

Author	Year	Country	Intervention	Sub-group Analysis	Sample Size	Study Duration (months)	Patient Population	Patient Withdrawals n(%)	Notes
Singh	2012	USA*	Anterior discectomy and fusion	Surgery level	176	42 (24-83)†	<ul style="list-style-type: none"> • Symptomatic degenerative disc disease with intractable radiculopathy and/or myelopathy • ≥6 weeks of neck/arm pain refractory to non-operative treatment 	17 (9.7)	Withdrawals due to lost-to-follow-up
Song	2010	NR	Anterior discectomy and fusion	1- vs. 2- vs. 3-level surgery	83	44 (25-69)†	<ul style="list-style-type: none"> • Degenerative cervical spine disease • 52 (63%) patients with radiculopathy; 31 (37%) with myelopathy 	0 (0)	
Tumialán	2008	USA*	Anterior discectomy and fusion	Surgery level	200	17 (8-36)†	No specific description provided	7 (3.5)	Withdrawals due to lost-to-follow-up
Wright	2007	United Kingdom	Anterior discectomy and fusion	1- vs. 2-level surgery	97	12‡	<ul style="list-style-type: none"> • Intractable symptomatic cervical spondylosis or radiculopathy 	0 (0)	
Yao	2011	China	Anterior discectomy and fusion with endoscopic approach	N/A	76	Minimum of 60 (60-96)†	<ul style="list-style-type: none"> • Cervical disc herniation • Radiculopathy, myelopathy or myeloradiculopathy with failed conservative treatment 	9 (11.8)	Withdrawals were patients lost-to-follow-up
Yue	2005a	USA	Anterior discectomy and fusion	Surgery level	176	86 (65-133)†	<ul style="list-style-type: none"> • Spondylosis and/or herniated nucleus pulposus 	105 (59.7)	Withdrawals: death, lost-to-follow-up, severe illness, and unwillingness to travel
Yue	2005b	USA	Anterior discectomy and fusion	Gender	176	86 (65-133)†	<ul style="list-style-type: none"> • Spondylosis and/or herniated nucleus pulposus 	102 (57.4)	Withdrawals: death, lost-to-follow-up, severe illness, and unwillingness to travel; same patient population as Yue, 2005a
Zheng	2004	NR	Anterior discectomy and fusion	N/A	55	43 (24-84)†	<ul style="list-style-type: none"> • Cervical discogenic pain, unresponsive to 6 months of conservative treatment 	0 (0)	

Author	Year	Country	Intervention	Sub-group Analysis	Sample Size	Study Duration (months)	Patient Population	Patient Withdrawals n(%)	Notes
Anterior Microdiscectomy and Fusion									
Balabhadra	2004	USA*	Anterior microdiscectomy and fusion	N/A	108	15 (12-25)†	<ul style="list-style-type: none"> • Cervical disc herniation with radiculopathy or myelopathy • 1- and 2-level surgeries 	10 (9.3)	Patients excluded due to poor radiological delineation of fusion
Bishop	1996	USA	Anterior microdiscectomy and fusion	Surgery level	132	31 (3-43)†	<ul style="list-style-type: none"> • Cervical spondylosis or disc herniation 	0 (0)	
Caroli	2007	Italy*	Anterior microdiscectomy and fusion	N/A	103	58 (40-72)†	<ul style="list-style-type: none"> • 1-level procedure for cervical spondylosis or disc herniation 	5 (4.9)	Withdrawals due to death (1) and lost-to-follow-up (4)
Chen	2009	Taiwan	Anterior microdiscectomy and fusion	N/A	92	Minimum of 24	<ul style="list-style-type: none"> • 1-level surgery for cervical disc herniation and compressive monoradiculopathy 	0 (0)	Different patient population from Chen, 2005
Chen	2005	Taiwan	Anterior microdiscectomy and fusion	N/A	72	Minimum of 24	<ul style="list-style-type: none"> • 1-level cervical disc herniation and compressive monoradiculopathy 	9 (12.5)	No data on withdrawals
Heidecke	2000	Germany*	Anterior microdiscectomy and fusion	1) Duration of symptoms in patients with radiculopathy 2) Duration of symptoms and myelopathy severity 3) Surgery level	106	78‡ (48-126)†	<ul style="list-style-type: none"> • Degenerative cervical spine disease with radiculopathy or myeloradiculopathy 	0 (0)	
Marotta	2011	Italy	Anterior microdiscectomy and fusion	N/A	167	77 (54-90)†	<ul style="list-style-type: none"> • 1-level symptomatic cervical spondylosis or disc herniation • Radicular pain and/or myelopathy 	35 (21.0)	Withdrawals due to death (17) and lost-to-follow-up (18)
Salame	2002	Israel*	Anterior microdiscectomy and fusion	N/A	100	25 (12-40)†	<ul style="list-style-type: none"> • Cervical myelopathy and/or radiculopathy 	0 (0)	
Schröder	2007	Germany*	Anterior microdiscectomy and fusion	N/A	100	20 (12-41)†	<ul style="list-style-type: none"> • Monoradicular pain or cervical myelopathy due to disc herniation 	0 (0)	

Author	Year	Country	Intervention	Sub-group Analysis	Sample Size	Study Duration (months)	Patient Population	Patient Withdrawals n(%)	Notes
Anterior Corpectomy and Fusion									
Epstein	2007	USA*	Anterior corpectomy and fusion	N/A	116	39 (minimum of 12)	• 2-level pathology (disc disease, spondylosis, stenosis and/or ossification of the posterior longitudinal ligament)	0 (0)	No patient overlap with Epstein, 1998
Epstein	1998	USA	Anterior corpectomy and fusion	N/A	76	36	• Multi-level OPLL	NR	No patient overlap with Epstein, 2007
Ikenaga	2005	Japan	Anterior corpectomy and fusion	N/A	112	102 (60-168)†	• Cervical myelopathy • Surgical procedure spanning ≥4 levels	12 (10.7)	Withdrawals due to death (4) and lost-to-follow-up (8)
Rajshekhar	2003	India	Anterior corpectomy and fusion	N/A	93	22 (6-71)†	• Cervical spondylotic myelopathy	0 (0)	
Miscellaneous Fusion Techniques									
Barnes	2002	USA*	Anterior discectomy and fusion; Anterior corpectomy and fusion	Surgery level	77	13.6-19† (minimum of 12)	• Cervical myelopathy and/or radiculopathy with degenerative changes • Refractory to ≥3 months of non-operative therapy	0 (0)	
Carreon	2006	USA*	Posterior fusion versus revision anterior fusion	Surgical approach	120	Minimum of 24 (24-132)†	• Diagnosis of non-union following ADF • Failed non-operative treatment	0 (0)	
Chen	2009	China	Laminectomy and fusion	1) Age 2) Gender 3) Duration of symptoms 4) Diabetes status	83	58 (48-78)†	• Ossification of the posterior longitudinal ligament	0 (0)	
Dean	2009	USA*	Anterior discectomy and fusion; Anterior corpectomy and fusion	N/A	58	83 (24-288)†	• Degenerative spondylolisthesis	0 (0)	

Author	Year	Country	Intervention	Sub-group Analysis	Sample Size	Study Duration (months)	Patient Population	Patient Withdrawals n(%)	Notes
Emery	1998	USA	Anterior discectomy and fusion (if indicated, partial corpectomy or subtotal corpectomy instead)	1) Age 2) Gender 3) Surgery level 4) Smoking status	108	54 (24-204)†	• Cervical spondylotic myelopathy	2 (1.9)	No data on withdrawals
Guo	2011	China*	Anterior discectomy and fusion; Anterior corpectomy and fusion	Surgery level	67	37	• Adjacent 3-level degenerative spondylosis • Signs and symptoms of neural compression refractory to conservative treatment	0 (0)	
Hida	2008	Japan	Anterior microdiscectomy and/or osteophyctomy and fusion	N/A	146	86 (72-101)†	• Cervical myelopathy or radiculopathy	0 (0)	Patients with a narrow spinal canal also underwent laminoplasty
Kadoya	2003	Japan*	Anterior microdiscectomy/osteophyctomy and fusion	1) Age 2) Duration of symptoms 3) Number of procedures 4) Surgery level	157	137 (12-270)†	• Cervical spondylotic myelopathy and radiculopathy	18 (11.5)	Withdrawals due to lost-to-follow-up (13) and death (5)
Khoueir	2007	USA*	Anterior discectomy/corpectomy and fusion	1) Number of disc levels 2) Number of corpectomy levels	66	Minimum of 18	• Myelopathy or radiculopathy • Failure of conservative treatment	6 (9.1)	Patients without complete follow-up data excluded
Sekhon	2006	USA*	Posterior laminectomy and fusion	N/A	50	30	• Symptomatic cervical myelopathy due to circumferential spondylotic spinal stenosis	0 (0)	
Thakar	2012	India*	Corpectomy and fusion	N/A	51	14 (12-31)†	• Cervical spondylotic myelopathy	0 (0)	

N: number; N/A: not available; NR: not reported; RCT: randomized controlled trial

* All authors from listed country

† Range

‡ Median

Table C22. Long-term complications and adverse events for case series

Intervention	Author	Year	Harm Category	Time (months)	Measure	Outcome	Comments
Anterior microdiscectomy and fusion	Balabhadra	2004	Reoperation	15	n(%)	0 (0)	
			New-onset radiculopathy	15	n(%)	1 (1.0)	
Anterior discectomy and fusion; Anterior corpectomy and fusion	Barnes	2002	Mortality	13.6 - 19*	n(%)	1 (1.3)	
Anterior discectomy and fusion	Barsa	2007	Reoperation	43	n(%)	0 (0)	
			Adjacent segment disease	43	n(%)	0 (0)	
Anterior decompression and fusion	Belanger	2005	Pseudarthrosis	48 (24-184)*	n(%)	1 (1.6)	
			Reoperation	48 (24-184)*	n(%)	9 (14.8)	
			Mortality	48 (24-184)*	n(%)	1 (1.6)	
Anterior decompression and fusion	Bindal	2007	Pseudarthrosis	20 (12-31)*	n(%)	2 (2.2)	
Anterior microdiscectomy and fusion	Bishop	1996	Reoperation	31	n(%)	7 (5.3)	
Anterior discectomy and fusion	Cabraja	2011	Pseudarthrosis	97	n(%)	17 (34.0)	
			Adjacent segment disease	97	n(%)	35 (70.0)	

Intervention	Author	Year	Harm Category	Time (months)	Measure	Outcome	Comments
Anterior microdiscectomy and fusion	Caroli	2007	Pseudarthrosis	58	n(%)	0 (0)	
			Mortality	58	n(%)	1 (1.0)	Mortality based on patient withdrawals due to death
Anterior microdiscectomy and fusion	Chen	2009	Reoperation	24	n(%)	3 (3.3)	
Anterior discectomy and fusion; Anterior corpectomy and fusion	Dean	2009	Pseudarthrosis	83 (24-288)*	n(%)	3 (5.2)	
Anterior discectomy and fusion (if indicated, partial corpectomy or subtotal corpectomy instead)	Emery	1998	Pseudarthrosis	54 (24-204)*	n(%)	16 (14.8)	
			Recurrent myelopathy	54 (24-204)*	n(%)	5 (4.6)	
			Reoperation	54 (24-204)*	n(%)	12 (11.1)	
			Mortality	54 (24-204)*	n(%)	2 (1.9)	
Anterior corpectomy and fusion	Epstein	2007	Pseudarthrosis	39	n(%)	2 (1.7)	
			Reoperation	39	n(%)	6 (5.2)	
			Adjacent segment disease	39	n(%)	1 (0.9)	
Anterior discectomy and fusion	Epstein	2000	Pseudarthrosis	82	n(%)	27 (15.2)	
			Reoperation	82	n(%)	15 (8.4)	

Intervention	Author	Year	Harm Category	Time (months)	Measure	Outcome	Comments
Anterior corpectomy and fusion	Epstein	1998	Reoperation	36	n(%)	3 (3.9)	
Anterior discectomy and fusion	Faldini	2012	Adjacent segment disease	Minimum of 120	n(%)	43 (40.0)	
Anterior decompression and fusion	Faldini	2010	Adjacent segment disease	Minimum of 120 (120-180)*	n(%)	18 (35.3)	
			Reoperation	Minimum of 120 (120-180)*	n(%)	0 (0)	
Anterior discectomy and fusion	Geisler	1998	Reoperation	46	n(%)	26 (6.5)	
Anterior discectomy and fusion	Goldberg	2002	Pseudarthrosis	48	n(%)	25 (31.3)	
			Reoperation	48	n(%)	4 (5.0)	
			Mortality	48	n(%)	0 (0)	
Anterior discectomy and fusion	Gore	1998	Pseudarthrosis	253	n(%)	3 (6.0)	
			Reoperation	253	n(%)	10 (20.0)	
			Mortality	253	n(%)	14 (21.9)	Mortality based on patient withdrawals due to death
Anterior discectomy and fusion; Anterior corpectomy and fusion	Guo	2011	Pseudarthrosis	37	n(%)	1 (0.8)	
			Reoperation	37	n(%)	1 (0.8)	

Intervention	Author	Year	Harm Category	Time (months)	Measure	Outcome	Comments	
Anterior discectomy and fusion	Hamburger	2001	Reoperation	146	n(%)	24 (9.6)	One case each hoarseness, tetraparesis and hepatitis C infection Reported in 194/249 (77.9%) patients	
			Permanent complications	146	n(%)	3 (1.2)		
			Return to work					
			within 1 month		n(%)	76 (39)		
			after 1-2 months		n(%)	62 (32)		
			after 2-3 months		n(%)	19 (10)		
			after 3-6 months		n(%)	19 (10)		
>6 months		n(%)	12 (6)					
Unable to return to work	146	n(%)	6 (3)					
Anterior microdiscectomy and fusion	Heidecke	2000	Pseudarthrosis	78‡	n(%)	6 (5.7)	No data provided on work status of patients prior to study entrance	
			Return to work -same job	78‡	n(%)	36 (34.0)		
			Began other job	78‡	n(%)	6 (5.7)		
			Unable to work	78‡	n(%)	28 (26.4)		
			Retired/permanently disabled	78‡	n(%)	36 (34.0)		
Anterior microdiscectomy and/or osteophyctectomy and fusion	Hida	2008	Reoperation	86	n(%)	4 (2.7)		
Anterior decompression and fusion	Hilibrand	2001	Pseudarthrosis	68	n(%)	48 (25.3)		
Anterior corpectomy and fusion	Ikenaga	2005	Pseudarthrosis	102	n(%)	15 (15.0)	Mortality based on patient withdrawals due to death	
			Adjacent segment disease	102	n(%)	12 (12.0)		
			Mortality	102	n(%)	4 (3.8)		

Intervention	Author	Year	Harm Category	Time (months)	Measure	Outcome	Comments
Anterior discectomy and fusion	Jagannathan	2008	Pseudarthrosis	22	n(%)	7 (4.1)	Includes sensory function and strength
			Reoperation	22	n(%)	7 (4.1)	
			Worsening neurologic symptoms	22	n(%)	5 (2.9)	
Anterior decompression and fusion	Javid	2001	Neck Disability Index	26	mean	32	Drooping eyelid as a result of nerve damage
			At work	26	n(%)	48 (58)	
			Ptosis	26	n(%)	1 (1.2)	
Anterior microdiscectomy/osteophyctomy and fusion	Kadoya	2003	Late neurological deterioration				
			Lower extremity motor function	137	n(%)	11 (34.3)	Among patients who were normal at baseline (n=32) Post-operative worsening of pre-operative function (n=118)
				137	n(%)	8 (6.8)	
			Upper extremity motor function	137	n(%)	0 (0)	Among patients who were normal at baseline (n=10) Post-operative worsening of pre-operative function (n=129)
				137	n(%)	4 (3.1)	
			Sensory/pain function	137	n(%)	5 (41.7)	Among patients who were normal at baseline (n=12) Post-operative worsening of pre-operative function (n=132)
				137	n(%)	3 (2.3)	
			Reoperation	137	n(%)	15 (10.8)	1 Reoperation (n=13); 2 Reoperations (n=2)
Mortality	137	n(%)	5 (3.5)	Mortality based on patient withdrawals due to death			

Intervention	Author	Year	Harm Category	Time (months)	Measure	Outcome	Comments
Anterior discectomy and fusion	Kaiser	2002	Reoperation	16	n(%)	2 (0.9)	
			Adjacent segment disease	16	n(%)	2 (0.9)	
Anterior discectomy and fusion	Kienapfel	2004	Paresis	0	n(%)	33 (61.1)	All pre- and post-assessments were significantly different (p<0.001)
				84† (36-144)*	n(%)	9 (16.7)	
			Mortality	84† (36-144)*	n(%)	5 (8.5)	Mortality based on patient withdrawals due to death
Anterior discectomy and fusion	Maldonado	2011	Adjacent segment disease	36	n(%)	11 (10.5)	
Anterior microdiscectomy and fusion	Marotta	2011	Pseudarthrosis	77	n(%)	17 (12.9)	
			Reoperation	77	n(%)	13 (9.8)	
			Adjacent segment disease	77	n(%)	24 (18.2)	
			Mortality	77	n(%)	17 (11.4)	Mortality based on patient withdrawals due to death
Anterior decompression and fusion	Matsumoto	2009	Presence of neck pain	144	n(%)	16 (25.0)	
			Numbness in upper extremities	144	n(%)	26 (40.6)	
Anterior corpectomy and fusion	Rajshekhar	2003	Pseudarthrosis	22	n(%)	1 (1.1)	
			Presence of neck pain	22	n(%)	0 (0)	
Anterior discectomy and fusion	Riina	2009	Worsening headache pain ^{II}	24	n(%)	51 (13.7)	

Intervention	Author	Year	Harm Category	Time (months)	Measure	Outcome	Comments
Anterior decompression and fusion	Riley	2005	Dysphagia	Incidence	24	n(%)	14 (7.0)
				Prevalence	24	n(%)	66 (21.3)
Anterior cervical fusion	Robertson	2005	Pseudarthrosis	24	n(%)	13 (7.6)	
			Reoperation	24	n(%)	5 (3.2)	Related to adjacent segment disease
			Adjacent segment disease	24	n(%)	54 (34.2)	Detailed based on new radiographic evidence
Anterior microdiscectomy and fusion	Salame	2002	Pseudarthrosis	25	n(%)	2 (2.0)	
			Reoperation	25	n(%)	3 (3.0)	
			Adjacent segment disease	25	n(%)	1 (1.0)	
			Laryngeal paresis	25	n(%)	1 (1.0)	Surgical reconstruction required
Anterior discectomy and fusion	Schmieder	2006	Presence of neck pain	24	n(%)	5 (9.3)	
			Radiculopathy	24	n(%)	10 (18.5)	
			Reoperation	24	n(%)	3 (5.6)	
Anterior microdiscectomy and fusion	Schröder	2007	Reoperation	20	n(%)	1 (1.0)	
Posterior laminectomy and fusion	Sekhon	2006	Reoperation	30	n(%)	2 (4.0)	
			Mortality	30	n(%)	0 (0)	
Anterior discectomy and fusion	Shin	2010	Pseudarthrosis	33	n(%)	1 (1.4)	
			Reoperation	33	n(%)	1 (1.4)	

Intervention	Author	Year	Harm Category	Time (months)	Measure	Outcome	Comments
Anterior discectomy and fusion	Silber	2003	Donor site pain	48	n(%)	35 (26.1)	
			Morbidity associated with donor site pain				
			Restriction in work/professional activities	48	n(%)	13 (9.7)	
			Restriction in activities of daily living	48	n(%)	9 (6.7)	
Anterior discectomy and fusion	Singh	2012	Reoperation	42	n(%)	12 (7.5)	
Anterior discectomy and fusion	Song	2010	Pseudarthrosis	44	n(%)	4 (4.8)	
Anterior cervical fusion	Takayasu	1998	Pseudarthrosis	33	n(%)	0 (0)	
			Adjacent segment disease	33	n(%)	2 (3.3)	
			Reoperation	33	n(%)	1 (1.7)	
Corpectomy and fusion	Thakar	2012	Pseudarthrosis	14	n(%)	5 (9.8)	
Anterior discectomy and fusion	Tumialán	2008	Laryngeal paresis	17	n(%)	2 (1.0)	
Anterior discectomy and fusion	Wright	2007	Neurologic injury	12‡	n(%)	0 (0)	
			Mortality	12‡	n(%)	0 (0)	
Anterior decompression and fusion (trephination with strut grafting)	Xu	2009	Deterioration§	120	n(%)	22 (20.6)	Pseudarthrosis and Reoperation reported for patients returning for office follow-up only
Anterior cervical fusion	Yang	2008	Adjacent segment disease	29	n(%)	9 (5.5)	

Intervention	Author	Year	Harm Category	Time (months)	Measure	Outcome	Comments	
Anterior discectomy and fusion with endoscopic approach	Yao	2011	VAS score	Arm	0	mean (SD)	8.1 (0.8)	
				Arm	Post-op	mean (SD)	2.2 (0.8)	Significantly different from baseline (p<0.05)
				Arm	60‡	mean (SD)	1.9 (1.0)	Significantly different from baseline (p<0.05)
				Neck	0	mean (SD)	7.3 (0.9)	
				Neck	Post-op	mean (SD)	2.3 (0.8)	Significantly different from baseline (p<0.05)
				Neck	60‡	mean (SD)	2.5 (0.9)	Significantly different from baseline (p<0.05)

Intervention	Author	Year	Harm Category	Time (months)	Measure	Outcome	Comments	
Anterior discectomy and fusion	Yue	2005a	Neck pain symptoms				Present in 67 (94.4%) patients at baseline	
			None	86	n(%)	35 (52.2)		
			Better	86	n(%)	29 (43.3)		
			Same	86	n(%)	1 (1.5)		
			Worse	86	n(%)	2 (3.0)		
			Radicular arm pain symptoms					Present in 65 (91.5%) patients at baseline
			None	86	n(%)	47 (72.3)		
			Better	86	n(%)	15 (23.1)		
			Same	86	n(%)	2 (3.1)		
			Worse	86	n(%)	1 (1.5)		
			Upper limb weakness symptoms					Present in 52 (73.2%) patients at baseline
			None	86	n(%)	32 (61.5)		
			Better	86	n(%)	11 (21.2)		
			Same	86	n(%)	6 (11.5)		
			Worse	86	n(%)	3 (5.8)		
			Upper limb numbness					Present in 47 (66.2%) patients at baseline
			None	86	n(%)	35 (74.5)		
			Better	86	n(%)	5 (10.6)		
			Same	86	n(%)	5 (10.6)		
			Worse	86	n(%)	2 (4.3)		
			Pseudarthrosis			86	n(%)	9 (12.7)
Adjacent segment disease			86	n(%)	52 (73.2)	New-onset or worsening of preexisting degeneration		

Intervention	Author	Year	Harm Category	Time (months)	Measure	Outcome	Comments		
Anterior discectomy and fusion	Yue	2005b	Dysphagia		None	0	n(%)	72 (97.3)	
					Mild	0	n(%)	2 (2.7)	
					Moderate	0	n(%)	0 (0)	
					Severe	0	n(%)	0 (0)	
					None	86	n(%)	48 (64.9)	
					Mild	86	n(%)	13 (17.6)	
					Moderate	86	n(%)	12 (16.2)	
					Severe	86	n(%)	1 (1.4)	
			Dysphonia			None	0	n(%)	72 (97.3)
						Mild	0	n(%)	0 (0)
						Moderate	0	n(%)	2 (2.7)
						Severe	0	n(%)	0 (0)
						None	86	n(%)	60 (81.1)
						Mild	86	n(%)	5 (6.8)
						Moderate	86	n(%)	6 (8.1)
						Severe	86	n(%)	3 (4.1)
Anterior discectomy and fusion	Zheng	2004	Pseudarthrosis	43	n(%)	3 (5.5)			

* Range

† Based on 100 mm scale

‡ Median

§ Determined as a decrease of ≥ 2 points in the JOA score as compared to the best post-operative score

|| Evaluated by a decrease of one grade on the Neck Disability Index

Table C23. Sub-group outcomes for case series

Intervention	Author	Year	Sub-group A	Sub-group B	Sub-group C	Sub-group D	Sub-group E	Index	Time (months)	Measure	Outcome A	Outcome B	Outcome C	Outcome D	Outcome E	P-value	Comments				
Anterior discectomy and fusion; Anterior corpectomy and fusion	Barnes	2002	1-level ADF	Multilevel ADF	1-level ACF	Multilevel ACF	--	Odom's Criteria													
								Satisfactory outcome‡	13.6 - 19§	n(%)	24 (77.4)	13 (65)	11 (91.6)	5 (83)	--	NR	Significantly lower rate for multilevel ADF (p<0.05)				
								Mortality	13.6 - 19§	n(%)	1 (3.2)	0 (0)	0 (0)	0 (0)	--	NR					
Anterior decompression and fusion	Bindal	2007	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Multivariate analysis showed no correlation between development of pseudarthrosis and pre-operative smoking status, age, and sex; no association was found between Neck Disability Index and pain scores with sex, age, work status and workers' compensation status				
Anterior microdiscectomy and fusion	Bishop	1996	1-level	Multiple level	--	--	--	Reoperation	31	n(%)	5 (5.4)	2 (5.0)	--	--	--						
Anterior discectomy and fusion	Cabraja	2011	Age	--	--	--	--	Adjacent segment disease	97	NR	NR	--	--	--	--	0.01	Patient age had significant impact on development of adjacent segment disease				
Posterior fusion versus revision anterior fusion	Carreon	2006	Posterior fusion	Anterior fusion	--	--	--	Reoperation	42-53§	n(%)	2 (2.2)	12 (44.4)	--	--	--	NR	All Reoperations were posterior fusion procedures				
Laminectomy and fusion	Chen	2009	Good Prognosis	Poor Prognosis	--	--	--	Age	58	mean (SD)	55.6 (6.4)	58.2 (7.6)	--	--	--	0.21					
								Gender													
								Male	58	n (%)	45 (70.3)	19 (29.7)	--	--	--	0.33					
								Female	58	n (%)	14 (73.7)	5 (26.3)	--	--	--						
								Duration of symptoms (months)	58	mean (SD)	40.8 (13.2)	50.4 (15.6)	--	--	--	0.18					
Diabetes																					
								Yes	58	n(%)	34 (73.9)	12 (26.1)	--	--	--	0.07					
								No	58	n(%)	25 (67.6)	12 (32.4)	--	--	--						
Anterior discectomy and fusion (if indicated, partial corpectomy or subtotal corpectomy instead)	Emery	1998	1-level	Multilevel	--	--	--	Rate of pseudarthrosis	54 (24-204)§	%	0	42	--	--	--	<0.002	Smoking not associated with development of pseudarthrosis; age negatively correlated with the development of pseudarthrosis (r=-0.24, p<0.05); better pre-operative neurological function associated with better post-operative neurological function (r=0.64, p<0.001); after controlling for pre-operative neurologic function, women has less post-operative improvement than men (partial r=0.31, p<0.01)				

Intervention	Author	Year	Sub-group A	Sub-group B	Sub-group C	Sub-group D	Sub-group E	Index	Time (months)	Measure	Outcome A	Outcome B	Outcome C	Outcome D	Outcome E	P-value	Comments						
Anterior discectomy and fusion	Epstein	2000	1-level	2-level	3-level	4-level	--	Nurick Scale	0	mean	1.3	1.2	2.1	2	--	NR							
									82	mean	0.2	0.2	0.5	0.5	--	NR							
								Odom's Criteria															
								Excellent	82	n(%)	68 (86.1)	73 (86.9)	7 (58.3)	2 (50.0)	--	NR							
								Good	82	n(%)	4 (5.1)	9 (10.7)	4 (33.3)	2 (50.0)	--	NR							
								Fair	82	n(%)	6 (7.6)	2 (2.4)	1 (8.3)	0 (0)	--	NR							
								Poor	82	n(%)	0 (0)	0 (0)	0 (0)	0 (0)	--	NR							
								Pseudarthrosis without motion	82	n(%)	4 (5.1)	12 (14.3)	2 (16.7)	0 (0)	--	NR							
Pseudarthrosis with motion	82	n(%)	1 (1.3)	8 (9.5)	0 (0)	0 (0)	--	0.035															
Reoperation	82	n(%)	7 (9.0)	5 (6.0)	1 (8.3)	2 (50.0)	--	NR															
Anterior discectomy and fusion	Garvey	2002	1-2 level surgery	≥3 levels	--	--	--	VAS score	0	mean (SD)	8.4 (1.9)	8.5 (0.9)	--	--	--	NR							
									53	mean (SD)	4.1 (3.0)	3.4 (1.9)	--	--	--	NR							
								Modified Oswestry Disability Index	0	mean (SD)	58.1 (20.4)	61.6 (17.9)	--	--	--	NR							
									53	mean (SD)	31.1 (22.7)	29.1 (17.1)	--	--	--	NR							
								Modified Roland & Morris Disability Index	0	mean (SD)	15.5 (6.3)	16.8 (6.5)	--	--	--	NR							
									53	mean (SD)	7.5 (6.8)	7.7 (5.9)	--	--	--	NR							
Anterior discectomy and fusion	Geisler	1998	1-level	2-level	3-level	4-level	--	Reoperation	46	n(%)	15 (5.8)	7 (6.5)	2 (8.0)	2 (16.7)	--	NR							
Anterior discectomy and fusion	Goldberg	2002	Workers' compensation	Non-workers' compensation	--	--	--	Odom's Criteria															
								Excellent	48	n(%)	15 (50.0)	30 (60.0)	--	--	--	NS							
								Good	48	n(%)	10 (33.3)	15 (30.0)	--	--	--	NS							
								Fair	48	n(%)	4 (13.3)	4 (8.0)	--	--	--	NS							
								Poor	48	n(%)	1 (3.3)	1 (2.0)	--	--	--	NS							
								Return to work															
								Without restriction	48	n(%)	21 (70.0)	40 (80.0)	--	--	--	NR							
								Modified duty	48	n(%)	8 (26.7)	9 (18.0)	--	--	--	NR							
								Not working	48	n(%)	1 (3.3)	1 (2.0)	--	--	--	NR							
								Donor site pain	peri-op	n(%)	2 (6.7)	3 (6.0)	--	--	--	NR							
								Dysphagia	peri-op	n(%)	1 (3.3)	0 (0)	--	--	--	NR							
								Infection	peri-op	n(%)	0 (0)	1 (2.0)	--	--	--	NR	Urinary tract infection						
								Pseudarthrosis	48	n(%)	11 (36.7)	14 (28.0)	--	--	--	0.49							
Pseudarthrosis	48	n(%)	15 (50.0)	10 (20.0)	--	--	--	0.001															

Intervention	Author	Year	Sub-group A	Sub-group B	Sub-group C	Sub-group D	Sub-group E	Index	Time (months)	Measure	Outcome A	Outcome B	Outcome C	Outcome D	Outcome E	P-value	Comments			
Anterior discectomy and fusion; Anterior corpectomy and fusion	Guo	2011	3-level ADF	2-level ACF	--	--	--	Peri-operative complications												
								Procedure duration (min)	--	mean (SD)	97.4 (17.1)	119.2 (16.4)	--	--	--	<0.01				
								Perioperative blood loss (mL)	--	mean (SD)	143.3 (72.7)	208.5 (136.9)	--	--	--	NR	Group B significantly different from Groups A			
								Hematoma	--	n(%)	0 (0)	0 (0)	--	--	--	NR				
								Paresthesia	--	n(%)	0 (0)	0 (0)	--	--	--	NR				
								CSF leak	--	n(%)	0 (0)	1 (4.2)	--	--	--	NR				
								Implant failure	--	n(%)	0 (0)	1 (4.2)	--	--	--	NR				
								Pseudarthrosis	37	n(%)	1 (2.3)	0 (0)	--	--	--	NR				
								Reoperation	37	n(%)	0 (0)	1 (4.2)	--	--	--	NR				
								JOA score	0	mean (SD)	8.3 (1.7)	7.7 (1.6)	--	--	--	NR	Post-operative scores significantly different from baseline (p<0.01)			
									37	mean (SD)	13.7 (1.9)	13.0 (2.0)	--	--	--	NR				
Hirabayashi recovery rate (%)	37	mean (SD)	60 (20)	60 (10)	--	--	--	NR												
Anterior discectomy and fusion	Hamburger	2001	Duration of symptoms <3 months	Duration of symptoms 3-12 months	Duration of symptoms >12 months	--	--	Odom's Criteria												
								Excellent	146	n(%)	45 (48.9)	21 (41.2)	31 (33.3)	--	--	NR	<3 months significantly associated with an excellent outcome versus >12 months (p<0.03);			
								Good	146	n(%)	26 (28.3)	22 (43.1)	37 (39.8)	--	--	NR	No correlation found between age and sex on outcome			
								Fair	146	n(%)	20 (21.7)	6 (11.8)	19 (20.4)	--	--	NR				
								Poor	146	n(%)	1 (1.1)	2 (3.9)	6 (6.5)	--	--	NR				
Anterior microdiscectomy and fusion	Heidecke	2000	Duration of radiculopathy symptoms <1 year	Duration of radiculopathy symptoms >1 year	--	--	--	Long-term outcome¶												
								Good	78*	n(%)	19 (100)	7 (77.8)	--	--	--	NR	Patients <40 years had significantly better outcomes than those > 40 years (p,0.05, data NR); Patients with myeloradiculopathy symptoms <1 year had significantly better outcomes (p<0.01)			
								Fair	78*	n(%)	0 (0)	2 (22.2)	--	--	--	NR				
			Poor	78*	n(%)	0 (0)	0 (0)	--	--	--	NR									
			Duration of myeloradiculopathy symptoms <1 year	Duration of myeloradiculopathy symptoms >1 year	--	--	--	--	--	Long-term outcome¶										
										Good	78*	n(%)	30 (78.9)	20 (50.0)	--	--	--	NR		
										Fair	78*	n(%)	7 (18.4)	12 (30.0)	--	--	--	NR		
Poor	78*	n(%)								1 (2.6)	8 (20.0)	--	--	--	NR					
1-level	2-level	3-level	--	--	Pseudarthrosis	78*	n(%)	3 (4.1)	2 (7.4)	1 (16.7)	--	--	NS							
Anterior decompression and fusion	Hilibrand	2001	Smoker	Non-smoker	--	--	--	Hilibrand Criteria												
								Excellent	68	n(%)	15 (27.3)	58 (43.0)	--	--	--	<0.03				
								Good	68	n(%)	27 (49.1)	62 (45.9)	--	--	--					
								Fair	68	n(%)	12 (21.8)	13 (9.6)	--	--	--					
								Poor	68	n(%)	1 (1.8)	2 (1.5)	--	--	--					

Intervention	Author	Year	Sub-group A	Sub-group B	Sub-group C	Sub-group D	Sub-group E	Index	Time (months)	Measure	Outcome A	Outcome B	Outcome C	Outcome D	Outcome E	P-value	Comments							
Anterior discectomy and fusion	Hwang	2005	Radiculopathy	Myelopathy	Myeloradiculopathy	--	--	Odom's Criteria																
								Excellent	12	n(%)	32 (64)	4 (31)	5 (33)	--	--	NR								
								Good		n(%)	14 (28)	5 (38)	6 (40)	--	--	NR								
								Satisfactory		n(%)	4 (8)	3 (23)	3 (20)	--	--	NR								
								Poor		n(%)	0 (0)	1 (8)	1 (7)	--	--	NR								
								Odom's Criteria																
			Disc herniation	Spondylosis	--	--	--	Odom's Criteria																
								Excellent	12	n(%)	18 (67)	23 (45)	--	--	NR									
								Good		n(%)	7 (26)	18 (35)	--	--	NR									
								Satisfactory		n(%)	2 (7)	8 (16)	--	--	NR									
								Poor		n(%)	0 (0)	2 (4)	--	--	NR									
								Presence of cervical pain	0	n(%)	10 (34.5)	10 (35.7)	8 (38.1)	--	--	NR								
	12	n(%)	2 (6.9)	1 (3.6)	2 (9.5)	--	--	NR																
Anterior decompression and fusion	Javid	2001	Male	Female	--	--	--	Pain Index##	26	mean	39	39	--	--	--	NR								
								Neck Disability Index	26	mean	32	32	--	--	--	NR								
								Cervical Spine Functional Score	26	mean	37	42	--	--	--	NR								
								Odom's Criteria																
								Excellent	26	n(%)	18 (37)	13 (38)	--	--	--	NR								
								Good	26	n(%)	20 (41)	13 (38)	--	--	--	NR								
								Fair	26	n(%)	8 (16)	6 (18)	--	--	--	NR								
								Poor	26	n(%)	3 (6)	2 (6)	--	--	--	NR								
								At work	26	n(%)	28 (57)	22 (65)	--	--	--	NR								
								1-level	2-level	--	--	--	Pain Index##	26	mean	37	42	--	--	--	NR			
													Neck Disability Index	26	mean	31	33	--	--	--	NR			
													Cervical Spine Functional Score	26	mean	39	41	--	--	--	NR			
			Odom's Criteria																					
			Excellent	26	n(%)	24 (41)	7 (29)						--	--	--	NR								
			Good	26	n(%)	24 (41)	9 (38)						--	--	--	NR								
			Fair	26	n(%)	9 (15)	5 (21)	--	--	--	NR													
			Poor	26	n(%)	2 (3)	3 (24)	--	--	--	NR													
			At work	26	n(%)	39 (66)	11 (46)	--	--	--	NR													
			Anterior discectomy and fusion	Jensen	2009	Smoker	Non-smoker	--	--	--	Odom's Criteria	19	NR	NR	NR	--	--	--	0.008	Patients who smoked were more likely to have a Fair or Poor result				
			Anterior microdiscectomy/osteophyctectomy and fusion	Kadoya	2003	Age at surgery (years) 29-39	Age at surgery (years) 40-49	Age at surgery (years) 50-59	Age at surgery (years) 60-69	Age at surgery (years) 70-78	Improvement score#	137	mean (SD)	3.4 (1.6)	3.1 (2.5)	2.7 (2.0)	2.3 (2.7)	0.7 (3.9)	0.27					
											Improvement rate**	137	mean (SD) (%)	71.0 (30.6)	61.1 (51.0)	52.8 (36.9)	37.2 (54.3)	11.1 (57.4)	0.014					
											Duration of symptoms (months) 0-6	Duration of symptoms (months) 7-12	Duration of symptoms (months) 13-24	Duration of symptoms (months) 25-48	Duration of symptoms (months) ≥ 49	Improvement score#	137	mean (SD)	3.3 (2.0)	2.9 (2.1)	3.0 (1.8)	2.5 (2.1)	1.2 (2.7)	0.01
											Improvement rate**	137	mean (SD) (%)	65.3 (37.0)	57.6 (40.9)	57.2 (33.3)	54.0 (39.8)	15.7 (60.3)	0.001					
1 procedure	2-3 procedures	--									--	--	Improvement score#	137	mean (SD)	2.8 (2.1)	1.9 (3.1)	--	--	--	0.26			
Improvement rate**	137	mean (SD) (%)				55.7 (41.6)	24.3 (66.4)	--	--	--	0.045													
1-level	2-level	3-level				--	--	Improvement score#	137	mean (SD)	2.9 (2.3)	2.5 (2.3)	2.6 (2.3)	--	--	0.58								
								Improvement rate**	137	mean (SD) (%)	58.3 (44.2)	45.7 (47.6)	46.0 (45.5)	--	--	0.28								

Intervention	Author	Year	Sub-group A	Sub-group B	Sub-group C	Sub-group D	Sub-group E	Index	Time (months)	Measure	Outcome A	Outcome B	Outcome C	Outcome D	Outcome E	P-value	Comments		
Anterior discectomy/ corpectomy and fusion	Khoueir	2007	2 and 3 disc levels	4 and 5 disc levels	--	--	--	Presence of fusion	18	n(%)	38 (100)	20 (91)	--	--	--	NR			
			1 and 2 corpectomy levels	3 and 4 corpectomy levels	--	--	--	Presence of fusion	18	n(%)	11 (100)	3 (75)	--	--	--	NR			
Anterior discectomy and fusion	Kim	2009	1-level	2-level	--	--	--	VAS score	0	mean (SD)	8.3 (0.9)	8.1 (1.0)	--	--	--	NR			
								NDI	Post-op 20 (12-40)	mean (SD)	6.2 (0.8)	5.8 (0.8)	--	--	--	NR			
									0	mean (SD)	25.5 (1.5)	26.2 (1.9)	--	--	--	NR			
								NDI	Post-op 20 (12-40)	mean (SD)	16.6 (2.0)	17.6 (1.5)	--	--	--	NR			
									0	mean (SD)	7.2 (1.6)	8.0 (0.9)	--	--	--	NR			
								Anterior decompression and fusion	Matsumoto	2009	Age < 50	Age ≥50	--	--	--	Decrease in signal intensity	144	n(%)	22 (55)
Posterior disc protrusion	144	n(%)	30 (75)	17 (71)	--	--	--									NS			
Disc space narrowing	144	n(%)	7 (18)	7 (29)	--	--	--									NS			
Foraminal stenosis	144	n(%)	10 (25)	4 (17)	--	--	--									NS			
Male	Female	--	--	--	--	--	Decrease in signal intensity				144	n(%)	29 (60)	7 (44)	--	--	--	NS	
							Posterior disc protrusion				144	n(%)	36 (75)	11 (69)	--	--	--	NS	
							Disc space narrowing				144	n(%)	8 (17)	6 (38)	--	--	--	NS	
							Foraminal stenosis				144	n(%)	10 (21)	4 (25)	--	--	--	NS	
1-level	2-level	--	--	--	--	--	Decrease in signal intensity				144	n(%)	22 (56)	14 (56)	--	--	--	NS	
							Posterior disc protrusion				144	n(%)	28 (72)	19 (76)	--	--	--	NS	
							Disc space narrowing				144	n(%)	11 (28)	3 (12)	--	--	--	NS	
							Foraminal stenosis				144	n(%)	8 (21)	6 (24)	--	--	--	NS	
Smoker	Non-smoker	--	--	--	--	--	Decrease in signal intensity				144	n(%)	12 (52)	24 (59)	--	--	--	NS	
							Posterior disc protrusion				144	n(%)	17 (74)	30 (73)	--	--	--	NS	
							Disc space narrowing				144	n(%)	4 (17)	10 (24)	--	--	--	NS	
							Foraminal stenosis				144	n(%)	7 (30)	7 (17)	--	--	--	NS	
Anterior cervical fusion	Papavero	2002	Radiculopathy	--	--	--	--	Odom's Criteria											
								Excellent	44*	n(%)	16 (57)	--	--	--	NR				
								Good		n(%)	11 (39)	--	--	--	NR				
								Fair		n(%)	1 (4)	--	--	--	NR				
								Poor		n(%)	0 (0)	--	--	--	NR				
Anterior decompression and fusion	Riley	2005	1-level	2-level	≥ 3-level	--	--	Dysphagia											
								Incidence	24	n(%)	5 (4.2)	7 (11.1)	2 (10.5)	--	--	NR			
								Prevalence	24	n(%)	17 (11.4)	26 (24.3)	23 (42.6)	--	--	NR			

Intervention	Author	Year	Sub-group A	Sub-group B	Sub-group C	Sub-group D	Sub-group E	Index	Time (months)	Measure	Outcome A	Outcome B	Outcome C	Outcome D	Outcome E	P-value	Comments	
Anterior discectomy and fusion	Samartzis	2005	Smoker	Non-smoker	--	--	--	Odom's Criteria										
								Excellent	22	n(%)	3 (13.6)	10 (22.7)	--	--	--	>0.05		
								Good		n(%)	16 (72.7)	31 (70.1)	--	--	--	>0.05		
								Fair		n(%)	3 (13.6)	3 (6.8)	--	--	--	>0.05		
	Poor		n(%)	0 (0)	0 (0)	--	--	--	>0.05									
		Work-related injury	Non work-related injury	--	--	--	--	Odom's Criteria										
								Excellent	22	n(%)	5 (16.7)	8 (22.2)	--	--	--	>0.05		
								Good		n(%)	21 (70.0)	26 (72.2)	--	--	--	>0.05		
Fair									n(%)	4 (13.3)	2 (5.6)	--	--	--	>0.05			
Poor		n(%)	0 (0)	0 (0)	--	--	--	>0.05										
Anterior discectomy and fusion	Shin	2010	Age	--	--	--	--	Recovery rate based on Hirabayashi (%)	33	NR	NR	--	--	--	--	0.06	Regression analysis	
			Duration of symptoms	--	--	--	--	--	Recovery rate based on Hirabayashi (%)	33	NR	NR	--	--	--	0.3	Regression analysis	
Anterior discectomy and fusion	Singh	2012	1-level	2-level	3-level	--	--	Reoperation	42	n(%)	2 (4.2)	6 (6.3)	4 (25.0)	--	--	NR		
Anterior discectomy and fusion	Song	2010	1-level	2-level	3-level	--	--	Clinical Outcome (Robinson's classification)										
								Excellent/ Good	44	n(%)	38 (92.7)	31 (91.2)	7 (87.5)	--	--	NR	No significant difference reported between 1-level and multilevel fusions	
								Pseudarthrosis	44	n(%)	0 (0)	3 (8.8)	1 (12.5)	--	--	NR		
Anterior discectomy and fusion	Tumialán	2008	1-level	2-level	3-level	4-level	--	Clinically significant dysphagia	Peri-op	n(%)	1 (1.0)	2 (3.2)	7 (19.4)	4 (66.7)	--	NR		
								Length of stay (days)		mean	1.6	2.2	3.6	3.6	--	NR		
Anterior discectomy and fusion	Wright	2007	1-level	2-level	--	--	--	Pseudarthrosis	12*	n(%)	6 (11.1)	12 (27.9)	--	--	--	NR		
Anterior discectomy and fusion	Yue	2005a	1-level	2-level	3-level	4-level	--	Pseudarthrosis	86	n(%)	1 (3.6)	3 (11.5)	4 (28.6)	1 (33.3)	--	NR		
								Implant complications†	86	n(%)	0 (0)	4 (15.4)	1 (7.7)	2 (66.7)	--	NR		
Anterior discectomy and fusion	Yue	2005b	Male	Female	--	--	--	Dysphagia	86	n(%)	8 (22.9)	18 (41.2)	--	--	--	<0.05	Dysphagia occurred in younger patients (mean age: 48.3) more than older patients (mean age: 54.9) (p<0.05)	
								Dysphonia	86	n(%)	3 (8.6)	11 (28.2)	--	--	--	<0.05		

* Median

† No definition provided

‡ Satisfactory outcome based on Excellent and Good outcomes utilizing Odom's Criteria

§ Range

|| Based on Hirabayashi recovery rate: Good= ≥50%; Poor= <50%

¶ Outcome evaluated on presence/absence of pathological symptoms: Good=no neurological deficits or greatly improved neurological deficits; Fair=unchanged or stable neurological deficits, no progression of disease;

Poor=increased neurological deficits, disease progression

Calculated as the difference between baseline and the last follow-up scores on the Neurological Cervical Spine Scale

** Calculated on the baseline and last follow-up scores on the Neurological Cervical Spine Scale

†† Defined as dysphagia that either delayed discharge, altered diet, or required supplemental nutrition

‡‡ Assessed on the VAS 100 mm scale, the index is the mean score of "pain right now" and "worst pain last week"

Figure C1. Forest plot of comparison: Preliminary Analysis, outcome: Odom's Criteria (Excellent/Good)

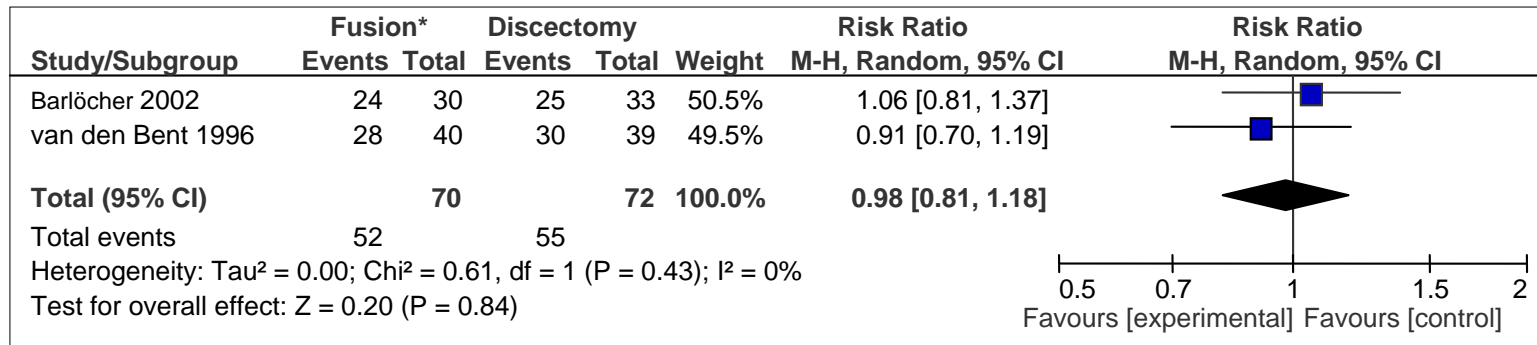


Figure C2. Forest plot of comparison: Sensitivity Analysis, outcome: Odom's Criteria (Excellent/Good)

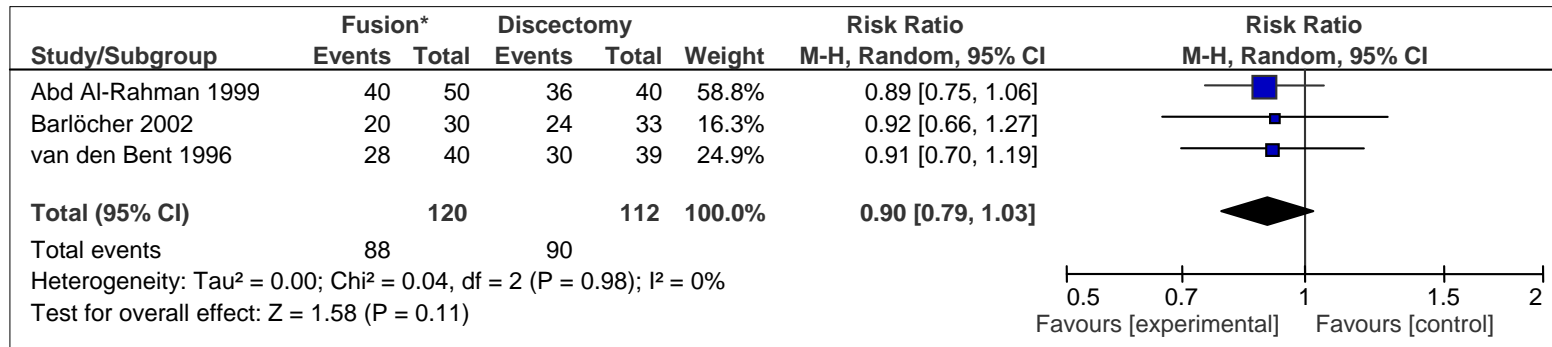


Figure C3. Forest plot of comparison: Sensitivity Analysis 1, outcome: VAS arm

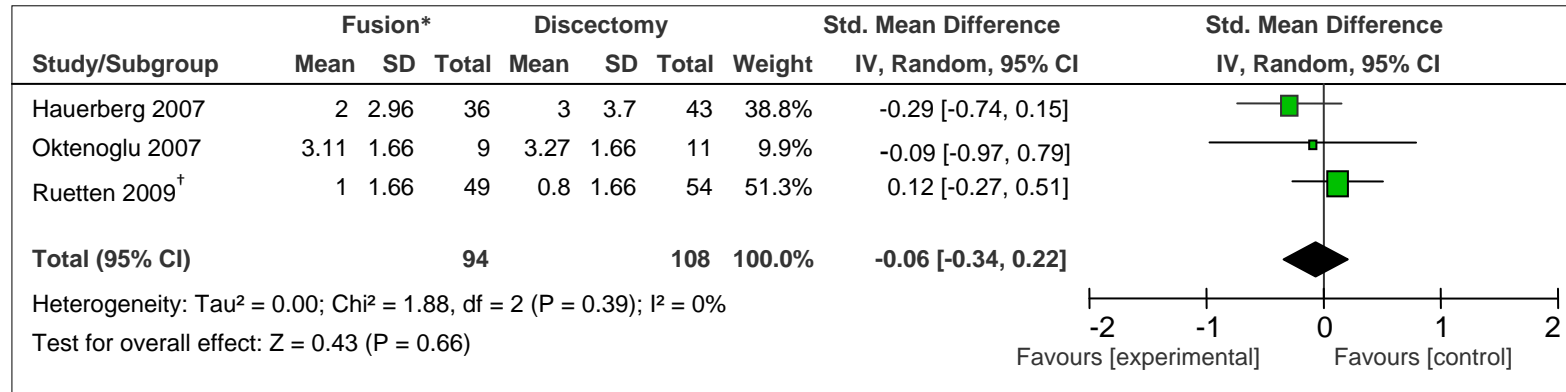


Figure C4. Forest plot of comparison: Sensitivity Analysis 1, outcome: VAS neck

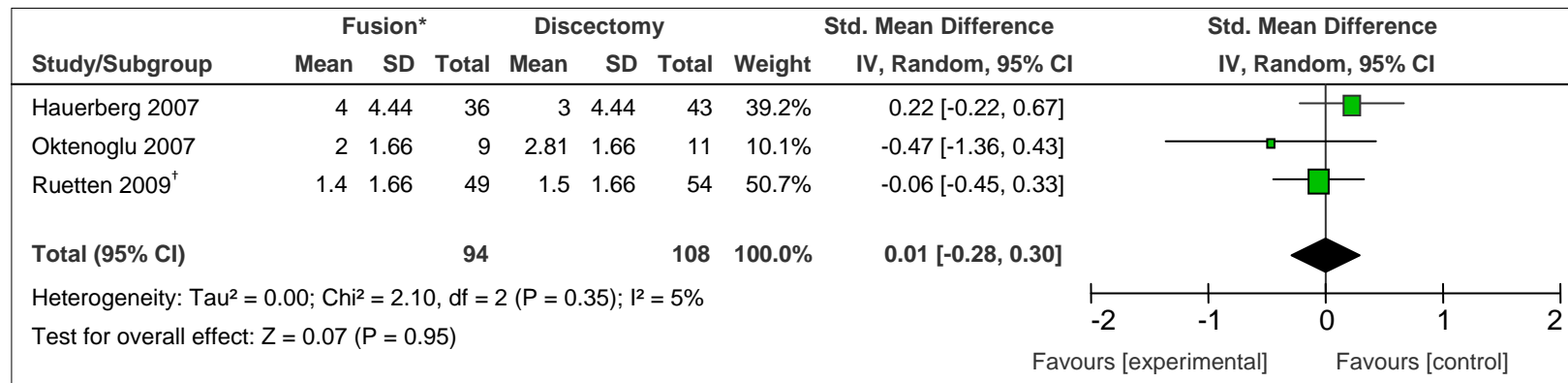


Figure C5. Forest plot of comparison: Sensitivity Analysis 2, outcome: VAS arm

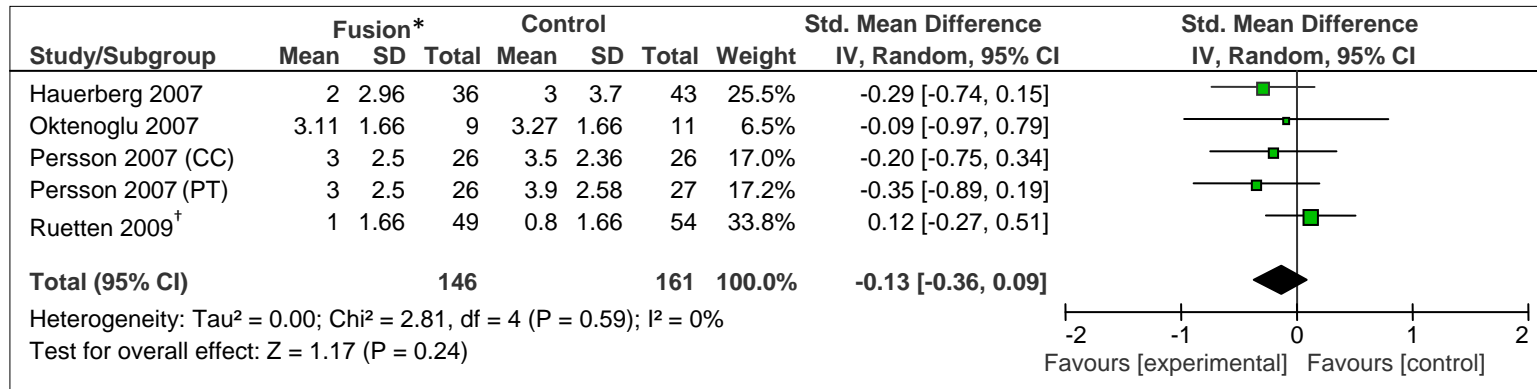


Figure C6. Forest plot of comparison: Sensitivity Analysis 2, outcome: VAS neck

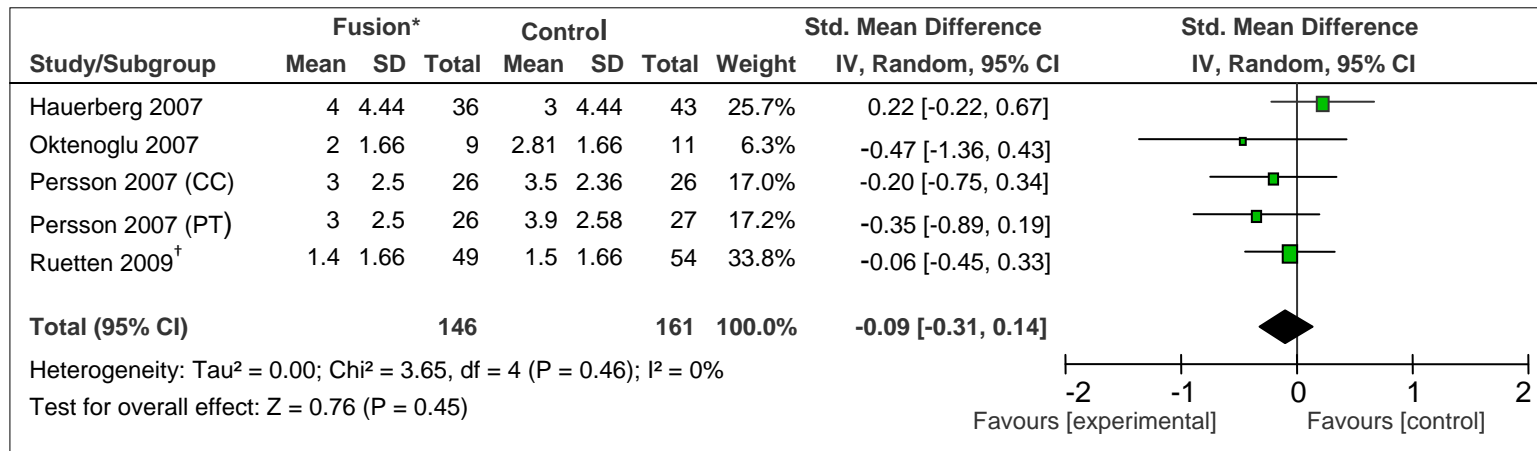


Figure C7. Forest plot of comparison: Sensitivity Analysis 3, outcome: VAS arm

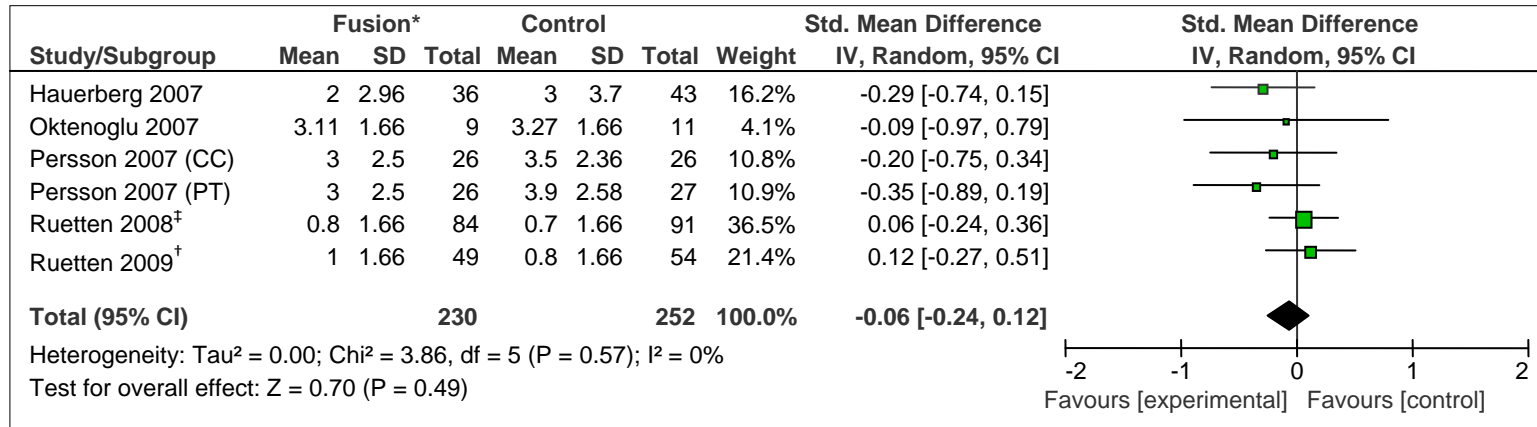


Figure C8. Forest plot of comparison: Sensitivity Analysis 3, outcome: VAS neck

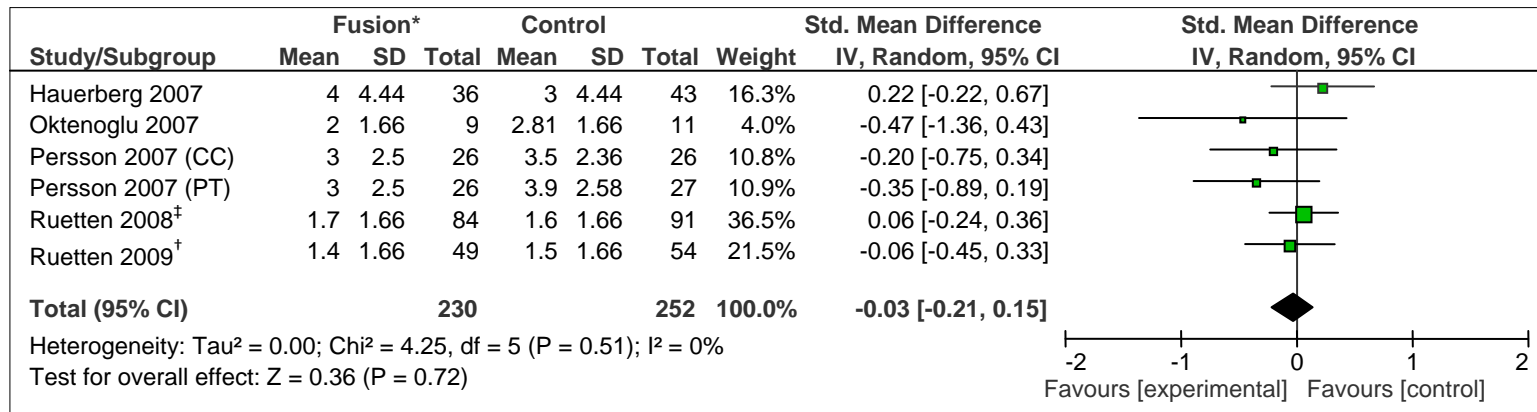


Figure C9. Forest plot of comparison: Preliminary Analysis, outcome: return to work

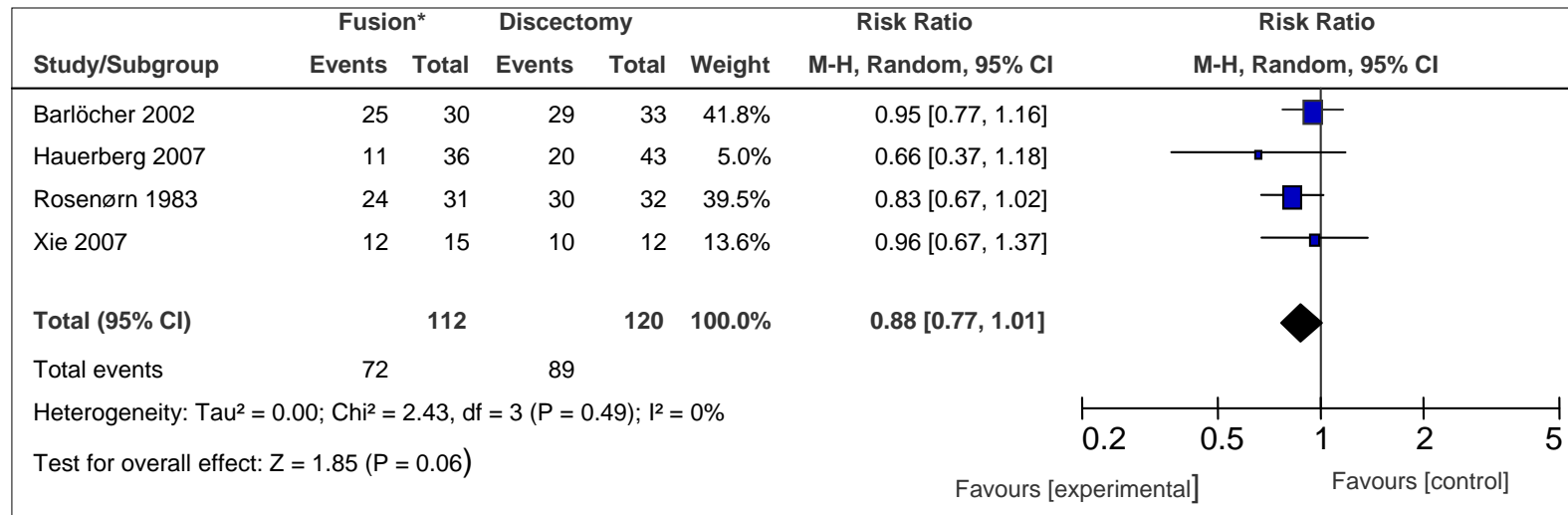
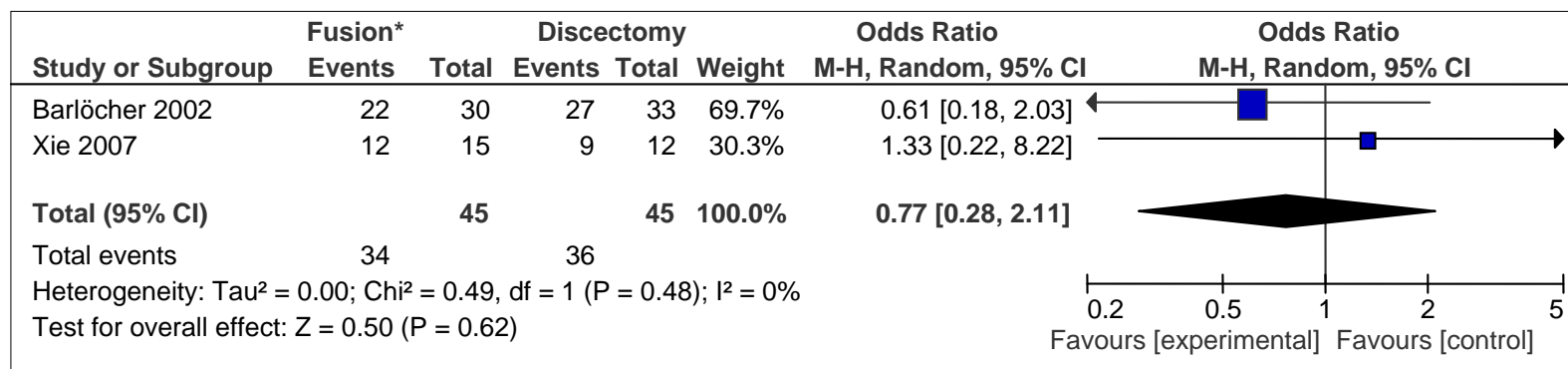


Figure C10. Forest plot of comparison: Preliminary Analysis, outcome: return to work at 6 months



* Anterior Discectomy and Fusion

† Intervention= Microdiscectomy and Fusion

‡ Intervention= Microdiscectomy and Fusion, Comparator= Full Endoscopic Posterior Foraminotomy

Figure C11. Funnel Plot: Preliminary Analysis, Outcome: return to work

