

Supplementary material

Table i. Spinal canal volume (SCV) and pedicle-lengthening osteotomy at L4

Group	Measurement	Control	Lengthening L4 pedicles					Per mm
			1 mm	2 mm	3 mm	4 mm	5 mm	
Control	L4-L5 SCV (mm ³)	21590.6 SD 2638.5*	22509.3 SD 2713.5	23427.3 SD 2734.5	24316.3 SD 2769.9	25246.5 SD 2808.6	26171.9 SD 2848.2	8111.4
	Percentage increases		4.3	8.6	12.8	17.1	21.5	4.3
CCS	L4-L5 SCV (mm ³)	11979.5 SD 3353.1	12669.8 SD 3499.4	13369.3 SD 3621.1	14037.9 SD 3710.0	14749.7 SD 3819.7	15450.4 SD 3923.7	4685.1
	Percentage increases		5.9	11.9	17.7	23.8	29.9	5.9
LRS	L4-L5 SCV (mm ³)	13032.0 SD 1583.8	13955.2 SD 1543.0	14893.6 SD 1587.1	15840.4 SD 1899.9	16796.5 SD 2133.3	17747.6 SD 2162.6	5282.2
	Percentage increases		7.2	14.5	21.7*	28.9*	36.3*	7.2
FS	L4-L5 SCV (mm ³)	15175.7 SD 2785.3	15991.9 SD 2906.3	16719.7 SD 2949.6	17546.6 SD 3123.3	18374.9 SD 3301.6	19203.2 SD 3422.1	5855.8
	Percentage increases		5.4	10.3	15.8	21.2%	26.8	5.3

*p < 0.05

SCV is presented as mean sd (n =12 in each group)

CCS, central canal stenosis; LRS, lateral recess stenosis; FS, foraminal stenosis

Table ii. Spinal canal volume (SCV) and pedicle-lengthening osteotomy at L5

Group	Measurement	Control	Lengthening L5 pedicles					Per mm
			1 mm	2 mm	3 mm	4 mm	5 mm	
Control	L4-L5 SCV (mm ³)	21590.6 SD 2638.5*	22612.7 SD 2833.6	23630.8 SD 2881.6	24449.0 SD 3013.7	25484.4 SD 3125.4	26489.7 SD 3155.9	8177.8
	Percentage increases		4.7	9.5	13.3	18.1	22.8	4.6
CCS	L4-L5 SCV (mm ³)	11979.5 SD 3353.1	12560.9 SD 3528.8	13174.6 SD 3681.4	13775.5 SD 3851.6	14335.7 SD 3954.9	14969.5 SD 4140.3	4587.7
	Percentage increases		4.8	10.0	15.1	19.9	25.2	5.0
LRS	L4-L5 SCV (mm ³)	13032.0 SD 1583.8	13965.2 SD 1563.8	14913.9 SD 1581.9	15856.9 SD 1595.0	16799.4 SD 1603.2	17747.6 SD 1643.4	5285.5
	Percentage increases		7.3	14.7	22.0*	29.3*	36.7*	7.3
FS	L4-L5 SCV (mm ³)	15175.7 SD 2785.3	16031.5 SD 2932.6	16902.9 SD 3095.6	17757.6 SD 3229.2	18600.0 SD 3350.9	19429.3 SD 3381.0	5914.8
	Percentage increases		5.7	11.5	17.2	22.8	28.4	5.7

*p < 0.05

SCV is presented as mean sd (n =12 in each group)

CCS, central canal stenosis; LRS, lateral recess stenosis; FS, foraminal stenosis

Table iii. Spinal canal volume (SCV) and pedicle-lengthening osteotomy at L4+L5

Group	Measurement	Control	Lengthening L4 and L5 pedicles					Per mm
			1 mm	2 mm	3 mm	4 mm	5 mm	
Control	L4-L5 SCV (mm ³)	21590.6 SD 2638.5*	23489.5 SD 2869.6	25374.7 SD 2962.8	27297.5 SD 3036.7	29160.1 SD 3121.6	31072.9 SD 3197.4	9093.1
	Percentage increases		8.8	17.6	26.6	35.3	44.2	8.8
CCS	L4-L5 SCV (mm ³)	11979.5 SD 3353.1	13170.7 SD 3690.6	14382.2 SD 4035.5	15612.6 SD 4389.2	16785.9 SD 4730.8	17997.5 SD 5051.4	5196.6
	Percentage increases		9.9	20.1	30.2	40.1	50.3	10.0
LRS	L4-L5 SCV (mm ³)	13032.0 SD 1583.8	14744.0 SD 1601.2	16398.0 SD 1636.6	18099.9 SD 1694.8	19827.1 SD 1784.3	21427.9 SD 1836.4	6033.1
	Percentage increases		13.3	26.2	39.3*	52.7*	65.2*	13.1
FS	L4-L5 SCV (mm ³)	15175.7 SD 2785.3	16781.0 SD 3006.7	18416.2 SD 3252.0	20019.2 SD 3495.7	21644.0 SD 3761.1	23261.8 SD 4010.1	6674.8
	Percentage increases		10.7	21.6	32.3	43.1	53.9	10.8

*p < 0.05

SCV is presented as mean sd (n =12 in each group)

CCS, central canal stenosis; LRS, lateral recess stenosis; FS, foraminal stenosis

Table iv. Neural foraminal dimension (NFD) and pedicle-lengthening osteotomy at L4; NFD is presented as mean SD (n =12 in each group)

Group	Measurement	Control	Lengthening L4 pedicles					Per mm
			1 mm	2 mm	3 mm	4 mm	5 mm	
Control	L4-L5 NFD (mm ²)	134.3 SD 18.5*	149.6 SD 18.7	159.10 SD 20.5	168.7 SD 22.3	178.8 SD 23.7	188.1 SD 24.7	56.3
	Percentage increases		11.7	18.7	25.8	33.3	40.3	8.7
CCS	L4-L5 NFD (mm ²)	93.3 SD 9.5	102.64 SD 9.7	115.0 SD 9.9	126.1 SD 10.0	142.5 SD 10.3	158.7 SD 11.3	43.2
	Percentage increases		10.1	23.5	35.6	53.6	71.4	12.9
LRS	L4-L5 NFD (mm ²)	87.7 SD 9.7	97.1 SD 9.7	106.8 SD 9.9	116.9 SD 10.2	154.4 SD 11.9	148.1 SD 12.8	34.4
	Percentage increases		10.8	22.0	33.6	50.9	69.3	12.4
FS	L4-L5 NFD (mm ²)	74.8 SD 8.6	87.9 SD 8.7	95.3 SD 9.1	104.3 SD 9.3	116.3 SD 9.5	129.0 SD 10.1	28.6
	Percentage increases		17.7	27.6*	39.9*	56.2*	73.2*	14.3

*p < 0.05

CCS, central canal stenosis; LRS, lateral recess stenosis; FS, foraminal stenosis

Table v. Neural foraminal dimension (NFD) and pedicle-lengthening osteotomy at L5; NFD is presented as mean SD (n = 12 in each group)

Group	Measurement	Control	Lengthening L5 pedicles					Per mm
			1 mm	2 mm	3 mm	4 mm	5 mm	
Control	L4-L5 NFD (mm ²)	134.3 SD 18.5*	145.4 SD 15.1	154.7 SD 15.3	162.4 SD 16.3	169.4 SD 16.7	178.7 SD 16.8	54.1
	Percentage increases		8.9	16.0	21.7	27.1%	34.2	7.2
CCS	L4-L5 NFD (mm ²)	93.3 SD 9.5	100.3 SD 9.8	110.6 SD 10.0	120.6 SD 10.2	132.9 SD 10.9	145.5 SD 12.0	32.6
	Percentage increases		7.7	18.9	29.7	43.2	57.0	10.4
LRS	L4-L5 NFD (mm ²)	87.7 SD 9.7	94.9 SD 9.9	103.5 SD 10.1	111.2 SD 10.8	121.6 SD 10.9	132.7 SD 11.2	23.3
	Percentage increases		8.3	18.3	27.1	39.1	52.0	9.7
FS	L4-L5 NFD (mm ²)	74.8 SD 8.6	79.7 SD 8.6	84.9 SD 8.8	90.0 SD 8.9	94.4 SD 9.2	99.7 SD 9.4	24.3
	Percentage increases		6.6	13.6	20.5	26.5	33.8	6.7

*p < 0.05

CCS, central canal stenosis; LRS, lateral recess stenosis; FS, foraminal stenosis

Table vi. Neural foraminal dimension (NFD) and pedicle-lengthening osteotomy at L4+L5; NFD is presented as mean SD (n =12 in each group)

Group	Measurement	Control	Lengthening L4 and L5 pedicles					Per mm
			1 mm	2 mm	3 mm	4 mm	5 mm	
Control	L4-L5 NFD (mm ²)	134.3 SD 18.5*	155.5 SD 18.9	172.8 SD 19.2	190.2 SD 19.6	205.9 SD 19.8	222.3 SD 20.0	50.4
	Percentage increases		16.2	29.3	42.5	54.5	66.9	14.0
CCS	L4-L5 NFD (mm ²)	93.3 SD 9.5	110.9 SD 9.7	123.4 SD 10.1	135.8 SD 10.4	148.3 SD 11.2	162.9 SD 11.4	45.4
	Percentage increases		19.1	32.7	46.2	59.7	75.5	15.5
LRS	L4-L5 NFD (mm ²)	87.7 SD 9.7	102.46 SD 9.9	115.0 SD 10.3	126.0 SD 10.5	136.3 SD 10.7	149.7 SD 11.3	42.1
	Percentage increases		17.0	31.4	44.0	55.9	71.3	14.6
FS	L4-L5 NFD (mm ²)	74.8 SD 8.6	91.02 SD 8.7	100.6 SD 8.9	111.7 SD 9.3	123.1 SD 9.8	133.8 SD 10.5	37.3
	Percentage increases		21.9	35.4	50.4	65.9	80.2	16.9

*p < 0.05

CCS, central canal stenosis; LRS, lateral recess stenosis; FS, foraminal stenosis